PLANNING SUBMISSION

ENGINEERING REPORTS

FOR

THE WATERHOUSE – HIGHGATE

AUGUST 2011

6.3 Ground source heat pumps

Heat pumps use refrigerant gases and an electrical compressor to take heat from a source and deliver it to an output. In this way they can be used to supply heat to a building.

Traditional heat pumps use air as the source of heat but ideally, sources should have stable temperatures for maximum efficiency and the ground provides such a source.

The ground acts as a huge solar collector and thermal store, which dampens fluctuations in ground temperature. The fluctuations reduce with depth and stabilise at the annual mean by about 12m below the surface; for the UK this is in the range 9–12°C.

Ground source heat pumps make use of this heat stored in the ground and raise it to a more useful temperature of around 40-50°C. It should be noted that at these temperatures, the heat produced is only useful for low temperature applications such as underfloor heating installations; otherwise, a degree of top-up by conventional means is required when used for generating domestic hot water for example.

The ground source heat pump system if applied to this project would comprise a thermal pile ground heat exchanger coupled to a heat pump unit located within the plantroom. It is proposed that structural piles will be incorporated in the foundation design and the feasibility of utilising some of these piles, and extending their depth as necessary has been found to be practical for heat transfer to and from the earth.

It will require extending 8 thermal piles 100 meters deep to provide 25 kW of heating, sufficient to satisfy most of the base space heating needs.

A system of this capacity would be expected to save up to 3,950kg CO_2/annum against a conventional gas fired heating system which equates to around 20.9% of the required CO_2 saving.

6.4 Space cooling heat pumps

The mechanical cooling installation will reject its heat utilising the GSHP heat dissipation system and therefore achieve a very minor energy saving as it will not require any air movement condenser fans.

6.5 Wind turbines

Wind power can be used to generate electricity either in parallel with mains supplies or as standalone solutions using battery back-up. For this project, the parallel option only will be considered owing to the requirement to only meet 20% of the site's needs.

In order to generate worthwhile quantities of electricity, average wind speeds of between 5-6m/s are necessary (the UK government are currently advising 5.5-6.0m/s as the threshold).

A cable connection would be required from the turbine to the mains electrical position for the site / block, where the system inverter can be installed along with connection into the mains electrical system for the building. In this way, a dedicated electrical load is not required, because the generated power can be exported back to the grid at times when site demand for electrical power is less than that being generated by the turbine. However, agreement with the Electricity Utility Company will be required and will involve installation of specialist metering equipment to allow 'export' of power. The cable route to the generator will be less expensive if the set is building mounted close to the electrical intake position.

A 6kW turbine will generate approximately 10,000 kWh of energy per annum assuming reasonable average wind speeds. Unfortunately, owing to the geographical location of the site the average prevailing wind speed is well below 5m/s, rendering the option unviable.

6.6 Biomass boilers

Energy from biomass is produced by burning organic matter. Organic matter is harvested and processed to create bio-energy which can take the form of liquid or solid fuels.

Although biomass is carbon-based (and hence generates carbon emissions), the carbon that is released during combustion is equal to that carbon that was absorbed during growth and so the fuel is classed as carbon neutral.

(The fuel generally requires treatment and transport, with associated carbon emissions however, but these effects will be ignored here).

This system based on a 65kw load would require approximately 25 tonnes/year of wood pellets and an estimated fuel store in the region of $30m^3$.

This would give rise to at least 10 deliveries of fuel/year which, with the sensitivity of traffic movement along Milford Lane has lead to this option not being considered further.

6.7 Summary of Renewables' Feasibility

Technology	Feasible	Reason
Photovoltaics	No	Insufficient roof area to achieve meaningful contribution.
Solar Water	Yes	Roof area supports integration but some shading affects efficiency.
Space Cooling Heat Pumps	Yes	Part of mechanical cooling system but can integrate with Ground Source heat pumps.
Ground source heat pumps	Yes	Can sensibly utilise the Structural piles with adaption as a heat source.
Wind Generators	No	Insufficient wind speeds at site
Biomass Boilers	No	Regular fuel deliveries would be unacceptable and require unavailable fuel storage space.

7.0 SUMMARY OF ESTIMATED ENERGY GENERATION FROM RENEWABLES

Feasibility of the various renewable energy technologies is discussed in the previous section together with assessments of the expected energy generation and these figures are presented in the table below.

Renewable Technology	Total Energy Requirement of development (kg CO_2/annum)	Expected CO_2 contribution from Renewable (kg CO_2/annum)	Resulting nett CO_2 requirement of building (kg CO_2/annum)	Percentage of CO_2 generation by renewable technology %
Photovoltaics	18,877	739		3.9%
Solar Water	18,877	930	245,332	4.9%
Air Source Heat Pumps	18,877	-	-	-
Ground source heat pumps	18,877	3,950	209,682	20.9%
Wind Generators	18,877	-	-	
Biomass Boilers	18,877			

CONCLUSIONS

It is the team's intention to minimise the visual effects of the renewables integration upon the landscape and building form and for this reason the team prefers to opt for the combination of both ground source heat pumps and solar water heating.

Whilst the assessment has shown that ground source heat pumps achieve 20.9% of the renewable target. Solar water heating gives 4.9% saving so both technologies which are proposed at this stage result in a renewable on site energy saving in the order of 245.8% against the base buildings energy target.

This offers some future flexibility in developing the final schemes within the constraints of the project to account for issues such as soil type and its effect on heat conduction.

