Your ref:

Our ref:

22 July 2014

Peter Brett Associates LLP
Caversham Bridge House
Waterman Place, Reading
Berkshire RG1 8DN
T: +44 (0)118 950 0761
F: F: +44 (0)118 959 7498
E: reading@peterbrett.com

Ham Hydro CIC
c/o SWLEN,
3 Phoenix Wharf,
Eel Pie Island,
Twickenham
TW1 3DY

Attn: Paul Parker

Dear Paul,

RE: Assessment of the Hydropower Scheme at Teddington Weir

Please find enclosed the following documents which provide the noise assessment of the Hydropower Scheme at Teddington Weir for submission with the planning application:

1. PBA report 'Hydropower Scheme at Teddington Weir – Noise Assessment' Rev 003 dated 11/09/2013,
    a. This report outlines:
        i. The guidance and methodology used in the assessment,
        ii. The ISO 9613-2 calculations,
        iii. The results of the noise survey at Romney Weir,
        iv. The consideration of Spring Tide,
        v. The prediction of noise from the Hydropower Scheme at Teddington Weir, and
        vi. Proposed mitigation measures.

2. PBA technical note 'Modelling of Teddington Hydropower Scheme' reference ESP N2 dated 22/07/2014,
    a. This technical note outlines:
        i. The changes proposed to the scheme design since issue of the above report,
        ii. The prediction of noise from the Hydropower Scheme at Teddington Weir based on noise modelling.

3. A summary of the correspondence with the Environmental Health Department at the London Borough of Richmond upon Thames between the issue of the report and the technical note.

I hope the above meets with your approval. Please do not hesitate to contact me if you have any queries or comments regarding the above.

Yours sincerely,

Angela Lamacraft
BSc(Hons) MIOA IEng
Senior Acoustic Engineer

For and on behalf of
PETER BRETT ASSOCIATES LLP

Enc:

1. PBA report 'Hydropower Scheme at Teddington Weir – Noise Assessment' Rev 003 dated 11/09/2013
2. PBA technical note 'Modelling of Teddington Hydropower Scheme' reference ESP N2 dated 22/07/2014
3. A summary of the correspondence with the Environmental Health Department at the London Borough of Richmond upon Thames between the issue of the report and the technical note

Item 1: PBA report 'Hydropower Scheme at Teddington Weir – Noise Assessment' Rev 003 dated 11/09/2013

Hydropower Scheme at Teddington Weir

Noise Assessment

Project Ref: 28307/004 | Rev: 002 Date: July 2013

Office Address: Caversham Bridge House, Waterman Place, Reading, Berkshire RG1 8DN
T: +44 (0)118 950 0761 F: +44 (0)118 959 7498 E: reading@peterbrett.com

Document Control Sheet

Project Name: Hydropower Scheme at Teddington Weir

Project Ref: 28307-004

Report Title: Noise Assessment

Doc Ref: 28307/004 Rev: 003

Date: 11 September 2013

	Name	Position	Signature	Date
Prepared by:	A Lamacraft	Acoustic Engineer		1st July 2013
Reviewed by:	C Ho	Senior Acoustic Engineer		10th July 2013
Approved by:	D Walker	LLP Director		10th July 2013
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
001	10/07/2013	Client comments / amendments	DPW/CH	DPW	DPW
002	11/09/2013	LBR and Prof. Kang comments addressed	AL	DPW	DPW
003	11/09/2013	Typo In appendix C corrected	DPW	DPW	DPW

Contents

Figures

Tables

Appendices

This page is intentionally blank

Executive Summary

Peter Brett Associates LLP (PBA) has been instructed to prepare a noise assessment of the proposed hydropower system at Teddington Weir, Ham, Richmond for inclusion with planning application 11/3908/FUL. The proposed application will involve the demolition of a section of the weir and the installation of three Archimedean Screw turbines to generate hydro-electricity, provision of a fish pass and sluice gate, cable route and construction of a plant room.

This PBA noise assessment uses baseline noise survey results and rating levels provided in previous noise assessment reports for the proposed hydropower scheme at Teddington Weir. In addition, measurements of an existing turbine installation of similar type to that which will be installed at Richmond have been taken a site at Romney Weir, Windsor. These have been used to estimate the sound power level of the scheme, which has been corrected for the number of turbines proposed at Teddington Weir.

The propagation of the sound from the Teddington Weir scheme to nearby noise-sensitive receptors has been estimated using ISO 9613-2 and compared to the required rating levels. Mitigation has been proposed in the form of an acoustic enclosure (comprised of acoustic panels with sound absorptive material) for the gearbox and a semi-circular Plexiglas™ (or similar) canopy over the screws. With the proposed mitigation the permitted rating level is expected to be met at all of the identified noise-sensitive receptors in the vicinity of the Teddington Weir hydropower scheme.

During conditions where high tides reduce the head to1.2m or less, the turbines will stop operating so all noise from both the turbines and the gearboxes will cease. A review of annual diurnal tidal data for 2006 suggests that this will happen for approximately 85% of the tidal peaks or 3% of the year. When the turbines continue running, noise from water passing through the turbines may lead to an infrequent and marginal exceedance of the adopted assessment criteria at some locations.

1 Introduction

1.1 Background

1.1.1 Peter Brett Associates LLP (PBA) has been instructed to prepare a noise assessment of the proposed hydropower system at Teddington Weir, Ham, Richmond for inclusion with planning application 11/3908/FUL. The proposed application will involve the demolition of a section of the weir and the installation of three Archimedean Screw turbines (with canopy over) to generate hydro-electricity, provision of a fish pass and sluice gate, cable route and construction of a plant room.

1.1.2 The previous noise assessments that have been undertaken to support the application are:

1. ZBP Acoustics report 'Noise Impact Assessment' doc ref 3207 rev C dated November 2011, written on behalf of Ham Hydro,
2. Adrian James Acoustics Limited (AJA) doc ref M001 dated 12 January 2012 'The Lensbury Club – Comments on Noise Impact of Ham Hydro Project', written on behalf of the Lensbury Club,
3. ZBP Acoustics report 'Revised Noise Impact Assessment' doc ref 3207-R01 dated January 2013, written on behalf of Ham Hydro to address concerns raised by the AJA assessment,
4. AJA doc ref 10663 M003 dated 3 February 13 'The Lensbury Club – Comments on Revised Noise Impact of Ham Hydro Project', written on behalf of the Lensbury Club,
5. 'Environmental Impact Assessment Non-Technical Summary' (NTS) dated February 2013 written by Mr Chris Hurst (Principal Environmental Health Officer (EHO) at LBRuT),
6. 'Review of the Consultancy Report' dated 8 April 2013 written by Prof Kang as instructed by the London Borough of Richmond upon Thames (LBRuT) to provide an impartial review of the previous reports,
7. AJA doc ref 10663 M004 dated 23 July 2013 'Ham Hydro CIC – AJA Comments on Peter Brett Associates Noise Assessment'.

1.1.3 The purpose of this assessment is to address short-comings of the previous assessment, as reported by Prof Kang, and to use noise measurement of an existing similar scheme as a basis of determining the likelihood of complaint from existing noise-sensitive receptors in the vicinity of the proposed site.

1.2 Site Description

1.2.1 The site is located on the river Thames at Teddington Weir, Ham, Richmond, approximately 3.5 km from the centre of Richmond.

1.2.2 The nearest dwellings to the site are at the junction of Beaufort Road and Burnell Avenue, approximately 210 m from the proposed location of the hydropower scheme. These are shown on **Figure 1**.

1.2.3 The Lensbury Club is situated to the south of the proposed scheme location. The AJA report suggested that noise to the grounds of the Lensbury Club should be assessed in the same way as noise to residential receptors and that noise to the following locations in particular should be assessed:

- A riverside path, approximately 5 m from the proposed scheme,
- Centre of the Lensbury Club gardens, approximately 50 m from the proposed scheme, and
- The rear façade of the Lensbury Club hotel, approximately 125 m from the proposed scheme.

1.3 Proposed Scheme

1.3.1 The hydrodynamic scheme proposed by Ham Hydro is comprised of three Archimedean turbines, each approximately 6.08 m in length and 4.00 m in diameter, to be installed in parallel in southern-most section the Weir as indicated in eWaterpower Ltd drawing reference DWG.TW-PS1 'Proposed Site Plan'.

1.3.2 The eWaterpower Ltd drawing reference DWG.TW-PS3 'Proposed Sections' shows the cross-section of the turbine layout.

1.3.3 It is understood that the anticipated overall power generation is approximately 168 kW of power output per turbine, with a total of 500 kW estimated from the overall installation.

1.4 Scope of Assessment

1.4.1 The purpose of this assessment is to use noise measurements taken at a similar scheme to predict the noise levels due to the proposed scheme at the nearby noise-sensitive receptors and compare them to local authority criteria, which are aimed at preventing disturbance at the sensitive locations from noise from the proposed scheme.

1.4.2 Noise mitigation measures have been recommended where necessary.

2 Legislation, Policy and Guidance

2.1 Introduction

2.1.1 This section sets out the extant planning policy and technical guidance which has been followed and referred to in the assessment presented in this report.

2.1.2 As the acoustics discipline is by necessity a technical subject therefore many technical terms appear throughout this report, a Glossary of Acoustics Terms is provided in **Appendix A**.

2.2 National Planning Policy

National Planning Policy Framework (NPPF)[1]

2.2.1 The Department for Communities and Local Government published the National Planning Policy Framework (NPPF) on 27 March 2012 and upon its publication, the majority of planning policy statements and guidance notes were withdrawn, including Planning Policy Guidance 24 'Planning and Noise', which had contained guidance on the national policy position on noise from 1994, and was widely understood and applied by developers and local authorities alike.

2.2.2 The NPPF outlines four aims with respect to noise, which are set out at paragraph 123 in Section 11 of the document, titled "Conserving and enhancing the natural environment", which states:

"*Planning policies and decisions should aim to:*

- *Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*."

2.2.3 There are two footnotes to the above guidance. The first footnote refers to the Explanatory Note of the Noise Policy Statement for England, which defines both "*significant adverse impacts on health and quality of life*" and "*adverse impacts on health and quality of life*" as described in the first two bullet points.

2.2.4 The second footnote indicates that the third bullet point is "subject to the provisions of the Environmental Protection Act 1990 and other relevant law".

2.2.5 The NPPF states that planning decisions should be made in accordance with the Local Development Plans.

[1] Department for Communities and Local Government, 2012. *National Planning Policy Framework*. London: HMSO.

Noise Policy Statement for England (NPSE)[2]

2.2.6 The Noise Policy Statement for England was published in March 2010. The document seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. It also sets out the long term vision of Government noise policy: "*to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development*".

2.2.7 The NPSE clarifies that noise should not be considered in isolation of the wider benefits of a scheme or development, and that the intention is to minimise noise and noise effects as far as is reasonably practicable having regard to the underlying principles of sustainable development.

2.2.8 The explanatory note of NPSE defines the terms used in the NPPF:

"2.20 There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur."

2.2.9 The NPSE does not provide a numerical value for the SOAEL, stating in paragraph 2.22:

"*It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available*."

2.2.10 There are three aims in the NPSE, which match, and expand upon, the first two bullet points in paragraph 123 of the NPPF and add a third aim that relates to a wider improvement in health and quality of:

"***The first aim of the Noise Policy Statement for England***

Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

[2] Department for Environment, Food and Rural Affairs, 2010. *Noise Policy Statement for England,* HMSO, London

2.23 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).

The second aim of the Noise Policy Statement for England

Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

2.24 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.

The third aim of the Noise Policy Statement for England

Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

2.25 This aim seeks, where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

2.2.11 It is clear that noise that would lead to significant adverse effects should be avoided, although there is no definition as to what constitutes a significant adverse effect. Similarly, noise should be mitigated where it is high enough to lead to adverse effects, but not so high that it leads to significant adverse effects.

British Standard 4142:1997 Rating industrial noise affecting mixed residential and industrial areas (BS 4142) [3]

2.2.12 BS 4142 sets out a method for determining the level of noise of an industrial nature (for example, fixed building services plant at schools or at the petrol filling station), together with procedures for assessing whether the noise is likely to give rise to complaints from people living nearby.

2.2.13 The method subtracts the background level ($L_{A90,T}$) from the 'rating level', ($L_{Ar,Tr}$) which is calculated by adjusting the noise source for a character correction where the noise contains a distinguishable, discrete, continuous note, contains distinct impulses; or is irregular enough to attract attention.

BS 4142 suggests that:

- A difference of "*around +10 dB or more indicates that complaints are likely*",

[3] British Standards Institution, 1997. BS 4142:1997 Rating industrial noise affecting mixed residential and industrial areas. London: BSI.

- A difference of "*around +5 dB is of marginal significance"* and
- A difference of more than -10dB is a "*positive indication that complaints are unlikely*".

2.2.14 The standard also advises that "*the greater this difference the greater the likelihood of complaints*"*.*

World Health Organization, Guidelines for Community Noise, 1999

2.2.15 Community noise is considered to include noise from road, rail and air traffic, industries, construction and public work, and the neighbourhood.

2.2.16 The WHO Guidelines provide guideline values for the effects of noise on annoyance of people and can be used to assess noise in outdoor amenity areas of dwellings such as gardens, balconies and open spaces.

2.2.17 The Guidelines advise that, based on the likelihood of annoyance within communities, the sound pressure level on "balconies, terraces and outdoor living areas" should not exceed 50-55 dB $L_{Aeq,T}$.

2.2.18 It is not considered that the Lensbury Club garden is a terrace or outdoor living area for a private dwelling as exposure will be more transient than for permanent residents.

International Organization for Standardization 9613-2:1996 Acoustics – Attenuation of Sound Propagation Outdoors – Part 2: General Method of Calculation (ISO 9613)[4]

2.2.19 The predicted noise levels generated by the operation of the proposed scheme have been calculated using the noise prediction framework set out in ISO 9613-2.

2.2.20 The standard predicts the $L_{Aeq,T}$ under meteorological conditions "*favourable to propagation from sources of known sound emission"* which are:

- "*Downwind propagation*" (wind direction within ±45° with the wind blowing from source to receiver with a speed of between 1ms^{-1} and 5 ms^{-1} at a height of between 3 m and 11 m above the ground) or
- "*Propagation under a well-developed moderate ground-based temperature inversion*", although not those over water.

2.2.21 The noise survey was undertaken in very still condition, therefore the calculations within ISO 9613-2 will not be as accurate as section 9 of the standard states (±3 dB for 0 to 100 m), however, due to the relatively short distance of measurement (1 m and 30 m, being much less than 100 m) the methodology within the standard has been used for this assessment.

2.2.22 The methodology is based on octave band frequencies from 63 Hz to 8 kHz and corrects the sound power level for:

- Geometric divergence,
- Atmospheric absorption,
- Ground effect,

[4] International Organization for Standardization, 1996. *ISO 9613-2:1996 – Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.* Geneva: ISO.

- Reflection from surfaces, and
- Screening by obstacle.

2.2.23 ISO 9613-2 includes noise from industrial sources and by use of BS 4142 for defining noise limits it is understood that the EHO at LBRuT considers noise from the hydropower schemes to fall into this category.

2.2.24 The standard applies to point sources, however, it is considered that is can be used for estimation for the hydropower schemes because the measurement close to the gearbox enclosure (Location 1) was in approximately the centre of the surface of the enclosure and the distance of Location 2 from the turbines was more than twice the largest dimension of the turbines.

2.2.25 The methodology in the standard (which uses the sound power level and site conditions to predict the $L_{Aeq,T}$) has been used in reverse to calculate the sound power level of the Romney Weir scheme using measured $L_{Aeq,T}$.

British Standard European Norm International Organization for Standardization 3746:1996 Acoustics – Determination of sound power levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane (BS EN ISO 3746:1996)[5]

2.2.26 The ISO 3740 series specifies various methods for determining the sound power levels of machines, equipment and their sub-assemblies. BS EN ISO 3746 specifies a method for calculating the sound power level (L_W) by measuring the sound pressure levels (L_p) on a theoretical measurement surface enveloping the source.

2.2.27 The maximum distance from the source allowed by the standard is 8 m and measurements must be taken at the same distance on all sides of the item being tested. Unfortunately, because the operational hydropower scheme was measured in-situ, it was not possible to measure the noise levels according to the standard, therefore this standard could not be used and the methodology provided in ISO 9613-2 has been used.

2.3 Local Planning Policy

2.3.1 LBRuT is currently writing planning policy for noise and as such no policy has formally been adopted at the time of writing this assessment.

2.3.2 Chris Hurst, Principal EHO at LBRuT, has recommended that predicted noise from the scheme is assessed in accordance with BS 4142 (see **paragraphs 2.2.12 to 2.2.14**) and recommended a criterion of a rating noise level ($L_{Ar,Tr}$) 5 dB below existing background level ($L_{A90,T}$) at residential receptors.

2.3.3 Although BS 4142 does not include assessment of commercial receptors, Mr Hurst has recommended a $L_{Ar,Tr}$ of 5 dB above $L_{A90,T}$ for the Lensbury Club to preserve the outdoor amenity areas. Mr Hurst did not consider an assessment of the riverside path to be reasonable as users will be passing through and advised a location in the centre of the garden would be more appropriate.

[5] British Standard European Norm International Organization for Standardization, 1995. *BS EN ISO 3746:1995 Acoustics - Determination of sound power levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane*. London: BSI.

3 Methodology

3.1 Baseline Noise Surveys

3.1.1 Baseline noise surveys were undertaken by ZBP Acoustics and LBRuT in the locations shown in **Table 3.1** and on **Figure 1**.

Table 3.1: Baseline Noise Survey Results

Location	Description	Survey by
MP1	North-western façade of the Riverside Pavilion	ZBP
MP2	North-eastern edge of Clubhouse roof	ZBP
MP3	North-eastern edge of the Conference Centre	ZBP
MP4	Burnell Avenue	ZBP
Riverside path	2 m from the proposed scheme location	LBRuT
Lensbury Club Garden	32 m from the proposed scheme location	LBRuT
Lensbury Club Garden	64 m from the proposed scheme location	LBRuT
Lensbury Club Hotel	100 m from the proposed scheme location	LBRuT

3.1.2 As outlined in **paragraph 2.3.3**, the riverside path has not been considered in this assessment due to the transient nature of users in this location.