17 February 2011

Slender Winter Partnership
The Old School
London Road
Westerham
Kent
TN16 1DN

For the attention of Mr P Dunk

Dear Sirs

THE WATERHOUSE, HIGHGATE, LONDON

The tracking and CCTV survey of the underground drainage serving the above premises was carried out on the 14 November 2011 and the findings were as follows:-

1. Survey Information

For details of individual sections of drain see survey notes (1 - 8), survey DVD, survey photographs CD and record drawing 3354/1.

2. Description of System

The drainage system is combined and collects the FW and SW discharge from connections at the ground and upper floor levels of the building and also a further foul drain from the rear annexe before leaving the site via a 150dia vitrified clay (Cl) drain. The 150dia outfall drain leaves the site at the south east corner beside the pond and runs through the rear of the adjoining gardens. We were unable to determine the termination of this drain but assume it must connect to a sewer in the direction of Millfield Lane/Fitzroy Park junction.

A further 150dia vitrified clay connection from the 'The Wallace House' connects to connect to MH2. We are unsure if this drain serves further properties.

The drainage pipework serving the property is predominantly vitirified clay. A cast iron section of drain has been installed between MH3 and MH4 beneath the building and a new uPVC branch drain has been installed from a gully to MH5.

Manholes are engineering brick construction with clay or vitreous chine channels. Access covers are light duty, single seal cast iron or infill pattern.

3. Summary

Our report concentrates on the 150dia drain from 'The Wallace House' and downstream section all of which is to be retained.

The existing 150dia drain running across the site was in a fair condition with only minor structural defects (refer to survey notes). We were unable to survey beyond 55.0 metres downstream of MH1. Some root ingress was noted in MH1, minor open/displaced joints, debris and sections holding water.

4. Recommendations

These recommendations are based on the existing retained drainage system and should be incorporated as part of the proposed site redevelopment.

a. Obtain TWA records to establish location of public sewers and whether the existing 150dia VC drain has been adopted by the water authority.

b. HV water jet clean 150dia VC drain upstream to MH2A and downstream from MH1 to the sewer outfall.

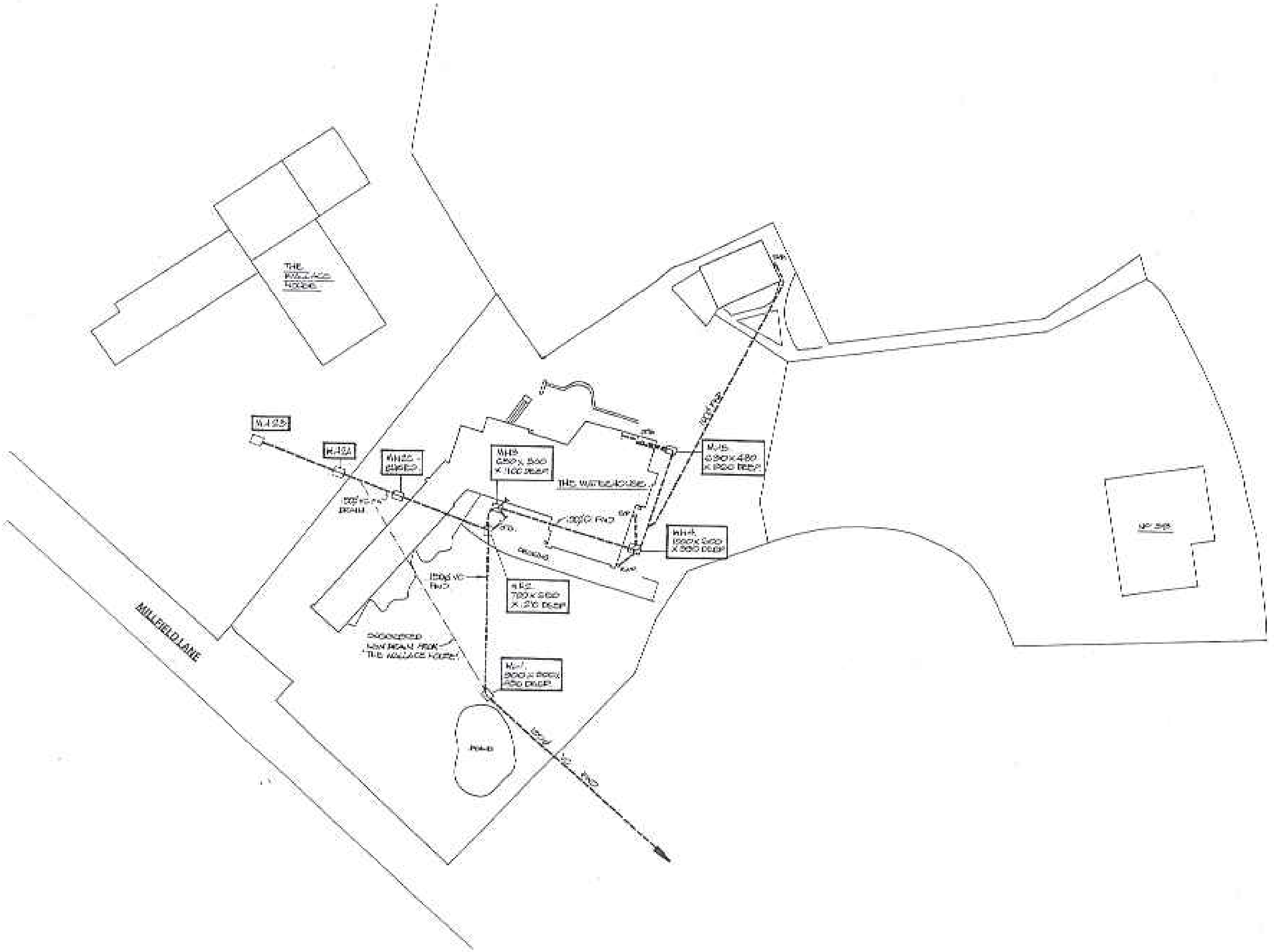
c. On completion of the cleaning works, CCTV survey the 150dia outfall drain with camera mounted crawler to determine the condition and location of the drain through to the public sewer.

d. We have indicated on the record drawing a proposal to re-route the 150dia VC drain from 'The Wallace House' boundary to MH1. This would remove any defective pipework that exists and allow the new construction to proceed.

Should you require further information or assistance then please contact the undersigned.

Yours faithfully

Jim Durkin
JPD Technical Services



NOTES

jpd technical services
SURVEY/DESIGN/CONTRACT
PUBLIC HEALTH ENGINEERS

SLENDER WINTER PARTNERSHIP

THE WATERHOUSE
HIGHGATE
LONDON

SITE PLAN
EXISTING DRAINAGE

TOP
JPD
1:200
3354/1

Paragon
Acoustic Consultants

Woodley House,
65/73 Crockhamwell Road,
Woodley,
Reading,
Berkshire,
RG5 3JP

Tel: 0118-944-8444

Project:	The Waterhouse			
Client:	Slender Winter Partnership			
Report Title:	Environmental Noise Assessment			
Author:	J A Gillott MIOA		Date:	09/03/2011
Checked:	P. Shortt MIOA		Date:	09/03/2011
Revision:	0			
Report Status:	**Final Issue**			
Reference:	2431_ENA_3_JG			

CONTENTS

Contents

1.0 Introduction

As part of development of land presently occupied by a property known as The Waterhouse, it is proposed that the building be demolished and a new property be built on the grounds. As part of the new development it is proposed that mechanical plant be installed within the site demise.

Paragon Acoustic Consultants Ltd has been commissioned to conduct an environmental noise survey to obtain statistical noise data to characterise the existing local background and ambient noise climate at the site. This information is used to determine if the proposed new plant selections will meet with the Local Authority noise policy.

The assessments contained within this report will include the principles and recommendations contained within the following documents.

- **BS 8233:1999 "Sound insulation and noise reduction for buildings – Code of practice"**

The client has advised that in certain instances the operational period of the proposed mechanical plant shall be 24 hours.

2.0 Site Description

The property of the Waterhouse is to be demolished and re-built. The following paragraphs describe the areas local to the Waterhouse site (the site).

The site is accessed via a gated entrance situated on Millfield Lane, beyond which lie wooded areas of Hampstead heath.

To the south and south east lie the gardens of number 55 Fitzroy Park, including a large pond within the space. To the east lie numbers 63 and 51 Fitzroy Park and associated grounds. Various other residential properties are located on the east side of Fitzroy Park.

To the north lie the residential properties and associated grounds of properties known as "The Wallace House" and "Dormers", beyond which lie other residential dwellings and associated grounds.

The site is illustrated by plan in Appendix A.

3.0 Existing Noise Climate

3.1 Road Traffic

Middle / far distance vehicular road traffic was deemed to provide the primary contribution to the ambient noise climate proximal to the nearest affected residential premises. The overall noise comprises both individual "event" type emissions from vehicles passing along local roads, and also continuous low frequency "rumble" due to middle distance traffic flows.

3.2 Rail traffic

Rail traffic noise events were not observed during the survey period.

3.3 Aircraft

Aircraft overflights were not observed during the manned survey period. Although it is likely that the noise levels measured will include contributions from medium and high altitude aircraft.

3.4 Mechanical Noise Sources

No other mechanical noise sources were observed at the site.

4.0 Environmental Noise Survey

4.1 Measurements

The environmental noise survey was carried out generally in accordance with the principles and procedures set out within **BS 4142:1997** "Method for rating industrial noise affecting mixed industrial and residential areas".

The noise monitoring commenced on 14th February 2010 at approximately 09:15 hours and continued until 09:46 hours the following day. The monitoring was generally un-manned.

The measurements were made at the assessment location as described below.

- **MP1**: Within the grounds of The Waterhouse, north of the existing premises.

The measurement location is illustrated on the site layout drawing in Appendix A.

Various statistical broad-band and spectral sound pressure level measurements were obtained during the survey. A measurement time interval T_m = 15 minutes was used for sampling. Measurements of the percentile level $L_{A90,T}$ were made using the sound level meter fast time constant (125ms), as per clause 3.10 of BS 4142:1997.

The quantities recorded included:

- **L_{Aeq}: the equivalent continuous noise level over the measurement period**
- **L_{Amax}: the maximum sound pressure level (Fast time-weighting)**
- **L_{A10}: the noise level exceeded for 10% of the measurement period**
- **L_{A90}: the noise level exceeded for 90% of the measurement period**

4.2 Weather during survey period

The weather conditions at the start of the survey during the manned period of the survey were dry and mild with a slight breeze. At the end of the survey the weather

conditions were similar. The weather forecast did not indicate that adverse weather conditions would occur for the survey duration.