3.1.3 The NTS does not provide the distances from the proposed hydropower scheme location to the measurement locations.

3.1.4 The original reports provide details of the instrumentation used and survey procedures.

3.2 Noise Survey of Operational Scheme

3.2.1 The hydropower scheme at Romney Weir, Windsor has been identified as a similar scheme to that proposed at Teddington Weir and **Table 3.2** provides a comparison of the two schemes. **Figure 2** provides a drawing of the Romney Weir scheme.

Table 3.2: Comparison of Romney Weir and Proposed Teddington Weir Schemes

Aspect	Operational Romney Weir Scheme	Proposed Teddington Weir Scheme
Gearbox housing	Length: 4.1 m Width: 3.9 m Height: 2.0 m	Length: 3.0 m Width: 2.5 m Height: 2.0 m
Screw length	5.85 m	6.08 m
Screw diameter	4.385 m	4.000 m
Material of encasement	Steel	Steel trough set in concrete
Bearing	Bearing bar (creates splash)	Fully submerged (no splash)
Number of blades per screw	5	4 (more efficient, therefore less noise)
Screw enclosure	None	Full length of screws

3.2.2 The land between the upstream measurement locations and the weir and top of the Romney Weir scheme is reasonably flat with no significant difference in level between the scheme and measurement location and no sizeable dips or peaks; the same is true for the downstream measurement locations and base of the screws.

3.2.3 The land between the proposed Teddington Weir scheme and the Lensbury Club garden and hotel is also reasonably flat with no sizeable dips, peaks or height difference.

3.2.4 Noise measurements at the Romney Weir scheme were undertaken on 19 June 2013.

3.2.5 Due to the proximity of Heathrow airport, the noise survey was undertaken between approximately 02:40 and 04:00 hrs as no air traffic is in operation at the airport during this time. No aircraft noise was heard during the survey.

3.2.6 Ideally, measurement would have been taken around the scheme using the method detailed in BS 3746[6]. However, because the scheme is operational and in-situ the positions required by the standard are inaccessible due to surrounding water, railings etc, and associated Health and Safety implications. The measurement methodology deployed has, by necessity required adaptation from the idealistic approach outlined in the Standard.

3.2.7 The accessible noise survey locations are provided in **Table 3.2**. Measurements on land were taken at 1.5 m above local ground level and measurements over the weir were taken 1.5 m above the bridge height.

Table 3.2: Noise Survey Locations

[6] British Standard European Norm International Organization for Standardization, 1996. *BS EN ISO 3746:1996 Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*. London: BSI.

Measurement Reference	Description
1	Between turbines: Approximately 3 m from top of turbines, 1 m to left of gearbox enclosure (looking downstream)
2	Downstream: Approximately 30 m from turbines
3	Left of the turbines: Approximately 5 m from top and 1 m to left the of the left hand turbine (looking downstream)
4	Upstream: By the fishpass: Approximately 10 m from bridge, 12 m from gearbox enclosure, 16 m from turbines
5	Half way across the weir: Approximately 25 m from scheme
6	Completely across the weir: Approximately 50 m from scheme
7	Inside gearbox enclosure

3.2.8 Measurements were taken in each location with both turbines operating, with one turbine operating and with no turbines running (the 'ambient' noise measurements). Each measurement was one minute in duration, considered to be suitable due to the steady noise of the hydropower scheme and water flow over the weir.

3.2.9 To maintain head level, the weir gate nearest the scheme had to be opened, therefore measurement locations influenced by noise from water flowing through the gate have not been used as the increase of water flow will artificially increase the 'ambient' noise level causing an underestimation of the specific noise level of the scheme. Unfortunately it was not possible to close the gate during the measurement period.

3.2.10 **Table 3.3** provides details of the instrumentation used during the noise survey.

Table 3.3: Instrumentation Used During the Noise Survey

Item	Type	Manufacturer	Serial Number	Laboratory Calibration Date
Calibrator	4231	Brüel & Kjær	2619375	18 January 2013
Hand-Held Analyzer	2250	Brüel & Kjær	2626233	23 January 2013
Microphone	4189	Brüel & Kjær	2621212	23 January 2013

3.2.11 On-site calibration checks were performed before and after the survey with no significant deviation being observed.

3.2.12 A windshield was fitted over the microphone at all times during the survey periods to minimise the effects of any wind induced noise and the sound level meter was tripod-mounted for all measurements.

3.2.13 The weather conditions during the noise survey were mild and calm with a temperature of 19°C, humidity of 82%, atmospheric pressure of 1012 mbar and no wind. These are considered to be suitable weather conditions for a noise survey, however, ISO 9613-2 requires a "*moderate downwind*", but it has been assumed that because there was no wind (rather than wind in the opposite direction) the method can still be used as an approximation.

3.2.14 It was advised by the site operator that the turbines were running at 100%, when turned on, and that the weir was closed, apart from the measurements with no turbines running.

3.3 Noise Assessment

Calculation of Permitted Teddington Weir Scheme Rating Level

3.3.1 The permitted rating levels identified in the previous reports have been used for this assessment and are summarised in **Table 4.4**.

Estimation of Romney Weir Scheme Sound Power Level

3.3.2 The ambient noise level measured at Romney Weir has been subtracted from the noise levels measured with one turbine running to provide the noise level due to the Romney Weir hydropower scheme alone. This was only possible in locations 1 and 2 due to the high ambient noise level and the influence of noise from water flowing through the open gate: one of the enclosures over the equipment acted as a barrier to the noise for location 1 and the scheme as a whole acted as a barrier for location 2.

3.3.3 The calculated noise levels for the scheme with one turbine operating have been used to approximate the sound power level of the scheme using ISO 9613-2 in reverse (i.e. environmental corrections have been applied to the $L_{Aeq,T}$ measurements to estimate the L_{WA}). The topography of the area between the weir and the measurement locations is flat, therefore no corrections for attenuation due to topography (for example, barriers due to hills) have been included in the calculations.

Prediction of Noise Levels at the Identified Noise-Sensitive Receptors

3.3.4 A correction of 10log(3) has been used to calculate the noise levels due to three turbines, as proposed at Teddington Weir. The correction has been applied to the total noise level, which is comprised of noise from the gearbox and hydrodynamic noise and applying the correction to the total noise level will result in an overestimate of the noise level.

3.3.5 ISO 9613-2 has then been used to predict the noise level at the noise-sensitive receptors identified in **paragraphs 1.2.2** and **1.2.3**. The topography of the area between the weir and the nearest receptors is flat, therefore no corrections for attenuation due to topography (for example, barriers due to hills) have been included in the calculations.

3.4 Uncertainty

3.4.1 The uncertainty of the calculations has been calculated using the paper 'Considering uncertainty when performing environmental noise measurements'[7]. The source does not vary with weather conditions and only one sound level meter was used for the measurements, therefore the greatest source of uncertainty is due to weather conditions affecting the transmission path.

3.4.2 The Kerry and Waddington methodology uses the methodology detailed in 'Uncertainties in Noise Measurement'[8] which is to:

[7] Kerry, G., Waddington, D., 2005. *Considering uncertainty when performing environmental noise measurements*. Institute of Acoustics, Oxford.

[8] Craven, N. J., Kerry, G. 2007. '*Uncertainties in Noise Measurement*'. University of Salford.

1. Define the half value (e.g. 3 for ± 3 dB) of each source of uncertainty,

2. Apply a correction for the standard uncertainty for a rectangular distribution (x / √3) for each source of uncertainty,

3. Add together the squared values found in 2,

4. Take the square root to find the combined uncertainty',

5. Multiply by 2 to calculate the expanded uncertainty to 95%.

3.4.3 The paper advises that for a single sound level meter the uncertainty budget would be "*like the ±0.7 dB tolerance of a type 1 sound level meter*". It also advises that "*measuring under downwind conditions usually produce worst-case conditions at distance of several hundred meters*", therefore the ± 3 dB uncertainty advised in ISO 9613-2 has been used due to the short distances between measurement location and source.

3.4.4 These calculations are repeated for the measurement of the Romney Weir scheme and the prediction of noise at the sensitive receptors due to the proposed Teddington Scheme.

3.5 Limitations

Noise Survey

3.5.1 The Romney Weir scheme is operational and measurements were taken in-situ, therefore it was not possible to adhere to the standards and guidance as closely as they ideally would have been. Results have been used in the prediction of noise from the operating scheme for measurements taken up to 30 m from the end of the turbines.

Calculations using ISO 9613-2

3.5.2 The 'ambient' noise level measurement was artificially increased due to the need to open a weir gate to maintain the head level of the water, which results in an overestimate of the noise contribution of water flowing over the weir and therefore an underestimation of noise from the scheme.

3.5.3 It is considered that applying a correction for the number of turbines operating based on the total noise level, rather than the turbine level (which will increase with the number of turbines operating) and gearbox noise (which will not change significantly with an increase in the number of operating turbines), compensates for the underestimate due to ambient noise level measurements.

3.5.4 The noise measurements used to estimate the sound power level of the scheme were taken in the absence of any wind, whereas ISO 9613-2 applies when there is a moderate downwind condition. However, the Kerry and Waddington paper suggests that the worst-case assessment provided by using downwind conditions occurs "*at distances of several hundred meters*", therefore ISO 9613-2 is considered appropriate for still conditions at short distances.

Proposed Hydropower Scheme at Teddington Weir

3.5.5 This noise assessment assumes that, other than the number of turbines, the Teddington Weir hydropower scheme is the same as the one at Romney Weir (e.g. same dimensions, power output, rotational speed etc for each turbine).

4 Results and Assessment

4.1 Baseline Noise Surveys

4.1.1 **Table 4.1** provides the noise survey results from the previous noise assessments (duplicated from Table 5 of the LBRuT NTS (item 5 in the list of previous assessments in **paragraph 1.1.2**) plus the 32 m measurement taken by LBRuT on 3rd September 2013).

Table 4.1: Baseline Noise Survey Results

Location	Time	$L_{Aeq,T}$ (dB)	L_{Amax} (dB)	$L_{AF10,T}$ (dB)	$L_{AF90,T}$ (dB)
MP1: North-western façade of the Riverside Pavilion	Daytime	57	85	57	52
	Night-Time	53	72	54	52
MP2: North-eastern edge of Clubhouse roof	Daytime	55	79	54	52
	Night-Time	53	59	54	51
MP3: North-eastern edge of the Conference Centre	Daytime	57	83	58	51
	Night-Time	53	73	55	41
MP4: Burnell Avenue	Daytime	49	63	53	45
	Night-Time	41	53	42	41
Lensbury Club garden: Downstream, 32 m from the proposed scheme	Daytime	58	91	58	53
	Night-Time	57	87	57	51

4.1.2 It can be seen that the lowest background noise levels were measured at Burnell Avenue and the rear façade of the hotel. This is expected as the dominant noise source closer to the river is due to the flow of water over the weir.

4.1.3 ZBP Acoustics advise that a noticeable drop in background noise level at MP3 occurred between approximately 02:00 hrs and 04:00 hrs and again at approximately 14:00 to 16:00 hrs on 15th November. This has been attributed to the Spring Tide and therefore is considered to be an exceptional circumstance and is not considered to be significant.

4.1.4 During the Spring Tide the $L_{A90,T}$ dropped by approximately 7 dB during the two hour daytime period and approximately 12 dB during the two hour night-time period close to the weir. However, as explained above, this occurs infrequently and it is not considered to be representative of the typical background noise levels by the EHO at LBRuT who has advised that the criteria do not apply during the few hours of low background noise levels caused by Spring Tides.

4.1.5 The turbine gear box and turbines will cease to operate when the height between the head and tail water levels (above the turbine and below the turbine) is less than 1.2 m. Based on a review of annual tidal data for 2006, it is estimated that this scenario happens for 85% of the occasions when the tide reaches its peak (which have a duration of two hours, twice a day).

4.1.6 This means that any concerns over lower background noise levels (resulting from decreased fall of water over the weir during high tide) and consequent higher differential between these lower background noise levels and noise from the gearboxes and turbines is mitigated because during these circumstances the turbines will not be operational. The turbines are expected to be operational during low background noise levels for 15% of the high tides and based on the ZPB Acoustics observation that high tides lasted two hours, it is estimated that there may be low background noise levels with the turbines still running for approximately 3% of the year (calculated as two hours twice a day x 15% x 365).

4.1.7 The downstream background noise levels are higher than the upstream levels due to noise from the movement of water across the weir and have been used to assess the noise in the downstream area of the Lensbury Club garden.

4.2 Noise Survey of Operational Scheme

4.2.1 **Table 4.2** summarises the results of the noise survey at Romney Weir. The octave frequency band spectra of the measurements used for ISO 9613-2 calculations are provided in **Appendix B**.

Table 4.2: Summary of Noise Survey Results at Romney Weir on 19 June 2013 undertaken by PBA.

Location	Measurement File Reference	Distance from turbines (m)	Distance from enclosure (m)	Number of Turbines Operating	$L_{Aeq,T}$ (dB)
1: Between turbines	3	3	1	2	75
	4	3	1	2	75
	Average	3	1	2	75
	19	3	1	1	72
	25	3	1	0	69
2: Downstream	9	30	36	2	70
	21	30	36	1	68
	27	30	36	0	65
3: Left of the turbines	5	5	6	2	73
	6	5	6	2	73
	Average	5	6	2	73
	18	5	6	1	71
	22	5	6	0	73
4: Upstream	7	15	10	2	71
	20	15	10	1	70
	26	15	10	0	70

Location	Measurement File Reference	Distance from turbines (m)	Distance from enclosure (m)	Number of Turbines Operating	$L_{Aeq,T}$ (dB)
5: Half way across the weir	10	25	25	2	72
	17	25	25	1	73
	24	25	25	0	72
6: Completely across the weir	11	50	50	2	73
	16	50	50	1	75
	23	50	50	0	75
7: Inside gearbox enclosure	1	-	-	2	92
	2	-	-	2	94

4.2.2 Measurements with 'ambient' noise levels greater than or not significantly lower than the noise level with one or two turbines operating have not been used for the estimation of the sound power level. This occurs at all locations except 1 and 2.

4.3 Estimation of Sound Power Level

4.3.1 **Appendix C** provides the full results of the calculations outlined in **paragraphs 3.3.4** and **3.3.5** which are summarised in **Table 4.3**.

Table 4.3: Results of the ISO 9613-2 Calculations

Number of turbines running	Measurement location	Overall L_{WA} (dB)	L_{WA} per Octave Band Frequency (dB, Hz)							
			63	125	250	500	1000	2000	4000	8000
1	Between turbines	79	54	56	65	76	73	70	65	59
	Downstream	103	79	82	87	96	97	96	95	92
2	Between turbines	83	56	61	67	81	76	72	67	61
	Downstream	106	85	85	92	99	100	100	98	95

4.3.2 It can be seen that there is a large variation in the noise levels upstream and downstream. This is because the screws are lower than the weir, therefore the weir and turbine enclosure act as a barrier to noise upstream but this barrier is not present downstream.

4.3.3 This assessment considers the nearest noise-sensitive receptors to the scheme and mitigates noise to these; receptors further from the scheme will receive lower noise levels from the scheme due to the propagation distance so if the noise criteria are met at the nearest noise-sensitive locations they will be met at receptors further away.

4.3.4 For this assessment the calculation using the measurement between the turbines has been used for all receptors except the 'Lensbury Garden: Downstream' as the measurement was upstream from the turbines and the noise-sensitive receptors at Teddington (except the downstream Lensbury garden location) are also upstream of the proposed turbines.

4.3.5 The downstream measurements have been used for the 'Lensbury Garden: Downstream'.

4.4 Uncertainty

4.4.1 **Table 4.4** provides a summary of the uncertainty calculations as outlined in **Section 3.4**.

Table 4.4: Uncertainties in the Determination of Sound Power Level

Source	Notes	Value (Half width)	Distribution (divisor)	Standard Uncertainty (dB)
Source				
No uncertainty	Operational pattern does not vary	-	-	-
Transmission path: Romney Weir scheme to measurement location				
Weather	1 m and 30 m	3	Rect(√3)	1.7
Transmission path				
Weather	1 m and 30 m	3	Rect(√3)	1.7
Receiver: Teddington Weir scheme to receptors				
Instrumentation	Type 1 practical	0.7	Rect(√3)	0.4
Combined uncertainty (root sum of square)				2.5
Expanded uncertainty (95% confidence)				5.0

4.4.2 This level of uncertainty means that the proposed Teddington scheme may be up to 5 dB under or over these levels for the overall predicted $L_{Aeq,T}$. These differences will depend on the weather conditions and it is likely that the average $L_{Aeq,T}$ will fall in the middle of the ± 5 dB uncertainty.

4.5 Prediction and Assessment of Noise from the Proposed Scheme at Teddington Weir

4.5.1 **Table 4.5** provides a comparison of the permitted rating levels advised in the LBRuT NTS for the nearby dwellings and the Lensbury Club and the predicted noise levels due to the proposed scheme. The calculations of rating level at the receptors are shown in **Appendix C**.

Table 4.5: Comparison of Permitted Rating Levels and Predicted Scheme, without mitigation.

Location	Criterion	Required Level (dB(A))	Predicted Scheme Noise Level (dB(A))	Level Difference (dB(A))	Compliant
MP2: Lensbury Club garden	BS 4142 (external)[1]	56	46	-10	Yes
	BS 8233 / WHO (internal)[3]	Not applicable			
	WHO (external)[3]	55	41	-14	Yes
Lensbury Club garden: Downstream	BS 4142 (external)[1]	58	70	12	No
	BS 8233 / WHO (internal)[3]	Not applicable			
	WHO (external)[3]	55	65	10	No
MP3: Rear façade of the Lensbury Club hotel	BS 4142 (external)[1]	32	38	6	No
	BS 8233 / WHO (internal)[3,4]	35	3	-32	Yes
	WHO (external)[3]	55	33	-22	Yes
MP4: Dwellings along Burnell Avenue	BS 4142 (external)[1]	36	35	-1	No
	BS 8233 / WHO (internal)[2,3]	30	18	-12	Yes
	WHO (external)[3]	55	30	-25	Yes

[1] Including 5 dB penalty (as per BS 4142)
[2] 12 dB attenuation allowed for an open window as per LBRuT NTS
[3] No penalty included (no penalty in BS 8233 or WHO 'Guidelines for Community Noise')
[4] 30 dB attenuation allowed for an open window as per LBRuT NTS

4.5.2 The difference in the permitted BS 4142 rating level compared to the LBRuT NTS is due to the lowest measured $L_{A90,5min}$ being used for this assessment to ensure that the criteria are met throughout the entire daytime and night-time periods. This is the cause of the discrepancy outlined in sections 2.7 and 2.8 of the AJA report dated 23 July 2013 (item 7 listed in **paragraph 1.1.2**). The ‘discrepancy’ of location description is due to **Table 4.1** providing results of the noise survey and **Table 4.5** providing results of the noise assessment, which considers different locations and uses the nearest background noise levels measurement (references in the table).