4.3 Instrumentation

Sound pressure level measurements were obtained using the following instrumentation complying with the Type 1 specification of IEC 60651, IEC 60804, IEC 61260 and IEC 61672:

- **Norsonic Type 118 Sound level analyser, serial number 31990**
- **Norsonic Type 1225 ½" microphone**

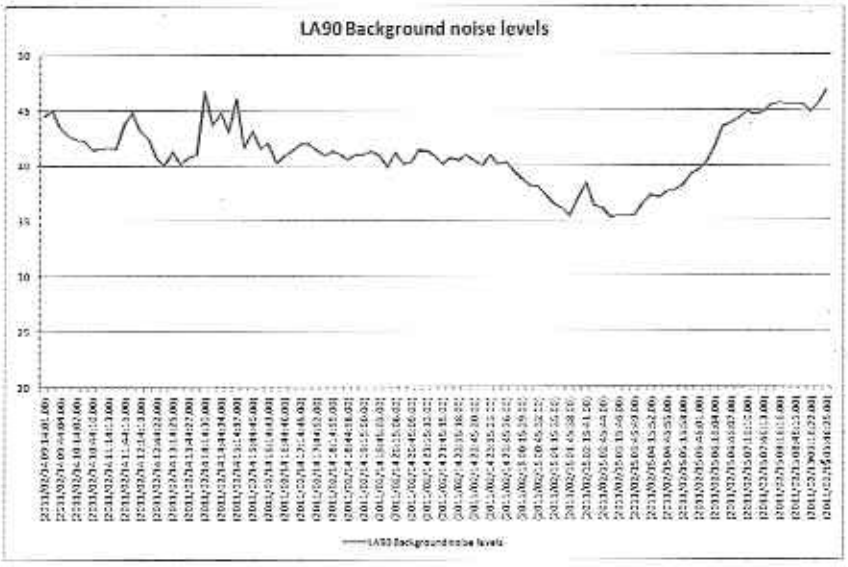
Additionally, the following equipment was used:

- **Norsonic CA-1317 Weather protection kit**
- **NOR 1212 microphone outdoor protection kit**
- **Tripod**
- **Camera**

Calibration checks were made prior to and after completion of measurements using a Norsonic Type 1251 acoustical calibrator complying with Class 1 of IEC 942 (1988), calibration level 114.0 dB ± 0.3 dB, @ 1.0 kHz. All instrumentation carries a current manufacturer's certificate of conformance a copy of which is attached to Appendix C.

4.4 Results

The recorded statistical broadband sound pressure levels are shown within Appendix B, and the LA90 background noise levels indicated graphically below:



The recorded statistical broad-band sound pressure levels are shown within Appendix B, and the lowest representative daytime, evening and night-time background noise levels obtained are rounded to the nearest integer and summarised in Table 1.

Table 1: Lowest Background Sound Pressure Level Measurements

Measurement Position	Day time $L_{A90(07:00-19:00)}$	Night time $L_{A90(23:00\ 07:00)}$
MP1	40 dB	35 dB

5.0 Evaluation of external Noise Criteria

The local vicinity primarily contains residential premises which must be given due consideration in terms of acceptable levels of noise exposure from the new plant.

5.1 Residential properties.

BS4142:1997 "Method for rating industrial noise affecting mixed residential and industrial areas" describes a method of determining the level of the noise of an industrial nature, together with procedures for assessing whether the noise under investigation is likely to give rise to complaints from persons living in the vicinity. In general, the likelihood of complaint in response to a noise depends upon factors including the margin by which it exceeds the background noise level.

In order to establish the Local Authority Noise Policy this practice visited the Camden Council web site and downloaded their noise strategy from the following web page:

http://search.camden.gov.uk/search?site=default_collection&client=camden_frontend&output=xml_no_dtd&proxystylesheet=camden_frontend&sort=date%3AD%3AL%3Ad1&oe=UTF-8&ie=UTF-8&ud=1&q=mechanical+plant+noise+policy+&x=15&y=7

The policy is reproduced in italicised text as follows:

> ***Ventilation ducts and air handling equipment***
> *16.33 The following standard applies to all air-cooling, heating, ventilation, extraction and conditioning systems and to any ancillary plant, ducting and equipment which would have an impact on the external environment. The Council seeks to ensure that noise level output from all such systems does not increase existing ambient noise levels, in order to protect existing levels and prevent "creep" (a rise in background noise levels). This may require close co-operation between an environmental or air handling engineer and the architect to agree an acceptable design solution for the particular premises and uses for which the system is designed.*
>
> *16.34 The Council considers that for new developments involving noisy plant/equipment or other uses, design measures should be taken to ensure that noise levels predicted at a point 1 metre external to sensitive facades are at least 5dB(A) less than the existing background measurement (LA90) when the equipment is in operation. Where it is anticipated that equipment will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses in the noise (bangs, clicks, clatters, thumps), special attention should be given to reducing the noise levels from plant and equipment at any sensitive facade to at least 10dB(A) below the LA90 level.*

Our interpretation of the wordage relating to *"sensitive facades"* is that this will refer to third party noise sensitive facades, i.e. not including the facades of the dwelling known as The Water House.