4.5.3 Section 2.7 of the AJA report dated 23 July 2013 (item 7 listed in **paragraph 1.1.2**) states that "*the predicted noise levels are lower than the data from Romney Weir suggests*" and uses the measurement 30 m downstream from the turbines at Romney and compares it to the Lensbury Club garden noise level, which they incorrectly state is "around 30 m downstream from the Ham Hydro installation". As stated in **paragraph 1.2.3**, the Lensbury Club garden location used in the assessment is 50 m from the proposed scheme, not "around 30 m", therefore the noise level will be lower here than 30 m from the Romney scheme.

4.5.4 It can be seen that additional mitigation is required to meet the BS 4142 criteria at all locations except upstream areas of the garden.

4.5.5 A spectrum comparison of the noise levels at location MP4 has been undertaken and is shown in **Table 4.6**. the comparison for other receptors is shown in **Tables C.3 to C.6** of **Appendix C**. The comparison does not contain a penalty for tonal noise as each octave band is assessed separately. Any exceedances of the LBRuT criteria are shown in **red**.

Table 4.6: Spectrum BS 4142 Comparison

Location	Level (dB)	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Burnell Avenue (MP4)	Predicted Hydropower Noise Level[1] (dB)	6	8	17	27	23	20	12	5
	Background Noise Level[2]	23	28	29	29	32	32	38	29
	Difference	-17	-20	-13	**-2**	-9	-13	-26	-25

[1] The overall noise level includes a 5 dB penalty but the octave band levels do not

[2] Calculated from LBRuT $L_{Aeq,T}$ measurements at this location

4.5.6 It can be seen that additional mitigation is required to meet the LBRuT criteria for the 500 Hz octave band at the dwellings along Burnell Avenue.

4.5.7 With the A-weighting (which was developed to replicate the response of people to sound) applied, the spectrum is relatively flat. However, the un-weighted spectrum (shown in **Appendix C)** shows a low frequency dominance. The mitigation has therefore been assessed using the frequency spectrum as well as overall level. However, the A-weighted level is reported as this corresponds with the perception of sound by people and is used in BS 4142.

5 Mitigation Measures

5.1 Summary of Enclosures

Gearbox Enclosure

5.1.1 The measurements of the Romney Weir scheme were undertaken with an enclosure surrounding the gearbox which is not designed to provide any significant acoustic mitigation. Therefore, the measurements of the noise from the gearbox at Romney are representative of a worst-case scenario without any mitigation in place. Thus the assessment presented here, which is based upon these measurements, is also a worst case assessment.

5.1.2 To meet the criteria installation of mitigation might be necessary, depending on the view of the local planning authority. It is recommended that the enclosure at the proposed Teddington Weir scheme should be constructed using acoustic panels with a higher sound reduction index and that provide absorption to reduce the build-up of reverberant sound in the enclosure.

5.1.3 Assuming the Romney Weir enclosure is constructed of 1.2 mm steel (from on-site observation), an enclosure constructed of 100mm thick panels having a 0.8mm thick Colorcoat sheet steel outer skin in-filled with 45kg/m^3 acoustic media with an inner skin of 0.8mm thick perforated Colorcoat sheet steel is expected to provide the additional mitigation shown in **Table 5.1**.

5.1.4 **Table 5.1** provides a comparison of an acoustic panel and sheet steel.

Table 5.1: Comparison of the Sound Transmission Loss of Sheet Steel and an Acoustic Panel

Material	Thickness (mm)	Sound Transmission Loss (dB, Hz)							
		63	125	250	500	1000	2000	4000	8000
Sheet steel	1.2 mm sheet steel[9]	8	13	20	24	29	33	39	44
Proposed Additional Acoustic panel	100mm thick panels having a 0.8mm thick Colorcoat sheet steel outer skin in filled with 45kg/m^3 acoustic media. Inner skin 0.8mm thick perforated Colorcoat sheet steel[10]	20	21	28	37	49	57	62	64
Difference between panel types		12	8	8	13	20	24	23	20

5.1.5 In addition, the air inlet and outlet should be acoustically attenuated with use of acoustic louvres and attenuators if required.

[9] Bies, D., Hansen, C., 1997. *Engineering Noise Control*. Second Edition. Spon: London.
[10] Manufacturer's data from Envirosound, provided by email to Angela Lamacraft on 1st July 2013.

Screw Canopy

5.1.6 The WHO 'Guidelines for Community Noise' relate to the annoyance effect of noise in outdoor living areas of private dwellings and are therefore not appropriate application for the assessment of noise in commercial premises such as hotel gardens, where exposure is more transient. The duration of exposure in the hotel will be much shorter, and the expectation of the noise climate that is experienced will be different. The context of the location by the river, with the weir close by also provides an expectation of a particular type of noise associated with this location, which is the same as the noise from water running through the turbines and is not introducing a new or different type of noise at this location.

5.1.7 However, a canopy can be used to mitigate noise from the screws themselves. The manufacturer has proposed a clear, high-density acrylic canopy such as Plexiglas™ or Perspex™.

5.1.8 **Table 5.2** provides a summary of the noise data for Gramm Plexiglas (provided in full in **Appendix D**). Unfortunately the octave frequency band data from 63 Hz to 8000 Hz could not be found for any acrylic product, therefore the Gramm data has been used assuming the following:

- The third-octave frequency band result has been assumed to apply for the octave frequency band result for frequencies 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz,
- The third-octave frequency band result for 125 Hz is assumed to representative of the 63 Hz octave frequency band. This assumption is considered valid as the sound reduction between 125 Hz and 100 Hz is not reducing.
- The third-octave frequency band result for 4000 Hz is assumed to representative of the 8000 Hz octave frequency band. This assumption is considered valid as the sound reduction between 4000 Hz and 5000 Hz is increasing, therefore an upward trend is seen in this frequency area.

Table 5.2: Assumed Sound Transmission Loss of 15 mm Plexiglas Soundstop

Material	Thickness (mm)	Sound Transmission Loss (dB, Hz)							
		63	125	250	500	1000	2000	4000	8000
Plexiglas	15 mm	21	21	24	29	35	29	39	39

5.1.9 The semi-circular tube enclosure should sit on a hinged mount (for maintenance purposes) over the top of each screw and extend partially into the water at the base of the installation and outwards to terminate at the top of the screw housing (ie. close to the gearbox and generator set).

5.2 Assessment with Mitigation

5.2.1 **Table 5.3** provides the BS 4142 assessment with the higher specification gearbox enclosure and screw canopy.

Table 5.3: Comparison of Permitted Rating Levels and Predicted Scheme with Additional Mitigation

Location	Criterion	Required Level (dB)	Predicted Scheme Noise Level (dB)	Level Difference (dB)	Compliant
MP2: Lensbury Club garden	BS 4142 (external)[1]	56	32	-24	Yes
	BS 8233 / WHO (internal)[3]	Not applicable			
	WHO (external)[3]	55	27	-28	Yes
Lensbury Club garden: Downstream	BS 4142 (external)[1]	58	40	-18	Yes
	BS 8233 / WHO (internal)[3]	Not applicable			
	WHO (external)[3]	55	35	-20	Yes
MP3: Rear façade of the Lensbury Club hotel	BS 4142 (external)[1]	32	24	-8	Yes
	BS 8233 / WHO (internal)[3,4]	35	-6	-41	Yes
	WHO (external)[3]	55	19	-36	Yes
MP4: Dwellings along Burnell Avenue	BS 4142 (external)[1]	36	21	-15	Yes
	BS 8233 / WHO (internal)[2,3]	30	-14	-44	Yes
	WHO (external)[3]	55	16	-39	Yes

[1] Including 5 dB penalty (as per BS 4142)
[2] 12 dB attenuation allowed for an open window as per LBRuT NTS
[3] No penalty included (no penalty in BS 8233 or WHO 'Guidelines for Community Noise')
[4] 30 dB attenuation allowed for an open window as per LBRuT NTS

5.2.2 It can be seen that with the proposed acoustic enclosure at the gearbox and semi-circular screw canopy, the permitted rating level is expected to be met at all of the identified noise-sensitive receptors in the vicinity of the Teddington Weir hydropower scheme.

6 Summary and Conclusion

6.1 Summary

6.1.1 This assessment uses baseline noise survey results and rating levels provided in previous noise assessment reports for the proposed hydropower scheme at Teddington Weir.

6.1.2 In addition, measurements have been undertaken at a similar scheme at Romney Weir, Windsor. These have been used to estimate the sound power level of the scheme, which has been corrected for the number of turbines proposed at Teddington Weir.

6.1.3 The propagation of the sound from the Teddington Weir scheme to nearby noise-sensitive receptors has been estimated using ISO 9613-2 and compared to the required rating levels.

6.1.4 Mitigation has been proposed in the form of a semi-circular canopy for the screws and an acoustic enclosure for the gearbox.

6.2 Conclusion

6.2.1 With the proposed mitigation comprised of acoustic panels with sound absorptive material surrounding the gearbox and Plexiglas canopy over the screws the permitted rating level is expected to be met at all of the identified noise-sensitive receptors in the vicinity of the Teddington Weir hydropower scheme for all but a small proportion of the time.

Figures

peterbrett

Offices throughout the UK and continental Europe.

www.peterbrett.com

Client

Ham Hydro CIC

Image Source: Google Earth Pro.

Date of Aerial Photography: June 2010

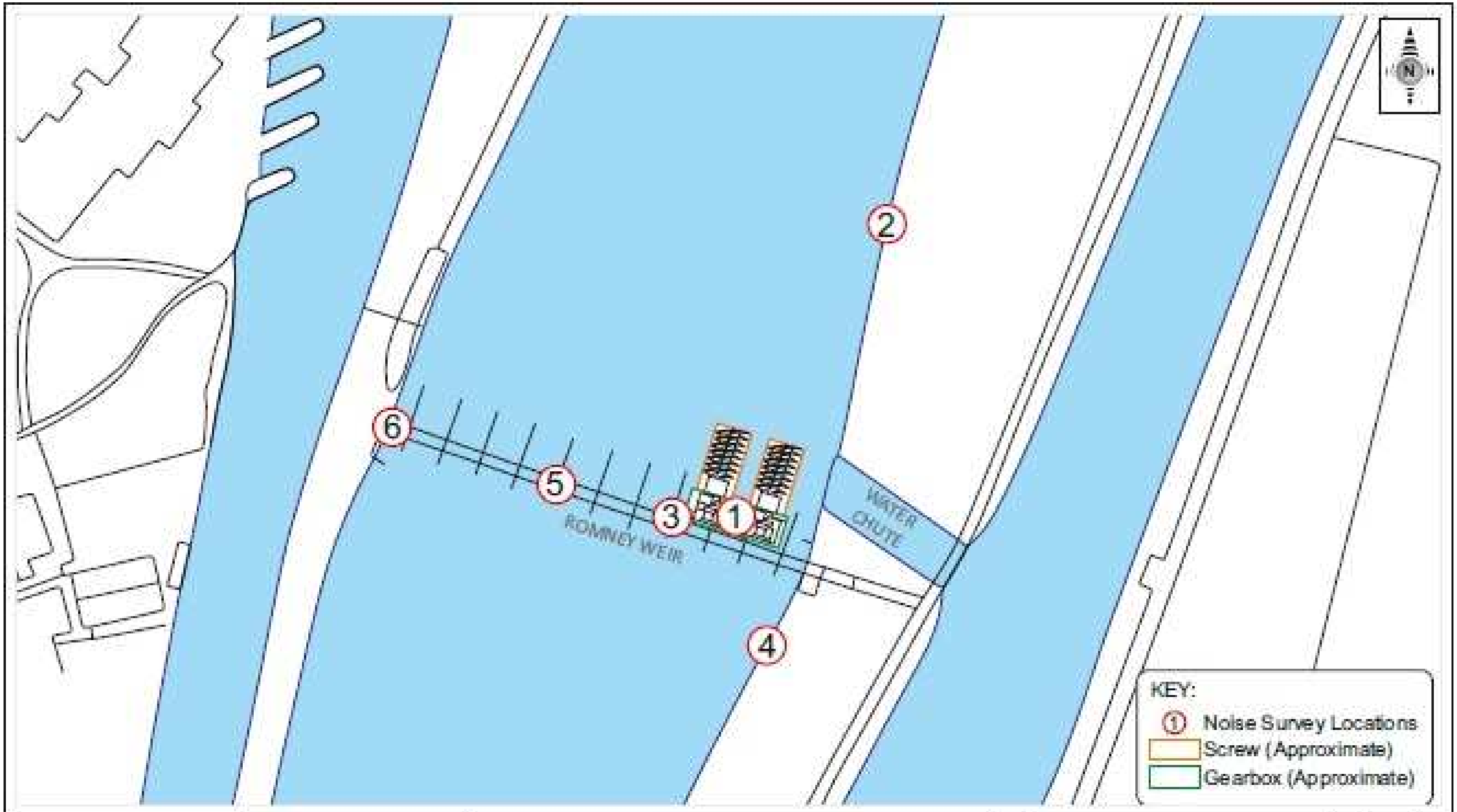
Teddington Weir

Noise Sensitive Receptors

Date	01.07.2013
Scale	1:2500
Drawn by	DC
Checked by	AL
Revision	-

FIGURE 1

J:\28307 Lower Thames Hydro\CAD & Graphics\Corel



peterbrett

Offices throughout the UK and Europe

www.peterbrett.com

Client

Ham Hydro

Teddington Weir Hydropower Scheme

Romney Weir Noise Survey Locations

Mark	Revision	Drawn	Date	Chkd

Date	04.09.2013
Scale	N.T.S.
Drawn by	ZB
Checked by	AL

FIGURE 2

Appendix A Glossary of Acoustics Terms

The following glossary of terms has been produced from BS 8233:1999 and BS 4142:1997. In addition, PPG 24 (HMSO, 1994) has been used for some definitions; although PPG 24 has been revoked by the NPPF, the daytime and night-time periods defined in it are typically still used. This Glossary provides explanations of the terms used within this document.

Ambient Noise	Total encompassing sound in a given situation at a given time, usually composed of sound from many sources far and near.
Background Noise	In BS 4142 this is defined as the A weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T ($L_{A90,T}$)
Daytime	Defined in PPG 24 as the period 07:00-23:00 hours.
Decibel (dB)	A unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure levels the reference quantity is 20 uPa. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
$L_{A10,T}$	The A weighted noise level exceeded for 10% of the measurement period, T. It gives an indication of the upper limit of fluctuating noise such as that from road traffic. $L_{A10,18h}$ is the arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{A90,T}$	The A weighted noise level exceeded for 90% of the measurement period, T. This is defined in BS 4142 as the background noise level.
$L_{Aeq,T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq, T}$ is used to describe many noises and can be measured directly with an integrating sound level meter.
L_{Amax},	The highest A weighted noise level recorded during a noise event. The time weighting (slow or fast) should be stated.
Night-time	Defined in PPG 24 as the period 23:00-07:00 hours.
Rating Level, $L_{Ar,Tr}$	The noise level of an industrial noise source which includes an adjustment for the character of the noise. Used in BS 4142:1997.