5.2 External noise criteria

The derived external noise criteria to which the new building services plant shall be required to achieve are summarised in Table 2:

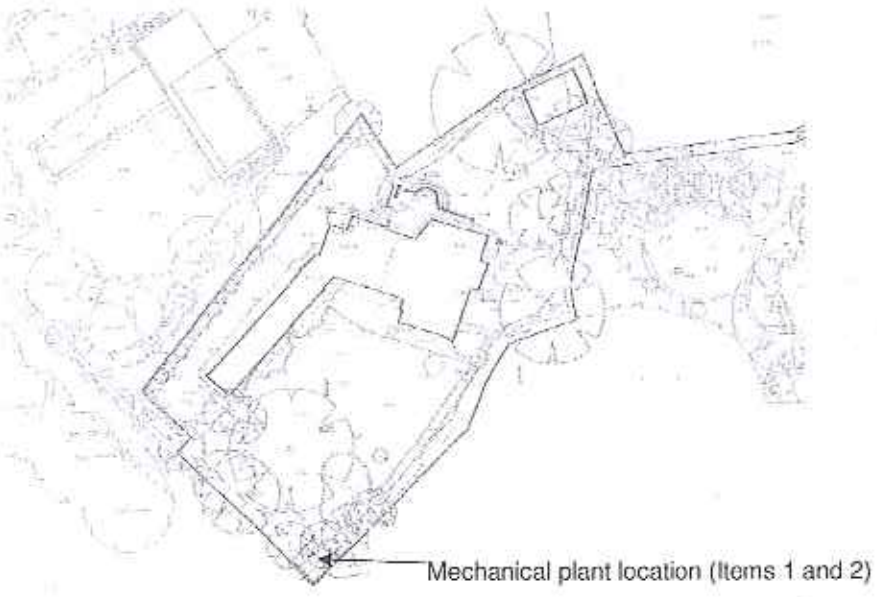
Table 2: Limiting Noise Criteria Applicable @ 1m From the Affected Premises

Plant location	Receptor	Rating level Daytime (07:00-19:00) $L_{Aeq,T}$	Rating level Night time (23:00-07:00) $L_{Aeq,T}$
Any location on site	All third party properties	35 dB	30 dB

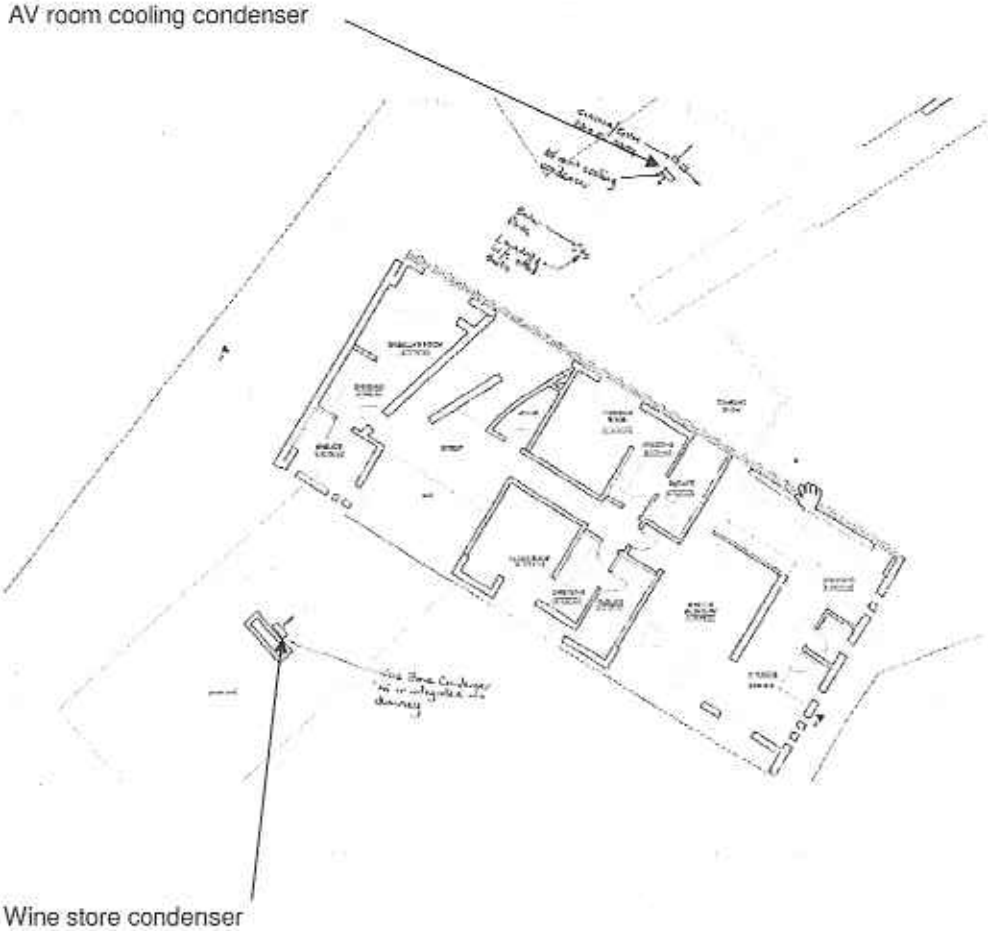
If mechanical plant contains noise of a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or distinct impulses (bangs, clicks, clatters, thumps) a 5 dB penalty shall be included within the assessment as described within BS 4142:1997 "Method for rating industrial noise affecting mixed industrial and residential areas" and the Local Authority Noise Policy.

6.0 Review of Proposed Mechanical plant noise sources

Detailed calculations have been carried out in order to determine the likely level of airborne noise transmission outside the identified assessment locations due to the operation of the proposed new plant to be installed on the site, indicated in the below two sketches:



AV room cooling condenser



Wine store condenser

The following sections provide a record of the proposed new plant, the operational sound levels used as the basis for this assessment.