Residual Level	The ambient $L_{Aeq,T}$ remaining when the specific noise source is not present or is suppressed to a degree such that it does not contribute to the ambient noise.
Sound Power Level, Lw	An absolute parameter widely used for rating and comparing sound sources. Sound power is a physical property of the source alone, independent of any external or environmental factors[11].
Specific Noise Level, $L_{Aeq,Tr}$	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval
Specific Noise Source	The noise source under investigation for assessing the likelihood of complaints

[11] Hassall, JR; Zaveri, K "Acoustic Noise Measurements" Brüel and Kjær 1988

Appendix B Results of Romney Weir Noise Survey

Table B.1: Spectral Results for Locations 1 and 2

Measurement Reference	Location	Number of Turbines	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)	$L_{Zeq,T}$ (Hz, dB)							
					31.5	40	50	63	80	100	125	160
3	Between turbines	2	75.1	77.4	70.2	69.9	69.0	72.1	68.2	67.0	64.9	65.3
4		2	75.1	77.8	70.3	69.4	69.4	72.0	68.2	67.0	64.7	65.2
Average		2	75.1	77.6	70.3	69.7	69.2	72.1	68.2	67.0	64.8	65.3
19		1	72.3	74.0	66.8	68.6	68.7	69.6	64.3	63.6	61.6	63.3
25		0	68.5	69.2	64.4	62.1	60.3	61.1	58.8	58.9	60.2	60.9
N/A		2 (ambient removed)	74.0	76.9	69.0	68.9	68.6	71.7	67.7	66.3	63.0	63.3
N/A		1 (ambient removed)	70.0	72.3	63.1	67.5	68.0	68.9	62.9	61.8	56.0	59.6
9	Downstream	2	69.8	70.6	65.3	67.2	69.7	71.0	65.4	63.0	61.7	60.2
21		1	68.2	69.3	67.4	66.6	65.9	66.6	62.9	60.3	60.9	59.9
27		0	65.3	67.0	66.3	63.7	61.8	62.3	60.6	58.5	58.5	58.4
N/A		2 (ambient removed)	67.9	68.1	-	64.6	68.9	70.4	63.7	61.1	58.9	55.5
N/A		1 (ambient removed)	65.1	65.4	60.9	63.5	63.8	64.6	59.0	55.6	57.2	54.6

Table B.1: Spectral Results for Locations 1 and 2 (Continued)

Measurement Reference	Location	Number of Turbines	$L_{Zeq,T}$ (Hz, dB)									
			200	250	315	400	500	630	800	1000	1250	1600
3	Between turbines	2	65.0	65.5	64.6	75.5	67.1	64.5	67.7	62.5	60.6	59.6
4		2	64.6	65.2	64.6	75.7	67.1	64.5	67.3	62.3	60.5	59.5
Average		2	64.8	65.4	64.6	75.6	67.1	64.5	67.5	62.4	60.6	59.6
19		1	63.8	64.4	62.4	70.6	64.1	62.4	64.5	60.5	59.2	58.6
25		0	60.5	60.0	60.5	60.4	60.3	59.5	58.6	58.1	57.2	56.9
N/A		2 (ambient removed)	62.8	63.9	62.5	75.5	66.1	62.8	66.9	60.4	57.9	56.3
N/A		1 (ambient removed)	61.1	62.4	57.9	70.2	61.8	59.3	63.2	56.8	54.9	53.7
9	Downstream	2	61.2	61.2	60.1	62.2	61.8	61.0	60.0	59.3	58.2	58.5
21		1	57.7	58.5	60.5	60.9	60.2	59.9	58.5	57.8	56.6	56.4
27		0	57.4	57.4	58.5	59.0	56.8	56.0	54.7	54.7	53.9	53.7
N/A		2 (ambient removed)	58.9	58.9	55.0	59.4	60.1	59.3	58.5	57.5	56.2	56.8
N/A		1 (ambient removed)	45.9	52.0	56.2	56.4	57.5	57.6	56.2	54.9	53.3	53.1

Table B.1: Spectral Results for Locations 1 and 2 (Continued)

Measurement Reference	Location	Number of Turbines	L_{Zeq} (Hz, dB)										
			2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
3	Between turbines	2	60.8	61.1	57.9	56.8	55.9	54.5	52.7	50.4	47.7	44.0	37.5
4		2	60.6	61.1	58.0	56.7	55.8	54.4	52.7	50.4	47.6	43.9	37.4
Average		2	60.7	61.1	58.0	56.8	55.9	54.5	52.7	50.4	47.7	44.0	37.5
19		1	59.5	59.3	57.1	56.1	54.9	53.8	51.9	49.2	46.3	42.3	35.6
25		0	56.6	56.2	55.5	54.8	53.4	52.2	50.2	47.1	43.8	39.1	31.7
N/A		2 (ambient removed)	58.6	59.4	54.4	52.5	52.3	50.6	49.1	47.7	45.4	42.3	36.2
N/A		1 (ambient removed)	56.4	56.4	52.0	50.2	49.6	48.7	47.0	45.0	42.7	39.5	33.3
9	Downstream	2	57.8	56.5	57.0	55.9	55.5	54.6	52.8	50.8	48.4	45.0	38.9
21		1	55.8	54.8	55.4	54.2	53.7	52.8	51.0	48.9	46.2	42.5	36.2
27		0	53.3	52.2	52.4	51.3	50.7	49.5	47.4	44.7	41.4	37.1	30.7
N/A		2 (ambient removed)	55.9	54.5	55.2	54.1	53.8	53.0	51.3	49.6	47.4	44.2	38.2
N/A		1 (ambient removed)	52.2	51.3	52.4	51.1	50.7	50.1	48.5	46.8	44.5	41.0	34.8

Appendix C Results of ISO 9613-2 Calculations

Table C.1: Results of the ISO 9613-2 Calculations for One Turbine – Location 1: Between Turbines (Upstream)

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Equivalent continuous downwind octave-band sound pressure level (dB)	$L_{Aeq,T}$	75	69	68	76	68	63	58	54	
Attenuation due to geometric divergence (dB)	A_{div}	11	11	11	11	11	11	11	11	
Attenuation due to atmospheric absorption (dB)	A_{atm}	0.00008	0.0003	0.001	0.003	0.005	0.01	0.02	0.07	
Attenuation due to ground effect (dB)	A_{gr}	-3	-3	-3	-3	-3	-3	-3	-3	
Attenuation due to barrier (dB)	A_{bar}	0	0	0	0	0	0	0	0	
Attenuation due to miscellaneous other effects (dB)	A_{misc}	0	0	0	0	0	0	0	0	
Total Attenuation (dB)	A	8	8	8	8	8	8	8	8	
Directivity correction (dB)	Dc	0	0	0	0	0	0	0	0	
Octave band sound power level (dB)	L_W	83	77	76	84	76	71	66	62	
A-weighting	A_f	-26	-16	-9	-3	0	1	1	-1	
A-weighted octave band sound power level (dB)	L_{WA}	56	61	67	81	76	72	67	61	83

Table C.2: Results of the ISO 9613-2 Calculations for One Turbine – Location 2: Downstream

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Equivalent continuous downwind octave-band sound pressure level (dB)	$L_{Aeq,T}$	73	64	63	64	62	61	59	56	
Attenuation due to geometric divergence (dB)	A_{div}	41	41	41	41	41	41	41	41	
Attenuation due to atmospheric absorption (dB)	A_{atm}	0.00237	0.0091	0.031	0.083	0.155	0.27	0.64	2.06	
Attenuation due to ground effect (dB)	A_{gr}	-3	-3	-3	-3	-3	-3	-3	-3	
Attenuation due to barrier (dB)	A_{bar}	0	0	0	0	0	0	0	0	
Attenuation due to miscellaneous other effects (dB)	A_{misc}	0	0	0	0	0	0	0	0	
Total Attenuation (dB)	A	38	38	38	38	38	38	38	40	
Directivity correction (dB)	Dc	0	0	0	0	0	0	0	0	
Octave band sound power level (dB)	L_W	111	101	100	102	100	98	97	96	
A-weighting	A_f	-26	-16	-9	-3	0	1	1	-1	
A-weighted octave band sound power level (dB)	L_{WA}	85	85	92	99	100	100	98	95	106

Table C.3: Results of the ISO 9613-2 Calculations for Three Turbines –Lensbury Club Garden: Upstream

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Octave band sound power level (dB)	L_W (dB)	80	73	74	79	73	68	64	60	84
Attenuation due to geometric divergence (dB)	A_{div}	45	45	45	45	45	45	45	45	
Attenuation due to atmospheric absorption (dB)	A_{atm}	0.00395	0.0151	0.052	0.139	0.258	0.449	1.07	3.43	
Attenuation due to ground effect (dB)	A_{gr}	-3	-3	-3	-3	-3	-3	-3	-3	
Attenuation due to barrier (dB)	A_{bar}	0	0	0	0	0	0	0	0	
Attenuation due to miscellaneous other effects (dB)	A_{misc}	0	0	0	0	0	0	0	0	
Total Attenuation (dB)	A	42	42	42	42	42	42	43	45	
Directivity correction (dB)	Dc	0	0	0	0	0	0	0	0	
Equivalent continuous downwind octave-band sound pressure level (dB)	L_{fT}(DW)	38	31	32	37	30	26	20	15	42
A-weighting	A_f	-26	-16	-9	-3	0	1	1	-1	
A-weighted equivalent continuous downwind octave-band sound pressure level (dB)	L_{Aeq} (dB)	12	14	23	34	30	27	21	13	36
For three turbines	L_{Aeq} (dB)	17	19	28	38	35	32	26	18	41
For three turbines + penalty	$L_{Ar,Tr}$ (dB)	Not applicable								46
Lowest background noise levels	L_{A90} (dB)	31	37	38	41	46	45	40	27	51
BS 4142 target (LBRuT criteria = 5 dB above $L_{A90,T}$)										56
BS 4142 assessment (LBRuT criteria = 5 dB above $L_{A90,T}$)										-5 (meets criterion)

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Additional mitigation (higher specification gearbox enclosure)	(dB)	12	8	8	13	20	24	23	20	
For three turbines with additional mitigation	(dB)	5	11	20	25	16	8	3	0	27
For three turbines with additional mitigation + penalty	(dB)	Not applicable								32
BS 4142 assessment (LBRuT criteria = 5 dB above $L_{A90,T}$)										-19 (meets criterion)

Table C.4: Results of the ISO 9613-2 Calculations for Three Turbines: Lensbury Club Garden: Downstream

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Octave band sound power level (dB)	L_W (dB)	105	98	95	100	97	95	94	93	108
Attenuation due to geometric divergence (dB)	A_{div}	45	45	45	45	45	45	45	45	
Attenuation due to atmospheric absorption (dB)	A_{atm}	0.00395	0.0151	0.052	0.139	0.258	0.449	1.07	3.43	
Attenuation due to ground effect (dB)	A_{gr}	-3	-3	-3	-3	-3	-3	-3	-3	
Attenuation due to barrier (dB)	A_{bar}	0	0	0	0	0	0	0	0	
Attenuation due to miscellaneous other effects (dB)	A_{misc}	0	0	0	0	0	0	0	0	
Total Attenuation (dB)	A	42	42	42	42	42	42	43	45	
Directivity correction (dB)	Dc	0	0	0	0	0	0	0	0	
Equivalent continuous downwind octave-band sound pressure level (dB)	L_{fT}(DW)	63	56	53	58	55	52	51	48	66
A-weighting	A_f	-26	-16	-9	-3	0	1	1	-1	
A-weighted equivalent continuous downwind octave-band sound pressure level (dB)	L_{Aeq} (dB)	37	40	45	54	55	54	52	46	60
For three turbines	L_{Aeq} (dB)	42	45	50	59	60	58	57	51	65
For three turbines + penalty	$L_{Ar,Tr}$ (dB)	Not applicable								70
Lowest background noise levels	L_{A90} (dB)	28	37	39	43	47	48	43	32	53
BS 4142 target (LBRuT criteria = 5 dB above $L_{A90,T}$)										58
BS 4142 assessment (LBRuT criteria = 5 dB above $L_{A90,T}$)										17 (exceeds criterion)

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Additional mitigation (15 mm Plexiglas canopy around screws)	(dB)	21	21	24	29	35	29	39	39	
For three turbines with additional mitigation	(dB)	21	24	25	30	25	29	19	13	35
For three turbines with additional mitigation + penalty	(dB)	Not applicable								40
BS 4142 assessment (LBRuT criteria = 5 dB above $L_{A90,T}$)										-13(meets criterion)

Table C.5: Results of the ISO 9613-2 Calculations for Three Turbines: Rear Façade of the Lensbury Club Hotel

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Octave band sound power level (dB)	L_W (dB)	80	73	74	79	73	68	64	60	84
Attenuation due to geometric divergence (dB)	A_{div}	53	53	53	53	53	53	53	53	
Attenuation due to atmospheric absorption (dB)	A_{atm}	0.00988	0.0378	0.130	0.346	0.644	1.123	2.66	8.58	
Attenuation due to ground effect (dB)	A_{gr}	-3	-3	-3	-3	-3	-3	-3	-3	
Attenuation due to barrier (dB)	A_{bar}	0	0	0	0	0	0	0	0	
Attenuation due to miscellaneous other effects (dB)	A_{misc}	0	0	0	0	0	0	0	0	
Total Attenuation (dB)	A	49	49	50	50	50	51	52	58	
Directivity correction (dB)	Dc	0	0	0	0	0	0	0	0	
Equivalent continuous downwind octave-band sound pressure level (dB)	L_{fT}(DW)	31	23	24	29	23	18	11	2	34
A-weighting	A_f	-26	-16	-9	-3	0	1	1	-1	
A-weighted equivalent continuous downwind octave-band sound pressure level (dB)	L_{Aeq} (dB)	4	7	15	26	23	19	12	1	29
For three turbines	L_{Aeq} (dB)	9	12	20	31	27	24	17	6	33
For three turbines + penalty	$L_{Ar,Tr}$ (dB)	Not applicable								38
Lowest background noise levels	L_{A90} (dB)	23	28	28	31	31	28	21	16	37
BS 4142 target (LBRuT criteria = 5 dB below $L_{A90,T}$)										32
BS 4142 assessment (LBRuT criteria = 5 dB above $L_{A90,T}$)										1 (exceeds criterion)

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Additional mitigation (higher specification gearbox enclosure)	(dB)	12	8	8	13	20	24	23	20	
For three turbines with additional mitigation	(dB)	0	4	12	18	8	0	0	0	19
For three turbines with additional mitigation + penalty	(dB)	Not applicable								24
BS 4142 assessment (LBRuT criteria = 5 dB above $L_{A90,T}$)										-13 (meets criterion)

Table C.6: Results of the ISO 9613-2 Calculations for Three Turbines: Dwellings on Burnell Avenue

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Octave band sound power level (dB)	L_W (dB)	80	73	74	79	73	68	64	60	84
Attenuation due to geometric divergence (dB)	A_{div}	57	57	57	57	57	57	57	57	
Attenuation due to atmospheric absorption (dB)	A_{atm}	0.01643	0.0628	0.216	0.576	1.071	1.868	4.43	14.27	
Attenuation due to ground effect (dB)	A_{gr}	-4	-4	-4	-4	-4	-4	-4	-4	
Attenuation due to barrier (dB)	A_{bar}	0	0	0	0	0	0	0	0	
Attenuation due to miscellaneous other effects (dB)	A_{misc}	0	0	0	0	0	0	0	0	
Total Attenuation (dB)	A	53	53	53	53	54	55	57	67	
Directivity correction (dB)	Dc	0	0	0	0	0	0	0	0	
Equivalent continuous downwind octave-band sound pressure level (dB)	L_{fT}(DW)	27	20	21	26	19	14	6	-7	31
A-weighting	A_f	-26	-16	-9	-3	0	1	1	-1	
A-weighted equivalent continuous downwind octave-band sound pressure level (dB)	L_{Aeq} (dB)	1	3	12	22	19	15	7	0	25
For three turbines	L_{Aeq} (dB)	6	8	17	27	23	20	12	5	30
For three turbines + penalty	$L_{Ar,Tr}$ (dB)	Not applicable								35
Lowest background noise levels	L_{A90} (dB)	23	28	29	29	32	32	38	29	41
BS 4142 target (LBRuT criteria = 5 dB below $L_{A90,T}$)										36
BS 4142 assessment (LBRuT criteria = 5 dB below $L_{A90,T}$)										-6 (meets criterion)

Item	Abbre-viation	Octave Band Centre Frequency (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Additional mitigation (higher specification gearbox enclosure)	(dB)	12	8	8	13	20	24	23	20	
For three turbines with additional mitigation	(dB)	0	0	9	14	4	0	0	0	16
For three turbines with additional mitigation + penalty	(dB)	Not applicable								21
BS 4142 assessment (LBRuT criteria = 5 dB below $L_{A90,T}$)										-20 (meets criterion)

Appendix D Sound Reduction Data for Plexiglas™

Fraunhofer Institut Bauphysik

Amtlich anerkannte Prüfstelle für die Zulassung neuer Baustoffe, Bauteile und Bauarten · Forschung, Entwicklung, Prüfung, Demonstration und Beratung auf den Gebieten der Bauphysik

Institutsleitung
Univ.-Prof. Dr.-Ing. habil.
Dr. h.c. mult. Dr. E.h. mult.
Karl Gertis

P-BA 115/1999e

Airborne sound insulation of a noise barriers in accordance with German technical provision ZTV-Lsw 88 and according to DIN EN 1793-2: 1997

Client: Röhm GmbH Chemische Fabrik
Kirschenallee
D-64293 Darmstadt

1. Place and date of the measurements

The measurements were performed between November 19 th, 1998 and November 25 th, 1998 in the test facilities of the Fraunhofer-Institut für Bauphysik in Stuttgart.

2. Test specimens

Noise barrier consisting of PMMA panels, manufacturer's designation: PLEXIGLAS® and PLEXIGLAS SOUNDSTOP® (test objects S 8732-1, S 8731-2, S 8731-3, S 8731-4, S 8731-5, S 8731-6 and S 8731-7), see Fig. 1 and
Fig. 2.
Plates of different thicknesses were inserted into a supporting frame constructed from carrying channels and H-sections, plate edges were sealed with perimeter gaskets. The frame construction was adapted to the various plate depths by way of displaceable contact angles. The following panel thicknesses were tested:

Nobelstr. 12 · D-70569 Stuttgart · Postfach 80 04 69, D-70504 Stuttgart · Telefon (07 11) 9 70-00 · Telefax (07 11) 9 70-33 95
Miesbacher Str. 10 · D-83626 Valley · Postfach 11 52 · D-83601 Holzkirchen · Telefon (0 80 24) 6 43-0 · Telefax (0 80 24) 6 43-66

Test specimen	Plate thickness [mm]	Designation	mass per unit area [kg/m²]
8731-5	12	PLEXIGLAS®	14.1
8731-3	15	PLEXIGLAS SOUNDSTOP®	17.6
8731-2	16	PLEXIGLAS SOUNDSTOP®	18,7
8731-1	18	PLEXIGLAS SOUNDSTOP®	21.9
8731-4	20	PLEXIGLAS SOUNDSTOP®	23.5
8731-6	22	PLEXIGLAS SOUNDSTOP®	26.6
8731-7	25	PLEXIGLAS SOUNDSTOP®	29.9

Dimensions of test specimens were 3.71 m (W) x 2.95 m (H),
visible panel surfaces were 1.91 m (W) x 2.85 m (H) and 1.495 m (W) x 2.85 m (H).

At the top and at the bottom, the gaskets were sealed with a permanent sealant; to the left and to the right side, U-sections were backed with mineral fibres, with a permanent seal towards the test facility.

3. Sampling procedure

The test material was delivered by the client in June 1998. The panels were mounted in November 1998.

4. Test procedure

The test specimens were mounted on the test facility following the instructions specified in ZTV-Lsw 88. Due to the wall construction, the wall's overlapping by the centre post was approx. 45 mm instead of 20 mm. This is however in accordance with the mounting conditions as specified in the standard DIN EN 1793-2: 1997.

According to the "Additional technical rules and directions for the construction of noise barriers along roads" (ZTV-Lsw 88) the test procedure laid down in German standard DIN 52 210 has to be applied. The tests were performed in a test facility with suppressed flanking transmission acc. to German standard DIN 52 210-2:1984; measurements were performed according to German standards DIN 52 210-1: 1984 and DIN 52 210-3: 1987. The test sound was pink noise, which was filtered by one-third octave band filters in an analyser. The sound reduction index was determined according to the following relation

$$R = L_1 - L_2 + 10 \lg (S/A) \text{ dB}.$$

where:

- R sound reduction index
- L_1 average sound pressure level in the source room
- L_2 average sound pressure level in the receiving room
- S area of test specimen
- A equivalent absorption area in the receiving room evaluated by measurements of the reverberation time

The sound reduction index relevant for noise barriers along roads $\Delta L_{A,R,Str}$ was computed acc. to the instructions specified in ZTV-Lsw 88. The single number rating for the airborne sound insulation was determined acc. to the standard DIN EN 1793-2: 1997.