6.1 Plant Noise Levels

The external heat rejection equipment will be either an air cooled condenser or a dry air cooler. The manufacturers published operational noise levels are reproduced for both of these options is indicated in Items 1 below, however it is noted that only one of these will be installed.

Item 1 – option A

1 Number Adiabatic cooler: Noise Data

Noise Data – per Cooler

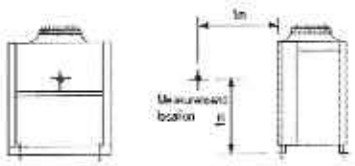
Frequency	(Hz)	63	125	250	500	1000	2000	4000	8000	Total
Sound Power	(L_wA)	26	49	53	57	65	62	59	51	67
Sound Pressure	(L_pA)	35	(@ 10m calculated in accordance with BS EN:13487 Parallel Piped)							

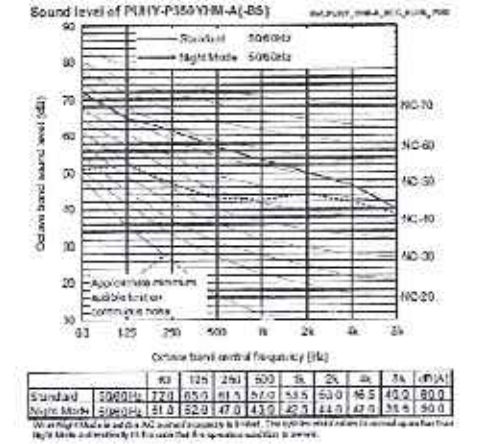
Note that the sound power levels shown are A weighted.

Item 1 – option B

One number Condenser ref Mitsubishi Model PUHY P 350 YHM-A (-BS)

Measurement condition
PUHY-P350,400,450YHM

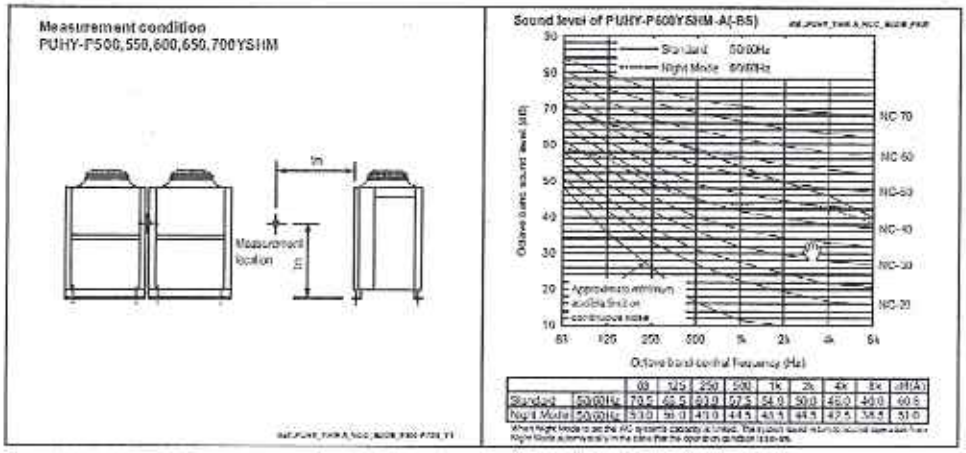




		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	72.0	65.0	61.5	57.0	53.5	50.0	46.5	43.0	60.0
Night Mode	50/60Hz	51.0	52.0	47.0	43.0	42.5	44.0	42.0	38.5	50.0

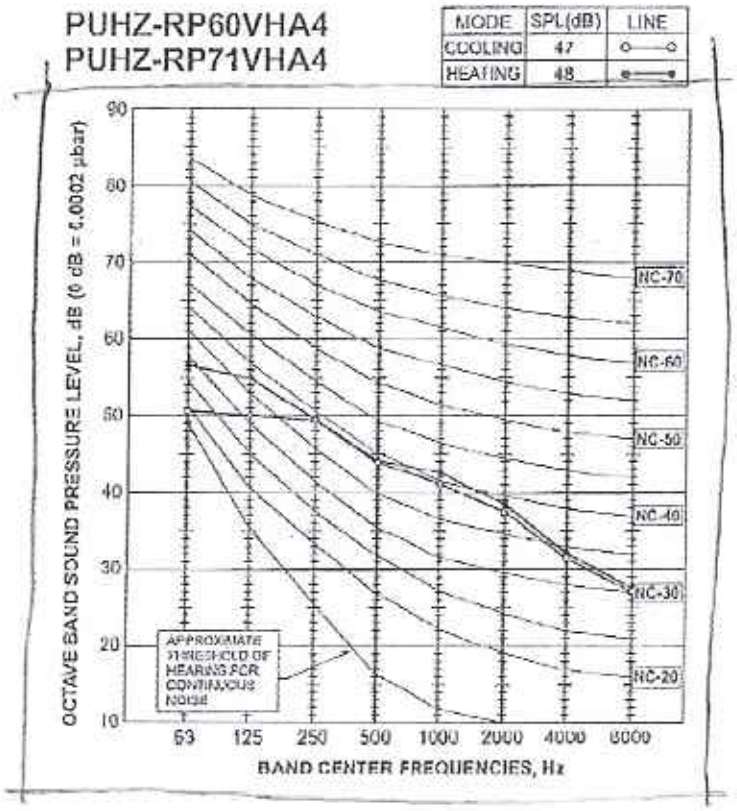
Item 2

If air source heat pump system is incorporated the external unit associated with that scheme would be located adjacent to the heat rejection unit. This will potentially be one number Mitsubishi Model PUHY 600