5. Test equipment and test conditions

Dimensions of test rooms:

Source room (L x W x H):	4.79 m x 3.56 m x 3.02 m; V = 51.5 m^3
Receiving room (L x W x H):	5.90 m x 3.56 m x 3.01 m; V = 63.2 m^3
Test opening (W x H):	3.71 m x 2.95 m; S = 10.9 m^2
Air temperature:	19 °C to 22 °C
Relative air humidity:	36 % to 45%

Measuring equipment:

Microphones:	B&K 4165
Preamplifier:	B&K 2639
Analyser:	Norsonic 840-2
Amplifier:	Klein & Hummel AK 120
Loudspeaker:	MLS Lanny 03/93

6. Measurement results

The measured sound reduction indices are indicated in Tables 1 to 7 and plotted versus frequency in Figs. 3 to 9. The relevant values for sound insulation acc. to ZTV-Lsw 88 and the single number ratings for the airborne sound reduction acc. to DIN EN 1793-2: 1997 are

Panel thickness [mm]	$\Delta L_{A,R,Str}$ [dB]	DL_R [dB]
12	29	29
15	30	30
16	30	31
18	31	31
20	32	32
22	32	32
25	33	33

All systems under test meet the requirements specified in clause 7.2.1 of ZTV-Lsw 88. The airborne sound insulation properties of the systems under test are to be classified in group B3 according to the standard DIN EN 1793-2. The adaptation of the noise barrier units to the test facility did not cause any degradation of the measured results.

The present test report comprises 5 pages, 7 tables and 8 figures. The measured results contained therein are only valid for the specimens under test. The publication of excerpts of this test report is subject to written authorisation by the Fraunhofer Institut für Bauphysik.

Stuttgart, December 17 th, 1999
Nic/Hy/Ec

Test engineer:

Dipl.-Ing. M. Nicolai

On behalf of the head of the laboratory

Dipl.-Ing. S. Koch

Table 2 Noise barrier with 15 mm thick panel
Single values for sound pressure levels L_1 in the source room and L_2 in receiving room, reverberation times T in the receiving room, sound insulation R_i and total sound reduction index $\Delta L_{A,R,Str}$
acc. to ZTV-Lsw 88, Table 7 and single figure rating for the air-borne sound insulation acc. to the standard DIN EN 1793-2

f [Hz]	L_1 [dB]	L_2 [dB]	T [s]	R_i [dB]
100	83,7	62,1	1,0	21,9
125	87,0	67,3	1,2	20,9
160	96,7	75,9	1,2	22,0
200	104,2	80,5	1,4	25,5
250	105,4	82,7	1,3	24,3
315	101,2	77,8	1,6	25,8
400	98,6	72,8	1,6	28,1
500	96,4	69,2	1,5	29,4
630	95,8	66,4	1,6	31,7
800	95,2	63,4	1,5	34,0
1000	94,6	61,6	1,4	34,9
1250	92,2	58,1	1,4	36,0
1600	92,1	59,0	1,3	34,9
2000	91,5	64,1	1,3	29,0
2500	88,0	59,2	1,2	30,1
3150	88,9	54,3	1,1	35,4
4000	87,0	49,1	1,1	38,5
5000	75,9	35,1	1,0	41,1

$\Delta L_{A,R,Str}$ = 30 dB

DL_R = 30 dB

Table 5 Noise barrier with 20 mm thick panel
Single values for sound pressure levels L_1 in the source room and L_2 in the receiving room, reverberation times T in the receiving room, sound insulation R_i and total sound reduction index $\Delta L_{A,R,Str}$
acc. to ZTV-Lsw 88, Table 7 and single figure rating for the air-borne sound insulation acc. to the standard DIN EN 1793-2

f [Hz]	L_1 [dB]	L_2 [dB]	T [s]	R_i [dB]
100	83,5	59,9	0,9	23,5
125	87,0	66,4	1,0	21,0
160	97,0	74,6	1,2	23,6
200	103,8	78,8	1,5	27,0
250	105,0	80,0	1,4	26,8
315	100,9	75,1	1,6	28,1
400	98,4	70,5	1,4	29,8
500	96,4	66,4	1,5	32,0
630	95,8	64,0	1,4	33,7
800	95,1	61,4	1,5	35,7
1000	94,6	59,9	1,4	36,5
1250	92,1	59,1	1,3	34,8
1600	92,0	63,7	1,3	30,0
2000	91,6	60,0	1,2	33,0
2500	88,2	52,6	1,2	36,7
3150	88,8	48,0	1,1	41,4
4000	87,0	43,2	1,0	44,1
5000	76,0	29,6	0,9	46,3

$\Delta L_{A,R,Str}$ = 32 dB

DL_R = 32 dB

Table 7 Noise barrier with 25 mm thick panel
Single values for sound pressure levels L_1 in the source room and L_2 in the receiving room, reverberation times T in the receiving room, sound insulation R_i and total sound reduction index $\Delta L_{A,R,Str}$
acc. to ZTV-Lsw 88, Table 7 and single figure rating for the air-borne sound insulation acc. to the standard DIN EN 1793-2

f [Hz]	L_1 [dB]	L_2 [dB]	T [s]	R_i [dB]
100	83,5	58,5	1,2	26,1
125	86,4	63,7	1,4	24,5
160	97,0	71,8	1,4	27,0
200	104,3	77,2	1,6	29,3
250	105,3	78,8	1,5	28,6
315	101,4	73,2	1,6	30,5
400	98,8	68,8	1,6	32,4
500	96,7	65,1	1,6	33,9
630	96,2	62,7	1,5	35,5
800	95,3	60,8	1,5	36,5
1000	94,9	61,6	1,4	35,2
1250	92,3	63,2	1,4	31,1
1600	92,2	60,7	1,4	33,4
2000	91,9	56,3	1,3	37,3
2500	88,5	50,0	1,2	39,9
3150	89,0	46,0	1,1	43,8
4000	87,3	41,4	1,0	46,3
5000	76,3	27,9	1,0	48,4

$\Delta L_{A,R,Str}$ = 33 dB

DL_R = 33 dB

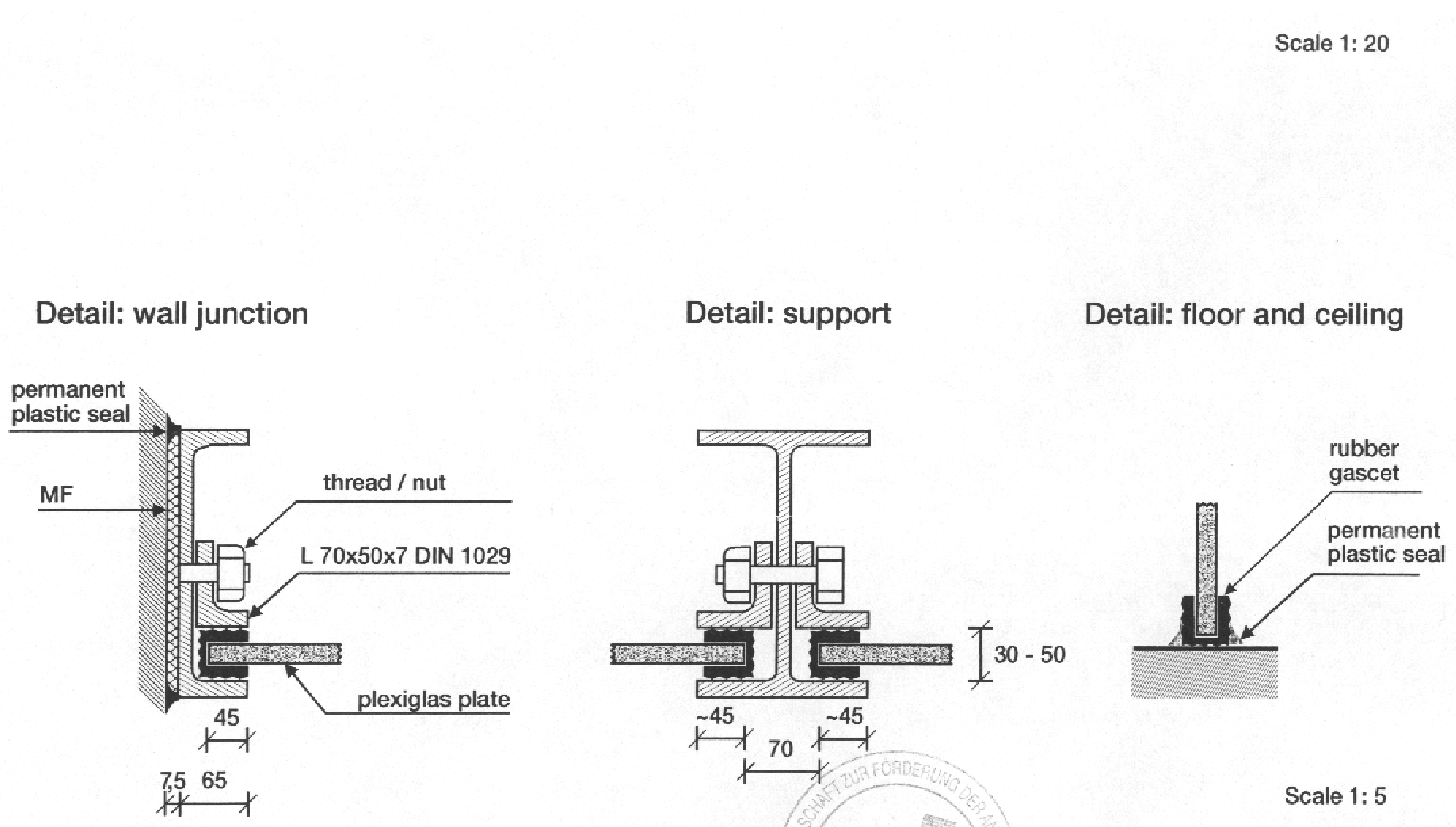
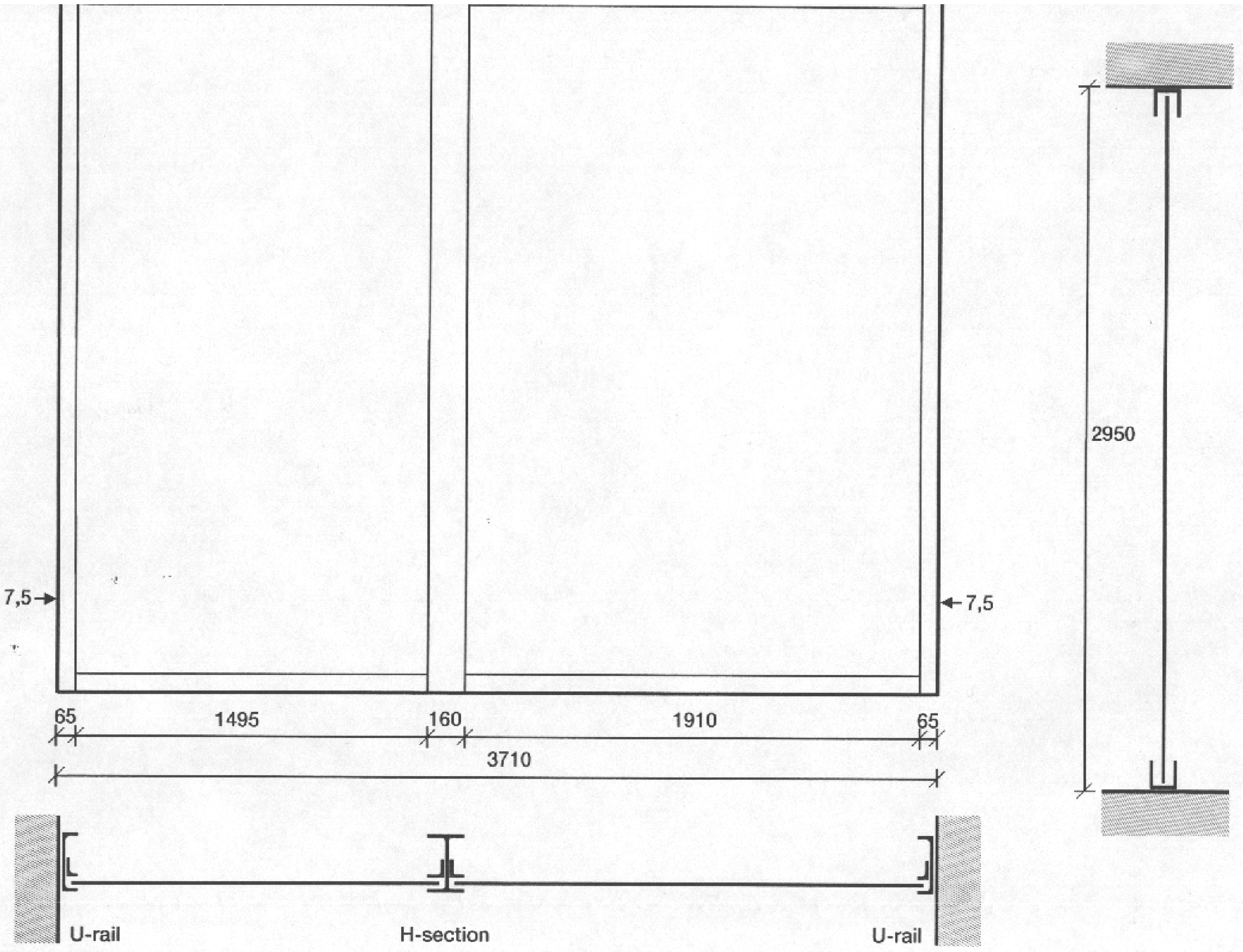


Fig. 1: View and sections of the tested noise barriers.



Scale 1: 20

Fig. 2: Photo of the test specimen
above: total view.
below: detail of the sealing.

Sound reduction in accordance with ZTV-Lsw 88 and acc. to DIN EN 1793-2 **Client:** Röhm GmbH Chemische Fabrik D - 64293 Darmstadt	P-BA 115/1999e **Fig. 4**

Test specimen:
Noise barrier consisting of PMMA panels, manufacturers designation: PLEXIGLAS SOUNDSTOP® (test object S 8731-3). Thickness of panels 15 mm, mass per unit area: 17,6 kg/m². Construction see Fig. 1 and Fig. 2.

Test area: 10,9 m²

Test rooms:
Volumes: V_S = 52 m³
V_E = 63 m³
Type: laboratory
Condition: empty
Upper limit:
$R'_{max,w}$ = 75 dB.

Test sound: pink noise

Test method:

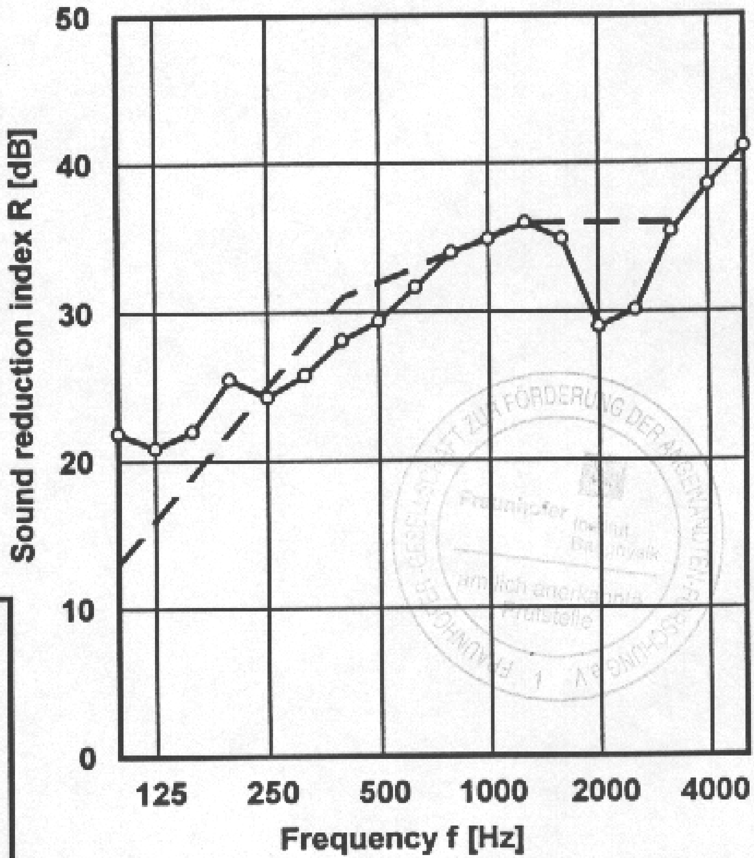
DIN 52 210-03-M-L-P-W

Date of measurement:

November 20 th, 1998

Test conditions:

Test temperature: 20 °C



Rating acc. to ZTV-Lsw 88
$\Delta L_{A,R,Str}$ = 30 dB.
The system under test meets the requirements specified in clause 7.2.1 of ZTV-Lsw 88.

Rating acc. to DIN EN 1793-2:1997
DL_R = 30 dB.
The airborne sound insulation properties of the system under test are to be classified in group B3.

Fraunhofer Institut Bauphysik (IBP)	Stuttgart, December 17 th, 1999 **On behalf of the head of the laboratory:**

Sound reduction following ZTV-Lsw 88 and acc. to DIN EN 1793-2

P-BA 115/1999e
Fig. 7

Client: Röhm GmbH Chemische Fabrik
D - 64293 Darmstadt

Test specimen:
Noise barrier consisting of PMMA panels, manufacturers designation: PLEXIGLAS SOUNDSTOP® (test object S 8731-4). Thickness of panels 20 mm, mass per unit area: 23,5 kg/m². Construction see Fig. 1 and Fig. 2.

Test area: 10,9 m²

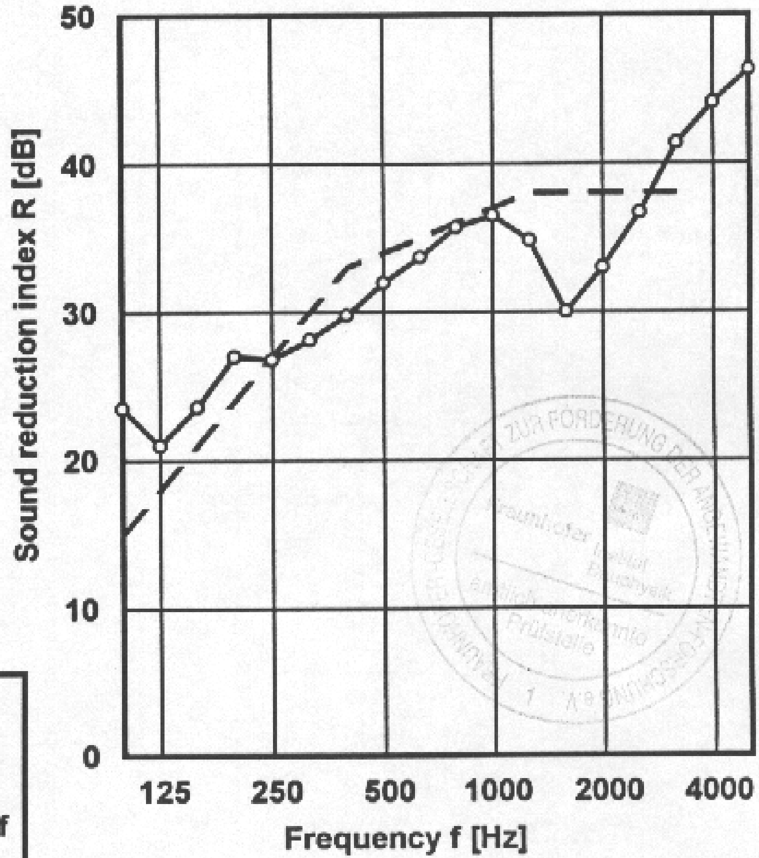
Test rooms:
Volumes: V_S = 52 m³
V_E = 63 m³
Type: laboratory
Condition: empty
Upper limit:
$R'_{max,w}$ = 75 dB.

Test sound: pink noise

Test method:
DIN 52 210-03-M-L-P-W

Date of measurement:
November 23 th, 1998

Test conditions:
Test temperature: 21 °C



Rating acc. to ZTV-Lsw 88
$\Delta L_{A,R,Str}$ = 32 dB.
The system under test meets the requirements specified in clause 7.2.1 of ZTV-Lsw 88.

Rating acc. to DIN EN 1793-2:1997
DL_R = 32 dB.
The airborne sound insulation properties of the system under test are to be classified in group B3.

Fraunhofer Institut Bauphysik

Stuttgart, December 17 th, 1999
On behalf of the head of the laboratory:
V. Koch

Sound in accordance with ZTV-Lsw 88 and acc. to DIN EN 1793-2 **Client:** Röhm GmbH Chemische Fabrik D - 64293 Darmstadt	P-BA 115/1999e **Fig. 9**

Test specimen:
Noise barrier consisting of PMMA panels, manufacturers designation: PLEXIGLAS SOUNDSTOP® (test object S 8731-7). Thickness of panels 25 mm, mass per unit area: 29,9 kg/m². Construction see Fig. 1 and Fig. 2.

Test area: 10,9 m²

Test rooms:
Volumes: V_S = 52 m³
V_E = 63 m³
Type: laboratory
Condition: empty
Upper limit:
$R'_{max,w}$ = 75 dB.

Test sound: pink noise

Test method:

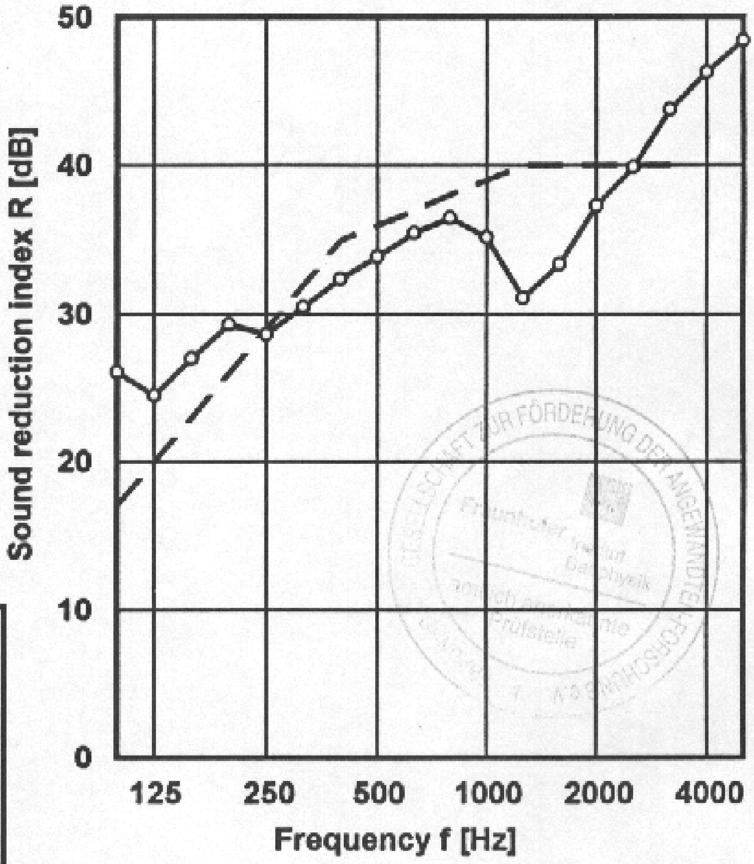
DIN 52 210-03-M-L-P-W

Date of measurement:

November 25 th, 1998

Test conditions:

Test temperature: 21 °C



Rating acc. to ZTV-Lsw 88
$\Delta L_{A,R,Str}$ = 33 dB.
The system under test meets the requirements specified in clause 7.2.1 of ZTV-Lsw 88.

Rating acc. to DIN EN 1793-2:1997
DL_R = 33 dB.
The airborne sound insulation properties of the system under test are to be classified in group B3.

IBP
Fraunhofer Institut Bauphysik

Stuttgart, December 17 th, 1999
On behalf of the head of the laboratory:
J. Lech

Item 2: PBA technical note ‘Modelling of Teddington Hydropower Scheme’ reference ESP N2 dated 22/07/2014

TECHNICAL NOTE

Job Name: Teddington

Job No: 28307-004

Note No: ESP N2

Date: 22 July 2014

Prepared By: Angela Lamacraft (PBA) for Paul Parker and Steve Jarvis (Ham Hydro)

Subject: **Modelling of Teddington Hydropower Scheme**

Item	Subject
1.	**Executive Summary** A noise impact assessment has been undertaken for the proposed hydropower scheme at Teddington Weir. The results of the assessment indicate that the requirements of the Local Authority should be achieved when the various noise sources are placed inside suitable acoustic enclosures. An acoustic specification for these enclosures has been provided alongside a list of suitable suppliers. This technical note should be read in conjunction with the PBA report 'Hydropower Scheme at Teddington Weir – Noise Assessment' Rev 003 dated 11/09/2013.
2.	**Introduction** A previous noise assessment predicted the noise levels from the proposed Archimedes Screw hydropower scheme at Teddington Weir, Richmond. The assessment, based on measurements of an existing turbine installation of similar type to estimate the sound power level of the Teddington Weir scheme, predicted that mitigation would be required to reduce noise levels from the scheme to meet the London Borough of Richmond upon Thames (LBRuT) criteria. The scheme design has been modified since the initial assessment and the purpose of this additional noise assessment is to predict the noise levels from the amended scheme.
3.	**Scheme Design** The following drawings have been used to model noise from the scheme: • eWaterpower Ltd drawing entitled 'Proposed Sections' reference DWG.TW-PS3 dated 20/06/2014, • eWaterpower Ltd drawing entitled 'Plan' reference DWG.TW-P1 'Teddington Weir Hydro-4-4' dated 190/06/2014

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
28307/004 ESP N2	-	22.07.14	A Lamacraft	D Walker	-	S Capel-Davies

Peter Brett Associates LLP Caversham Bridge House, Waterman Place, Reading, Berkshire RG1 8DN
T: +44 (0)118 950 0761 F: +44 (0)118 959 7498 E: reading@peterbrett.com

Item	Subject
	It is understood that the current proposals relate to three gearboxes, three Archimedes Screws and a single transformer. **Screw Canopies** The design team has advised that the canopies will cover the screw section, leaving the shaft exposed. They will be constructed of 15 mm Plexiglas (or a material with similar or superior acoustic properties) which will sit tight against the shaft at the termination with no air gap. **Gearboxes** The gearbox enclosures have been modelled with 100 mm thick acoustic panels. **Plant Room** The design team have advised that glass-reinforced plastic (GRP) will be used to construct the enclosure.
4.	**Methodology** The previously prepared noise model has been modified with the proposed changes using the previous methodology. **Consideration of High Tide** During the Spring Tide the $L_{A90,T}$ dropped by approximately 7 dB during the two hour daytime period and approximately 12 dB during the two hour night-time period close to the weir. This occurs infrequently and it is not considered to be representative of the typical background noise levels by the EHO at LBRuT who has advised that the criteria do not apply during the few hours of low background noise levels caused by Spring Tides. The turbine gear box and turbines will cease to operate when the height between the head and tail water levels (above the turbine and below the turbine) is less than 1.2 m. Based on a review of annual tidal data for 2006, it is estimated that this scenario happens for 85% of the occasions when the tide reaches its peak (which have a duration of two hours, twice a day). This means that any concerns over lower background noise levels (resulting from decreased fall of water over the weir during high tide) and consequent higher differential between these lower background noise levels and noise from the gearboxes and turbines is mitigated because during these circumstances the turbines will not be operational. The turbines are expected to be operational during low background noise levels for 15% of the high tides and based on the ZBP Acoustics observation that high tides lasted two hours, it is estimated that there may be low background noise levels with the turbines still running for approximately 3% of the year (calculated as two hours twice a day x 15% x 365). **Changes to Topography used in the Noise Model** Results of a topographical survey demonstrated that the previously acquired data was not providing reliable ground height information, therefore more accurate topographical data has been used in the amended noise model. The mean downstream water height has now been modelled as 2.5 m AOD and upstream as 4.5 m AOD. **Estimation of Sound Power Level** A noise survey was undertaken at a similar scheme in operation at Romney Weir. Appendix A of

Item	Subject
	the PBA report provides the full results of the calculations. The ambient noise level measured at Romney Weir has been subtracted from the noise levels measured with one turbine running to provide the noise level due to the Romney Weir hydropower scheme alone. This was only possible in locations 1 and 2 due to the high ambient noise level and the influence of noise from water flowing through the open gate: one of the enclosures over the equipment acted as a barrier to the noise for location 1 and the scheme as a whole acted as a barrier for location 2.

The calculated noise levels for the scheme with one turbine operating have been used to approximate the sound power level of the scheme using ISO 9613-2 in reverse (i.e. environmental corrections have been applied to the $L_{Aeq,T}$ measurements to estimate the L_{WA}). The topography of the area between the weir and the measurement locations is flat, therefore no corrections for attenuation due to topography (for example, barriers due to hills) have been included in the calculations.

Mitigation

In order to represent the effect of the mitigation measures in the model, the attenuation given by an acoustic enclosure has been subtracted from the previous sound power level spectrum for the gearbox. This has been modelled in this way as the noise measurements at Romney Weir were undertaken with an enclosure, therefore the only difference is the performance of the acoustic panels compared to the steel panels at the Romney Weir scheme.

In addition, the attenuation offered by a Plexiglas canopy over the screws has been subtracted from the amended sound power level used for the screws. This has been modelled in this way as the noise modelling software does not allow insertion of a barrier with a defined sound transmission loss, it assumes that no sound passes through a noise barrier, therefore the model would under-predict the scheme noise.

The calculations for the transformer are provided in **Appendix A**.

Table 4.1 provides the sound reduction indices used within the calculations and **Table 4.2** provides the sound power levels.

Table 4.1: Sound Reduction Indices of Materials

Material	Thickness (mm)	Sound Transmission Loss (dB, Hz)					
		125	250	500	1000	2000	4000
PlexiGlas	15 mm	21	24	29	35	29	39
GRP[1]	15 mm	21	24	29	35	29	39
Acoustic panel	100 mm	21	28	37	49	57	62
Note 1: In lieu of detailed data, GRP is assumed to have a similar performance to PlexiGlas							

Table 4.2: L_W used within the Noise Assessment

Item	L_{WZ} (dB, Hz)						L_{WA} (dB)
	125	250	500	1000	2000	4000	
Transformer with GRP housing[1]	69	71	66				57
Gearbox with acoustic panels	65	66	66	53	44	40	64
Turbine with Plexiglas	81	75	74	66	69	59	76
Note 1: Transformers are highly tonal with very little acoustic energy above 400 Hz.							

Item	Subject
	Uncertainty The uncertainty of the calculations has been calculated using the methodology described in the paper 'Considering uncertainty when performing environmental noise measurements'[1]. The source does not vary with weather conditions and only one sound level meter was used for the measurements, therefore the greatest source of uncertainty is due to weather conditions affecting the transmission path. • The Kerry and Waddington methodology uses the methodology detailed in 'Uncertainties in Noise Measurement'[2] which is to: 1. Define the half value (e.g. 3 for ± 3 dB) of each source of uncertainty, 2. Apply a correction for the standard uncertainty for a rectangular distribution (x / √3) for each source of uncertainty, 3. Add together the squared values found in 2, 4. Take the square root to find the combined uncertainty', 5. Multiply by 2 to calculate the expanded uncertainty to 95%. • The paper advises that for a single sound level meter the uncertainty budget would be "*like the ±0.7 dB tolerance of a type 1 sound level meter*". It also advises that "*measuring under downwind conditions usually produce worst-case conditions at distance of several hundred meters*", therefore the ± 3 dB uncertainty advised in ISO 9613-2 has been used due to the short distances between measurement location and source. These calculations are repeated for the measurement of the Romney Weir scheme and the prediction of noise at the sensitive receptors due to the proposed Teddington Scheme.
5.	**Commentary and Limitations** **Noise Survey** The noise surveys at Teddington Weir were undertaken by ZBP Acoustics and LBRuT. The BS 4142 criteria have been based on these results, therefore any error in the noise survey results will cause incorrect criteria to be set. The Romney Weir scheme is operational and measurements were taken in-situ, therefore it was not possible to adhere to the standards and guidance as closely as they ideally would have been. Results have been used in the prediction of noise from the operating scheme for measurements taken up to 30 m from the end of the turbines. **Calculations using ISO 9613-2** The 'ambient' noise level measurement was artificially increased due to the need to open a weir gate to maintain the head level of the water, which results in an overestimate of the noise contribution of water flowing over the weir and therefore an underestimation of noise from the scheme.

[1] Kerry, G., Waddington, D., 2005. *Considering uncertainty when performing environmental noise measurements*. Institute of Acoustics, Oxford.

[2] Craven, N. J., Kerry, G. 2007. '*Uncertainties in Noise Measurement*'. University of Salford.

Item	Subject
	It is considered that applying a correction for the number of turbines operating based on the total noise level, rather than the turbine level (which will increase with the number of turbines operating) and gearbox noise (which will not change significantly with an increase in the number of operating turbines), compensates for the underestimate due to ambient noise level measurements. The noise measurements used to estimate the sound power level of the scheme were taken in the absence of any wind, whereas ISO 9613-2 applies when there is a moderate downwind condition. However, the Kerry and Waddington paper suggests that the worst-case assessment provided by using downwind conditions occurs "*at distances of several hundred meters*", therefore ISO 9613-2 is considered appropriate for still conditions at short distances. **Proposed Hydropower Scheme at Teddington Weir** This noise assessment assumes that, other than the number of turbines, the Teddington Weir hydropower scheme is the same as the one at Romney Weir (e.g. same dimensions, power output, rotational speed etc for each turbine). **Mitigation Measures** **Section 8**, demonstrating the achievement of the LBRuT criteria, has been based on an estimation of enclosure and screw canopy performance based solely on the sound reduction index of the enclosure and screw canopy walls. The overall performance of the enclosures and screw canopies, including any doors, ventilation louvres etc, will need to be designed with regard to the limiting sound pressure levels at 1 m provided in **Section 8**.
6.	**Results of the Uncertainty Calculations** **Table 6.1** provides a summary of the uncertainty calculations. Table 6.1: Uncertainties in the Determination of Sound Power Level

Source	Notes	Value (Half width)	Distribution (divisor)	Standard Uncertainty (dB)
Source				
No uncertainty	Operational pattern does not vary	-	-	-
Transmission path: Romney Weir scheme to measurement location				
Weather	1 m and 30 m	3	Rect(√3)	1.7
Transmission path				
Weather	1 m and 30 m	3	Rect(√3)	1.7
Receiver: Teddington Weir scheme to receptors				
Instrumentation	Type 1 practical	0.7	Rect(√3)	0.4
Combined uncertainty (root sum of square)				2.5
Expanded uncertainty (95% confidence)				5.0

However, the EHO at LBRuT has requested that the assessment is repeated with an uncertainty

Item	Subject
	value of + 10 dB to allow for: • *"Measurement of source* • *Measurements of ambient* • *Background measurement* • *Differences with the schemes i.e. topography, tidal variation etc* • *Effectiveness of mitigation."*
7.	**Predicted Results of the Noise Model** **Table 7.1** provides the results of the assessment with the assumptions outlined in **Sections 3** and **4**.

Table 7.1: Assessment of the Amended Scheme Design

Location	Criterion	Required Level (dB)	Predicted Scheme Noise Level (dB)	Difference between Required and Predicted Levels (dB)	Compliant
Lensbury Club garden: upstream	BS 4142 (external)	56	35	-21	Yes
	BS 8233 / WHO (internal)[2]	Not applicable			
	WHO (external)[2]	55	30	-25	Yes
Lensbury Club garden: downstream	BS 4142 (external)	58	36	-22	Yes
	BS 8233 / WHO (internal)[2]	Not applicable			
	WHO (external)[2]	55	31	-24	Yes
Rear façade of the Lensbury Club hotel	BS 4142 (external)	42	26	-16	Yes
	BS 8233 / WHO (internal)[2,3]	35	-9	-44	Yes
	WHO (external)[2]	55	21	-34	Yes
Dwellings along Burnell Avenue (MP4)	BS 4142 (external)[1]	36	23	-13	Yes
	BS 8233 / WHO (internal)[2,4]	30	7	-23	Yes
	WHO (external)[2]	55	19	-36	Yes

Item	Subject

1 Including 5 dB penalty (as per BS 4142)
2 No penalty included (no penalty in BS 8233 or WHO 'Guidelines for Community Noise')
3 30 dB attenuation allowed for an closed window as per LBRuT NTS
4 12 dB attenuation allowed for an open window as per LBRuT NTS

It can be seen that the noise criteria are met at all receiver locations with the revised scheme design.