Item 3

AV room cooling condenser



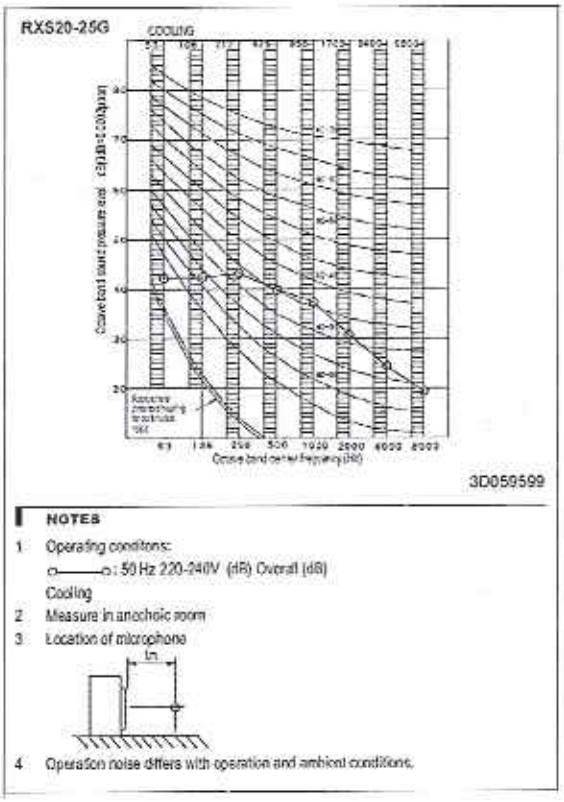
Item 4

Wine store condenser RXS20-25G.

2-2 TECHNICAL SPECIFICATIONS				RXS20G3V1B
Sound Level (nominal)	Cooling	Sound Power	dBA	61
		Sound Pressure (Low)	dBA	43
		Sound Pressure (High)	dBA	46

8 Sound data

8 - 1 Sound pressure spectrum



Paragon has assumed that the Wine store condenser will operate at High mode in cooling.

6.1.2 Vibration – condensing units

Apart from the wine store condenser and AV condenser all other plant indicated herein shall be located on the ground and not structurally connected to the building, as such the manufacturers internal isolators will suffice. However, the wine cooler condenser

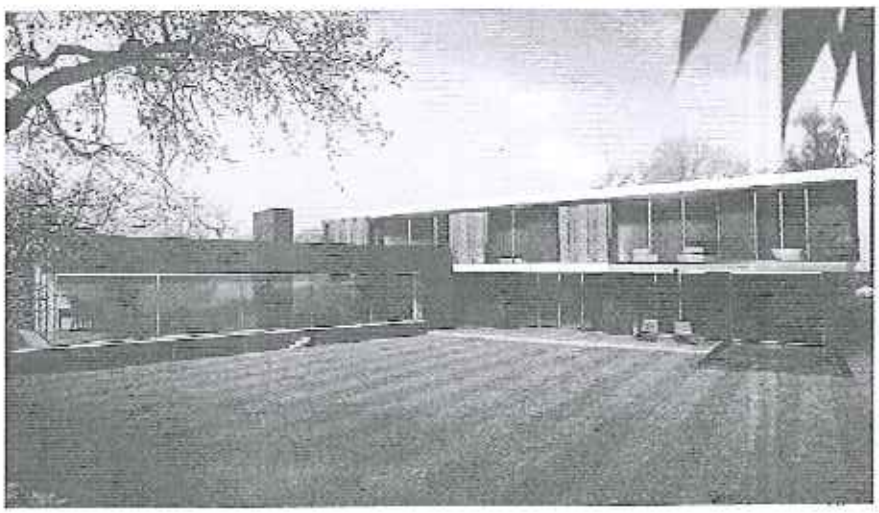
PLANNING SUBMISSION

ENERGY STATEMENT

FOR

THE WATERHOUSE – HIGHGATE

AUGUST 2011



and AV condenser are to be located on the roof of the building and shall be installed on vibration isolation mounts.

It is recommended that the client provisions for appropriate vibration isolation mountings for the proposed wine cooler condenser and AV condenser. It is proposed that the condensing unit be placed upon the roof of a residential property. It is recommended that the plant be installed on vibration isolation mounts providing a minimum of 98% isolation efficiency at the lowest forcing frequency using an isolation mount system approved by the condensing unit suppliers. In addition, all pipework should be suitably isolated from the building structure.

6.2 Predicted Condenser Noise Levels

Calculations have been carried out utilising the noise data presented in Section 6.1, assuming that:

Either the Mitsubishi Model PUHY P 350 YHM-A (-BS) or the Adiabatic cooler can be used in the assessment, as the worst case noise levels have been taken for the plant*

* If used, the Mitsubishi Model PUHY P 350 YHM-A (-BS) will operate at "Night mode" noise levels between the hours of 23:00-07:00.

The Mitsubishi Model PUHY 600 will operate at "Night mode" noise levels between the hours of 23:00-07:00.

Using CADNA A software to predict the resultant sound pressure levels due to airborne transmitted noise outside the nearest exposed noise assessment positions. The predicted results are summarised in Tables 3 and 4 as follows.