Table 7.2 provides the results of the assessment with the uncertainty budget added to the noise model results.

Table 7.2: Assessment of the Amended Scheme Design plus 10 dB Uncertainty

Location	Criterion	Required Level (dB)	Predicted Scheme Noise Level (dB)	Difference between Required and Predicted Levels (dB)	Compliant
Lensbury Club garden: upstream	BS 4142 (external)[1]	56	45	-11	Yes
	BS 8233 / WHO (internal)[2]	Not applicable			
	WHO (external)[2]	55	40	-15	Yes
Lensbury Club garden: downstream	BS 4142 (external)[1]	58	46	-12	Yes
	BS 8233 / WHO (internal)[2]	Not applicable			
	WHO (external)[2]	55	41	-14	Yes
Rear façade of the Lensbury Club hotel	BS 4142 (external)[1]	42	36	-6	Yes
	BS 8233 / WHO (internal)[2,3]	35	1	-34	Yes
	WHO (external)[2]	55	31	-24	Yes
Dwellings along Burnell Avenue (MP4)	BS 4142 (external)[1]	36	33	-3	Yes
	BS 8233 / WHO (internal)[2,4]	30	17	-13	Yes
	WHO (external)[2]	55	29	-26	Yes

1 Including 5 dB penalty (as per BS 4142)
2 No penalty included (no penalty in BS 8233 or WHO 'Guidelines for Community Noise')
3 30 dB attenuation allowed for an closed window as per LBRuT NTS
4 12 dB attenuation allowed for an open window as per LBRuT NTS

It can be seen that the noise criteria are met at all receiver locations with the revised scheme

Item	Subject
	design and a + 10 dB uncertainty budget.
8.	**Acoustic Specification** The various components of the Teddington Weir Hydropower Scheme shall be supplied complete with acoustic treatment which shall achieve adequate levels of attenuation to ensure that the limiting sound pressure levels provided in **Table 8.1** are not exceeded at 1 m from each enclosure in any horizontal direction and under any conditions.

Table 8.1: Limiting Sound Pressure Levels

Item	Limiting Sound Pressure Level @ 1m (dB re 2 x 10^{-5} Pa)
Gearbox	56
Transformer	50
Screw	56

Exceedances in excess of the measurement tolerance for a Class 1 sound level meter shall constitute a failure.

It should be noted that the above acoustic specification may be onerous as a direct result of the requirements of the local authority and the 10 dB accuracy allowance. The supplier of the acoustic enclosures may propose alternative ways of commissioning the installation in order to ensure the requirements of the local authority are met at the various noise sensitive receptors.

A list of suitable suppliers of acoustic enclosures is provided as **Appendix B**.

Item	Subject
9.	**Conclusion** A noise impact assessment has been undertaken for the proposed hydropower scheme at Teddington Weir. The results of the assessment indicate that the requirements of the Local Authority should be achieved when the various noise sources are placed inside suitable acoustic enclosures. An acoustic specification for these enclosures has been provided alongside a list of suitable suppliers.

Appendix A – Calculation of Transformer Enclosure Sound Power Level

Item	Value	Z-Weighted (dB, Hz)						A-Weighted (dB)
		125	250	500	1000	2000	4000	
L_W		69.0	70.8	66.0				66.0
l	3.8							
w	2.7							
h	3.5							
$\alpha_{Plexiglas}$		0.2	0.1	0.0	0.0	0.0	0.0	
$S_{Plexiglas}$	55.8							
$\alpha_{concrete}$		0.0	0.0	0.0	0.0	0.0	0.0	
$S_{concrete}$	10.3							
$\acute{\alpha}$		0.2	0.1	0.0				
$S_{total} = 2(l*w)+2(l*h)+2(w*h)$	66.0							
$V = l*w*h$	35.9							
$R_c = S\acute{\alpha}/(1-\acute{\alpha})$		12.0	3.6	2.4				
$K_{rev} = 10log(4/R_c)$		-4.8	0.4	2.2				
$L_{prev} = L_W + K_{rev}$		64.2	71.2	68.2				
$SRI_{wall\_and\_ceiling}$		20.9	20.9	24.3	29.4	34.9	29.0	
S_{long_wall} (m^2)	13.3							
$L_{Wlong\_wall} = L_{prev} - 3 - SRI + 10logS$		51.6	58.6	52.1				50.5
S_{short_wall} (m^2)	9.5							
$L_{Wshort\_wall} = L_{prev} - 3 - SRI + 10logS$		50.1	57.1	50.6				49.0
$S_{ceiling}$ (m^2)	10.3							
$L_{Wceiling} = L_{prev} - 3 - SRI + 10logS$		50.4	57.4	51.0				49.3
L_{Wtotal}		57.8	64.8	58.3				56.7

Where:

- L_W = sound power level (dB)
- l = length of the enclosure (m)
- w = width of the enclosure (m)
- h = height of the enclosure (m)
- α_n = absorption coefficient of individual material n
- $\acute{\alpha}$ = average absorption coefficient
- S_m = surface area of element m (m^2)
- V = volume (m^3)
- R_C = room constant (m^2)
- K_{rev} = correction factor for internal sound pressure level (dB)
- L_{prev} = reverberant sound pressure level (dB)
- SRI_n = sound reduction index of material n (dB)

TECHNICAL NOTE

Appendix B – Suppliers of Acoustic Enclosures

Name & Address	Telephone Number	Contact
Industrial Acoustic Company IAC House Moorside Road Winchester Hampshire SO23 7US	01962 873000	Scott Simmons
Allaway Acoustics Ltd 1 Queens Road Hertford SG14 1EN	01992 550825	Jim Grieves Roger Wade
Acoustic Engineering Services Ltd 78 High Road Byfleet Surrey KT14 7QW	01932 352733	Barry Austin Mark Stagg

Please note that the above are not recommendations or endorsements and the appearance of these organisations in this list does not imply any warranty on the part of PBA on the products produced by these suppliers.

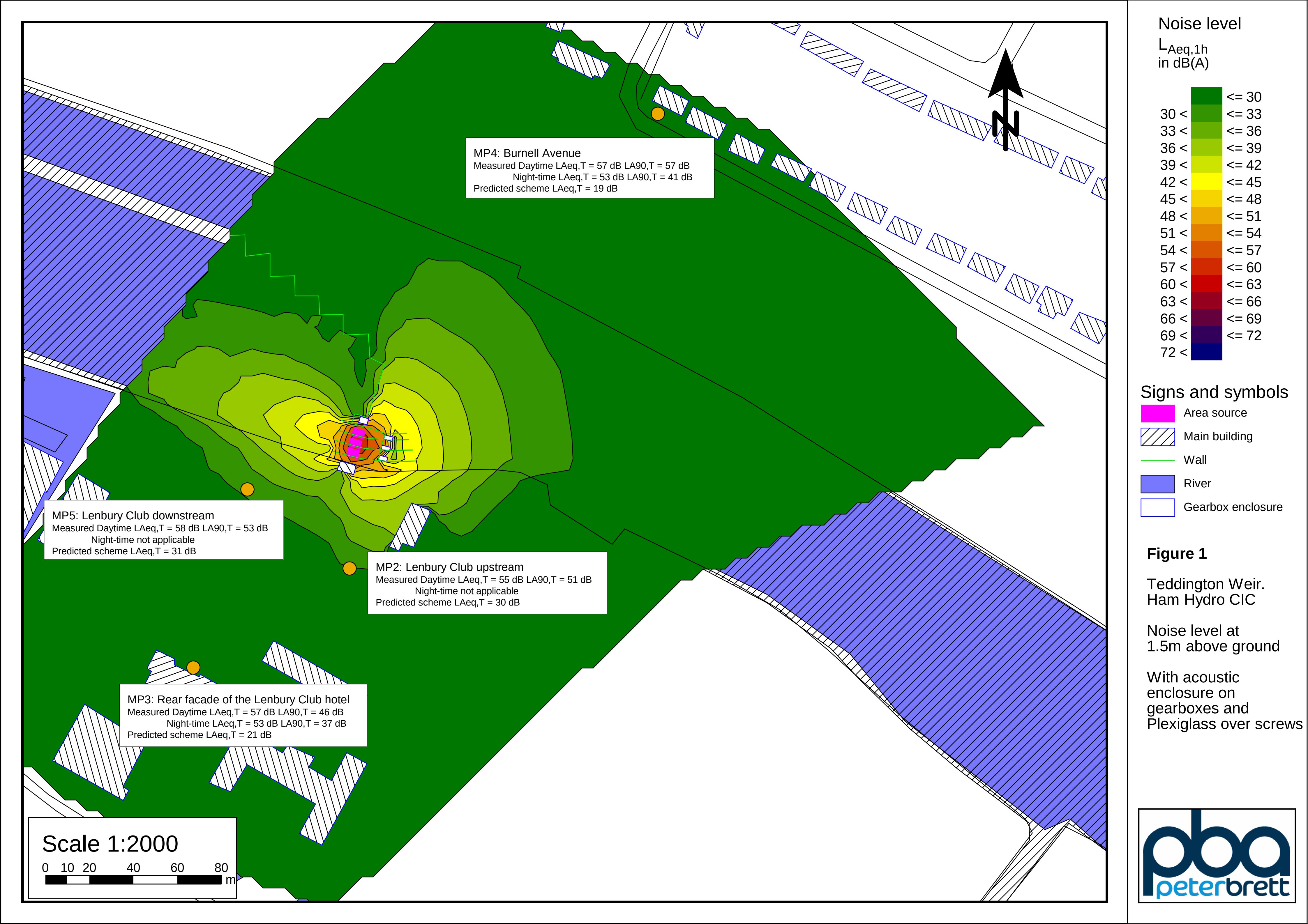
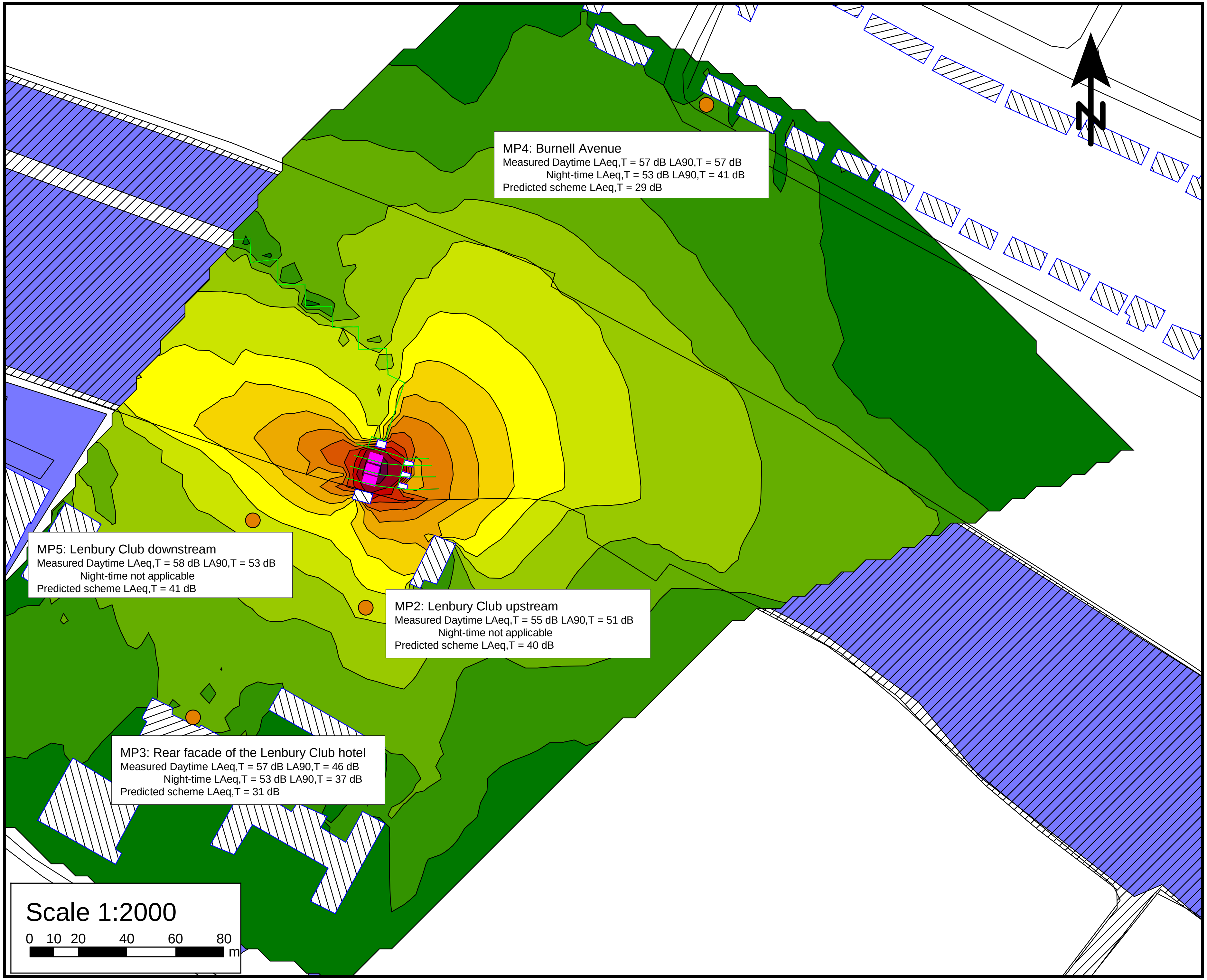


Figure 1

Teddington Weir.
Ham Hydro CIC

Noise level at
1.5m above ground

With acoustic
enclosure on
gearboxes and
Plexiglass over screws



Noise level
$L_{Aeq,1h}$
in dB(A)

	<= 30
30 <	<= 33
33 <	<= 36
36 <	<= 39
39 <	<= 42
42 <	<= 45
45 <	<= 48
48 <	<= 51
51 <	<= 54
54 <	<= 57
57 <	<= 60
60 <	<= 63
63 <	<= 66
66 <	<= 69
69 <	<= 72
72 <	

Signs and symbols

- Area source
- Main building
- Wall
- River
- Gearbox enclosure

Figure 2

Teddington Weir.
Ham Hydro CIC

Noise level at
1.5m above ground

With acoustic
enclosure on
gearboxes and
Plexiglass over screws

+ 10 dB for
uncertainty

pba peterbrett

Item 3: Correspondence between Peter Brett Associates LLP and the London Borough of Richmond upon Thames

Correspondence between Peter Brett Associates LLP and the London Borough of Richmond upon Thames

The below provides a summary of the correspondence between PBA and London Borough of Richmond upon Thames between submission of the PBA report 'Hydropower Scheme at Teddington Weir – Noise Assessment' Rev 003 dated 11/09/2013 and the PBA Technical Note ESP N2 'Modelling of Teddington Hydropower Scheme' dated 18/07/2014.

1.

From: Christopher Hurst [mailto:C.Hurst@richmond.gov.uk]
Sent: 19 September 2013 10:30
To: 'Chas Warlow'; Angela Lamacraft
Cc: Derek Tanner
Subject: Locations

Hi Chas

I think there may have been a mistake with Alex's descriptions of the locations which has lead to the confusion and which has been subsequently replicated- I have checked our measurements and locations which were originally sent to Alex and the locations should read as below

Location MP1 – Roof of The Riverside Pavilion

Location MP2 – External Conference Marquee

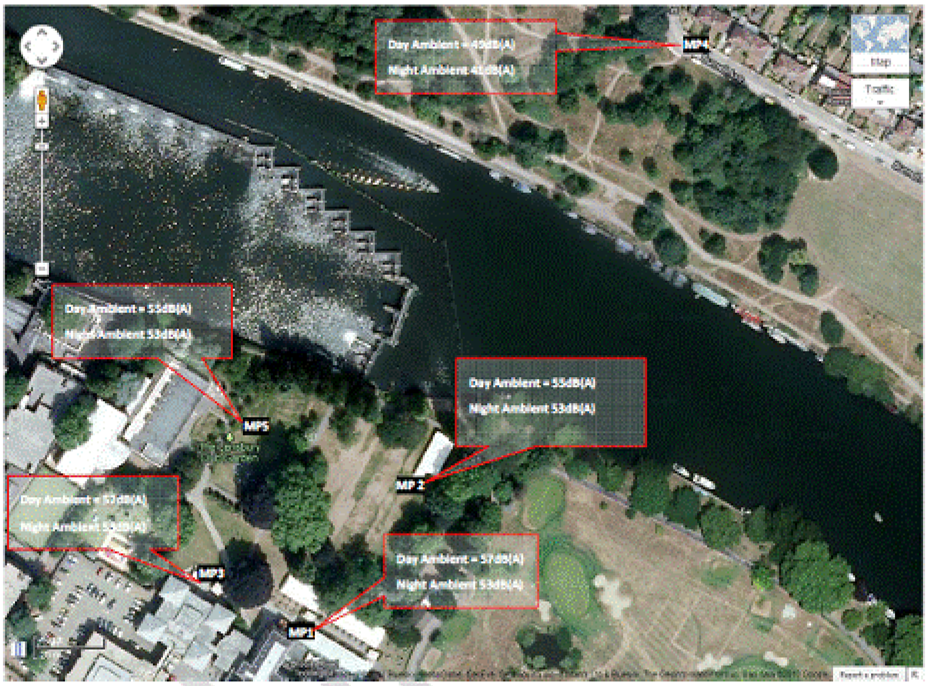
Location MP3 –Conference Centre Patio

Location MP4- Burnell Avenue

Location MP5- Lensbury Garden Area

Angela – can you get back and confirm.

Figure 3: Existing Measured Daytime / Night-time Ambient Noise $L_{Aeq,T}$ levels dB(A)



Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

2.

From: Angela Lamacraft
Sent: 27 September 2013 10:11
To: 'Christopher Hurst'
Cc: 'Chas Warlow' (chas@hamhydro.org)
Subject: RE: Teddington Hydropower Scheme

Chris,

Many thanks for your email. I'm pleased that your results are in line with ours and also that you didn't perceive a subjective impact.

I've previously been advised that the envelope of the enclosure is sheet steel so whilst the air intake and extract are attenuated the material of the enclosure itself would not attenuate noise very much.

Please could you tell me how was the figure of 10 dB was derived? I don't want to be too onerous with the results obviously as I need to put forward a typical scenario.

Many thanks,

Angela

From: Christopher Hurst [mailto:C.Hurst@richmond.gov.uk]
Sent: 27 September 2013 09:59
To: Angela Lamacraft
Subject: RE: Teddington Hydropower Scheme

Hi Angela

I think this should be ok- Derek is on holiday at the moment.

I visited Romney last Friday and spoke with the operator.(only one turbine was operational) I undertook measurements at the same positions indicated in your report and the results are broadly the same as yours for one turbine.

My aural impression was that the operational noise did not cause a negative impact.

However Mr DeChambeau indicated that for the Teddington scheme there will be a change in the hydrodynamic noise due to the changing tidal level of the river relative with the turbine- he states that the angle and depth of the turbine has an effect on the hydrodynamic noise. He also said that the gearbox housing at Romney had been significantly attenuated to reduce breakout.

I have also been in touch with the EA- the following link is from a small scheme in Kendal that enclosed the turbines-this maybe of use. I have also sent to Chas.

http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&ved=0CDQQFjAB&url=http%3A%2F%2Fwww.british-hydro.org%2Fdownloads%2F2%2520Chris%2520Brett%2520-%2520Inter%2520Hydro%2520Technology.pdf&ei=DDxEUonoNsOm4gT43IH4DA&usg=AFQjCNEZ4AZKYL9MWs_RLRC85U_U8iEsUg&bvm=bv.53217764,d.bGE

Having also spoken further to Prof Kang regarding the above issues we are still concerned about the level of uncertainty you have applied as this seems to be rather low given the differences between the schemes and the problems associated with determining the ambient and source level data as well as the effect of the mitigation.

When you model the results can you therefore also provide a +10dB level of uncertainty scenario-

Happy to discuss further.

Kind regards

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Angela Lamacraft [mailto:alamacraft@peterbrett.com]
Sent: 27 September 2013 09:20
To: Christopher Hurst
Subject: RE: Teddington Hydropower Scheme
Importance: High

Chris,

I've very nearly finished the modelling exercise and report for Teddington but I'm unlikely to be able to get it reviewed today, is there any way we could still have it included if we send it to you on Monday please?

Many thanks,

Angela

0118 952 0248

From: Christopher Hurst [mailto:C.Hurst@richmond.gov.uk]
Sent: 13 September 2013 16:00
To: Angela Lamacraft
Subject: FW: Teddington Hydropower Scheme

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Derek Tanner
Sent: 13 September 2013 15:58
To: Christopher Hurst
Cc: Bryan Staff
Subject: RE: Teddington Hydropower Scheme

For the 10th cttee would really need this by the end of next week otherwise as they are acting for the applicants we can give them as much time as they want

Regards

Derek Tanner

Planning Officer (part time)

Development Management (West Team)

Please note I am normally in the office on Wednesdays and Thursdays

---

From: Christopher Hurst
Sent: 13 September 2013 15:50
To: Derek Tanner
Subject: RE: Teddington Hydropower Scheme

When is the deadline

Thanks

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Derek Tanner
Sent: 13 September 2013 15:43
To: Christopher Hurst
Subject: RE: Teddington Hydropower Scheme

I am happy to wait for this as it is no longer going to a September committee.

Regards

Derek Tanner

Planning Officer (part time)

Development Management (West Team)

Please note I am normally in the office on Wednesdays and Thursdays

From: Christopher Hurst
Sent: 13 September 2013 15:39
To: Derek Tanner
Subject: FW: Teddington Hydropower Scheme

Hi Derek

See below from the acoustic consultant- if they can provide a noise model this will be very helpful and illustrate the noise impact in colour contours which is much easier for the layperson to understand than a table of numbers

Regards

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Angela Lamacraft [mailto:alamacraft@peterbrett.com]
Sent: 13 September 2013 15:31
To: Christopher Hurst
Subject: Teddington Hydropower Scheme

Dear Chris,

As discussed, please could you ask Derek to confirm whether the Teddington application will be put to September's committee? If it will be delayed until October, please could you ask whether it's possible for us to submit further information (a noise model of the proposed scheme) and if so, what the deadline for submission would be.

Many thanks,

Angela Lamacraft

BSc(Hons) MIOA IEng

Acoustic Engineer

For and on behalf of Peter Brett Associates LLP

Caversham Bridge House, Waterman Place, Reading, Berkshire, RG1 8DN

t 0118 9520248

f 0118 9597498

e alamacraft@peterbrett.com

w www.peterbrett.com

3.

From: Christopher Hurst [mailto:C.Hurst@richmond.gov.uk]
Sent: 27 September 2013 10:25
To: Angela Lamacraft
Subject: RE: Teddington Hydropower Scheme

Hi Angela

If you undertake a uncertainty budget for

1.measurement of source

2.measuremets of ambient

3.background measurement

4.differences with the schemes i.e topography, tidal variation etc

5.effect of mitigation

This will result in a higher level of uncertainty that +/-5dB – see Salford guidance on applying uncertainty budgets

Although we have not undertaken a full uncertainty budget- Prof Kang agrees that +/-10 maybe more realistic- with a caveat the transposition of the results from Romney to Teddington is still rather problematic.

However that being said Romney operates without causing a problem- you are confident t that you will achieve our design requirements and you are proposing a higher level of mitigation than Romney- so the desired outcome should be achievable.

Regards

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Angela Lamacraft [mailto:alamacraft@peterbrett.com]
Sent: 27 September 2013 10:11
To: Christopher Hurst
Cc: 'Chas Warlow' (chas@hamhydro.org)
Subject: RE: Teddington Hydropower Scheme

Chris,

Many thanks for your email. I'm pleased that your results are in line with ours and also that you didn't perceive a subjective impact.

I've previously been advised that the envelope of the enclosure is sheet steel so whilst the air intake and extract are attenuated the material of the enclosure itself would not attenuate noise very much.

Please could you tell me how was the figure of 10 dB was derived? I don't want to be too onerous with the results obviously as I need to put forward a typical scenario.

Many thanks,

Angela

From: Christopher Hurst [mailto:C.Hurst@richmond.gov.uk]
Sent: 27 September 2013 09:59
To: Angela Lamacraft
Subject: RE: Teddington Hydropower Scheme

Hi Angela

I think this should be ok- Derek is on holiday at the moment.

I visited Romney last Friday and spoke with the operator.(only one turbine was operational) I undertook measurements at the same positions indicated in your report and the results are broadly the same as yours for one turbine.

My aural impression was that the operational noise did not cause a negative impact.

However Mr DeChambeau indicated that for the Teddington scheme there will be a change in the hydrodynamic noise due to the changing tidal level of the river relative with the turbine- he states that the angle and depth of the turbine has an effect on the hydrodynamic noise. He also said that the gearbox housing at Romney had been significantly attenuated to reduce breakout.

I have also been in touch with the EA- the following link is from a small scheme in Kendal that enclosed the turbines-this maybe of use. I have also sent to Chas.

http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&ved=0CDQQFjAB&url=http%3A%2F%2Fwww.british-hydro.org%2Fdownloads%2F2%2520Chris%2520Brett%2520-%2520Inter%2520Hydro%2520Technology.pdf&ei=DDxEUonoNsOm4gT43IH4DA&usg=AFQjCNEZ4AZKYL9MWs_RLRC85U_U8iEsUg&bvm=bv.53217764,d.bGE

Having also spoken further to Prof Kang regarding the above issues we are still concerned about the level of uncertainty you have applied as this seems to be rather low given the differences between the schemes and the problems associated with determining the ambient and source level data as well as the effect of the mitigation.

When you model the results can you therefore also provide a +10dB level of uncertainty scenario-

Happy to discuss further.

Kind regards

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Angela Lamacraft [mailto:alamacraft@peterbrett.com]
Sent: 27 September 2013 09:20
To: Christopher Hurst

Subject: RE: Teddington Hydropower Scheme
Importance: High

Chris,

I've very nearly finished the modelling exercise and report for Teddington but I'm unlikely to be able to get it reviewed today, is there any way we could still have it included if we send it to you on Monday please?

Many thanks,

Angela

0118 952 0248

From: Christopher Hurst [mailto:C.Hurst@richmond.gov.uk]
Sent: 13 September 2013 16:00
To: Angela Lamacraft
Subject: FW: Teddington Hydropower Scheme

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Derek Tanner
Sent: 13 September 2013 15:58
To: Christopher Hurst
Cc: Bryan Staff
Subject: RE: Teddington Hydropower Scheme

For the 10th cttee would really need this by the end of next week otherwise as they are acting for the applicants we can give them as much time as they want

Regards

Derek Tanner

Planning Officer (part time)

Development Management (West Team)

Please note I am normally in the office on Wednesdays and Thursdays

---

From: Christopher Hurst
Sent: 13 September 2013 15:50
To: Derek Tanner
Subject: RE: Teddington Hydropower Scheme

When is the deadline

Thanks

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Derek Tanner
Sent: 13 September 2013 15:43
To: Christopher Hurst
Subject: RE: Teddington Hydropower Scheme

I am happy to wait for this as it is no longer going to a September committee.

Regards

Derek Tanner

Planning Officer (part time)

Development Management (West Team)

Please note I am normally in the office on Wednesdays and Thursdays

From: Christopher Hurst
Sent: 13 September 2013 15:39
To: Derek Tanner
Subject: FW: Teddington Hydropower Scheme

Hi Derek

See below from the acoustic consultant- if they can provide a noise model this will be very helpful and illustrate the noise impact in colour contours which is much easier for the layperson to understand than a table of numbers

Regards

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Angela Lamacraft [mailto:alamacraft@peterbrett.com]
Sent: 13 September 2013 15:31
To: Christopher Hurst
Subject: Teddington Hydropower Scheme

Dear Chris,

As discussed, please could you ask Derek to confirm whether the Teddington application will be put to September's committee? If it will be delayed until October, please could you ask whether it's possible for us to submit further information (a noise model of the proposed scheme) and if so, what the deadline for submission would be.

Many thanks,

Angela Lamacraft

BSc(Hons) MIOA IEng

Acoustic Engineer

For and on behalf of Peter Brett Associates LLP

Caversham Bridge House, Waterman Place, Reading, Berkshire, RG1 8DN

t 0118 9520248

f 0118 9597498

e alamacraft@peterbrett.com

w www.peterbrett.com

4.

From: Christopher Hurst <C.Hurst@richmond.gov.uk>
Date: 17 January 2014 16:20:53 GMT
To: "'paul.parker@hamhydro.org'" <paul.parker@hamhydro.org>
Cc: Derek Tanner <D.Tanner@richmond.gov.uk>
Subject: RE: Fwd: RE: Planning application letter:ref 11/3908/ful

Hi Paul

This is really a matter that the planning department should give you advice on.

However I would suggest that we need more detail than you included in your initial email.

What I would like is something from your consultant to indicate what their opinion is regarding the effect of the changes in terms of any reduction, or not in attenuation to the proposed mitigation.

Kind regards

Chris Hurst

Principal Environmental Health Officer

Commercial Environmental Health
London Borough of Richmond upon Thames

Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

Tel: 020 88917431 | Mobile 07931745078

From: Paul Parker [mailto:paul.parker@hamhydro.org]
Sent: 17 January 2014 10:35
To: Christopher Hurst
Cc: Steve Jarvis
Subject: Fwd: Fwd: RE: Planning application letter:ref 11/3908/ful

Dear Chris,

Thanks for responding to my email earlier this week.

I'd just like to clarify one important point in an effort to avoid any confusion. Our legal team have been in contact with your planning department, via Robert Angus, Development Control manager in an effort to confirm the exact and complete list of requirements for the planning application to move forward.

The email trail is below. You can see in the mail from Mr Angus on 15th November that he considers that the noise issues can be dealt with via a condition. We and our legal team therefore have taken this to be confirmation that we do not need to make any further amendments to the report which you have already received from our acoustic consultants Peter Brett, other than to amend the description of the acoustic barrier covering the shaft (as described in my last mail).

Please confirm that this is the case in order that we can issue an amended noise report and drawings.

Kind regards

Paul Parker

-------- Original Message --------

Subject: Fwd: RE: Planning application letter:ref 11/3908/ful

Date: Thu, 16 Jan 2014 12:30:58 +0000

From: Chas Warlow <chas@hamhydro.org>

To: Paul Parker <paul.parker@hamhydro.org>

See correspondence below for Council's position.

Chas Warlow

Director

Ham Hydro CIC

chas@hamhydro.org

www.hamhydro.org

----- Original message -----

From: "Hewitson, Nigel" <Nigel.Hewitson@nortonrosefulbright.com>

To: Robert Angus <R.Angus@richmond.gov.uk>, "Steve@hamhydro.org.uk" <Steve@hamhydro.org.uk>, Chas Warlow <chas@hamhydro.org>

Cc: Derek Tanner <D.Tanner@richmond.gov.uk>, Zac Goldsmith <zac@zacgoldsmith.com>, Gillian Norton External <G.Norton@richmond.gov.uk>, Paul Chadwick <P.Chadwick@richmond.gov.uk>, Jon Freer <j.freer@richmond.gov.uk>

Subject: RE: Planning application letter:ref 11/3908/ful

Date: Fri, 22 Nov 2013 10:59:08 +0000

Dear Mr Angus

Thank you for your e-mail of last Friday on which I have now had the opportunity of taking instructions.

My client is currently in discussion with the Environment Agency with regard to the eel pass and it is hoped the matter will be resolved very shortly. Once a solution is found it will be communicated to you.

My understanding is that the only issue with the plans is the exact extent of the proposed perspex cover. This is being resolved with my client's advisers at the moment and, if necessary, revised drawings will be submitted to show exactly what is proposed.

You mention resubmission. At the moment my feeling is that that should only become necessary if it is necessary to change the red line boundary of the application to accommodate the eel pass (if it is outside the existing red line) but we will respond substantively once the above matters are resolved.

Kind regards

Nigel Hewitson | Partner
Solicitor, qualified in England & Wales
Norton Rose Fulbright LLP
3 More London Riverside, London, SE1 2AQ, United Kingdom
Tel +44 20 7444 5117 | Mob +44 77 2549 6654 | Fax +44 20 7283 6500
nigel.hewitson@nortonrosefulbright.com

NORTON ROSE FULBRIGHT

Law around the world
nortonrosefulbright.com

Our website and email addresses have changed – please update your records accordingly.

From: Robert Angus [mailto:R.Angus@richmond.gov.uk]
Sent: 15 November 2013 11:48
To: 'Steve@hamhydro.org.uk'; Hewitson, Nigel; Chas Warlow
Cc: Derek Tanner; Zac Goldsmith; Gillian Norton External; Paul Chadwick; Jon Freer
Subject: RE: Planning application letter:ref 11/3908/ful

Dear Mr Hewitson

Re: Ham Hydro, Teddington Weir – Planning Application (Ref 11/3908/FUL)

Thank you for your letter of 13th November 2013, which I have discussed with the relevant officers.

Firstly I would like to assure you I do understand your client's frustration in the difficulty they are having in getting their application heard at a Planning Committee meeting with a recommendation for permission. You suggest the application is ready to be put to the Planning Committee or if there are outstanding matters what they are in order for your clients to address them without further delay.

I have discussed the matter with the case officer Derek Tanner, who yesterday had a lengthy meeting with your clients to discuss how best to progress the matter. The matters that need to be resolved are the provision of an eel pass; this is a requirement for planning purposes as well by the Environment

Agency. If as your clients are hoping it is possible to accommodate this within the application site and the Environment Agency can confirm this is acceptable then I would be happy to treat the details by way of a condition. If, as I am currently being advised, your clients have to provide it elsewhere then this would necessitate a fresh planning application. To my mind there are advantages in your client following this course of action. It would address the eel pass requirement, provide an opportunity to update the drawings (possibly removing the canopy) with the opportunity to improve their presentation as well as give back the right of appeal if it was considered that the new application was not progressing. If the eel pass could however be accommodated within the site the existing application could be updated in a similar fashion, I would be willing to re-register the application, which again would give back the opportunity to appeal the application. Although I do naturally hope that an appeal can be avoided on this occasion.

You might also be aware there has been considerable concern over the impact on the river ecology, but on advice from the Environment Agency, I consider suitable conditions can safeguard these important matters. There is a significant concern over noise, but having assessed this in some detail with external consultants I also consider this may be covered by condition. Your clients have advised they are willing to accept very strict conditions as they are confident they can be met. In addition, the design of the structure and its impact on local heritage assets has attracted a surprisingly high level of objection. This is more subjective than technical, whilst my view is it can be argued that it is in character with the existing infrastructure of the weir I appreciate that others do view it differently. I consider it is therefore important that the submitted drawings and presentation are both accurate and informative.

I understand that at the meeting your clients where hoping the application could be heard before Christmas. However, I have to advise there would not be sufficient time to address the above points and allow the application to go forward with a recommendation for approval.

I do hope you find this letter of assistance, but if you require further clarification on any points please contact me.

Regards

Robert Angus
Development Control Manager
Development and Street Scene
Tel: 020 8891 7271
Fax: 020 8891 7789
www.richmond.gov.uk

From: Steve@hamhydro.org.uk [mailto:Steve@hamhydro.org.uk]
Sent: 14 November 2013 16:28
To: Gillian Norton External; Robert Angus; Paul Chadwick; d.barnes@richmond.gov.uk; Jon Freer
Cc: Chas Warlow; Derek Tanner; Nigel Hewitson; Zac Goldsmith
Subject: Planning application letter:ref 11/3908/ful

Dear Gillian and team,

I'm attaching a letter from our legal team at Norton Rose for your attention. A hard copy is in the post to Robert Angus.

I have cc'd Chas Warlow, managing director of Ham Hydro cooperative, Nigel Hewittson, partner at Norton Rose and Zac Goldsmith, MP for Richmond Park and North Kingston.

We would appreciate a reply with five days please.

Many thanks,

Steve Jarvis