Table 3: Predicted Noise Levels @ Nearest Exposed Residential Dwelling -DAY

Plant under consideration	Worst case Assessment location	Approx source receiver distance	Predicted Lp at receiver including a + 5 dB acoustic feature correction	Derived noise limit Day time 07:00-23:00
Either option A of item 1 (Adiabatic cooler) or option B of item 1 (PUHY P 350 YHM-A (-BS) and a Mitsubishi Model PUHY 600	55 Fitzroy Park	68 m	33 dB	35 dB day time
	Wallace House	57 m	31 dB	
	51 Fitzroy Park	76 m	31 dB	
	Dormers	75 m	24 dB	

Table 4: Predicted Noise Levels @ Nearest Exposed Residential Dwelling -DAY

Plant under consideration	Worst case Assessment location	Approx source receiver distance	Predicted Lp at receiver including a + 5 dB acoustic feature correction	Derived noise limit Night time 23:00-07:00
Either option A of item 1 (Adiabatic cooler) or option B of item 1 (PUHY P 350 YHM-A (-BS) and a Mitsubishi Model PUHY 600	55 Fitzroy Park	68 m	24 dB	30 dB night time
	Wallace House	57 m	28 dB	
	51 Fitzroy Park	76 m	23 dB	
	Dormers	75 m	21 dB	

It can be seen from the results indicated in Tables 3 and 4 that the proposed plant will maintain the Local Authority Noise Policy requirements for residential properties during the daytime and night time periods.

A screenshot of the plan of the Cadna A model is reproduced as follows:

Fig 1: plan view of area local to the proposed plant – night

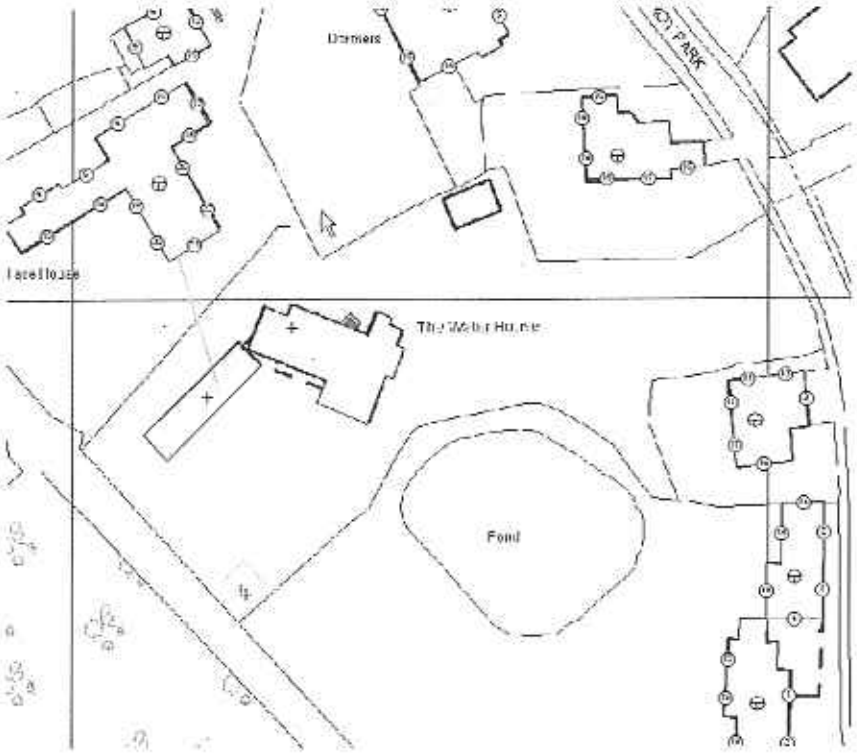
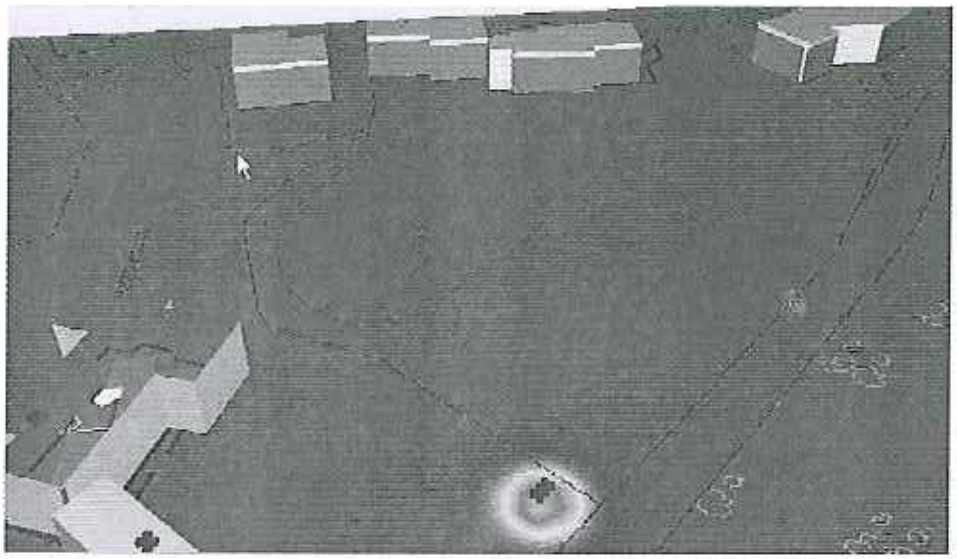


Fig 2: 3D view of area local to the proposed plant looking towards 55 Fitzroy Park

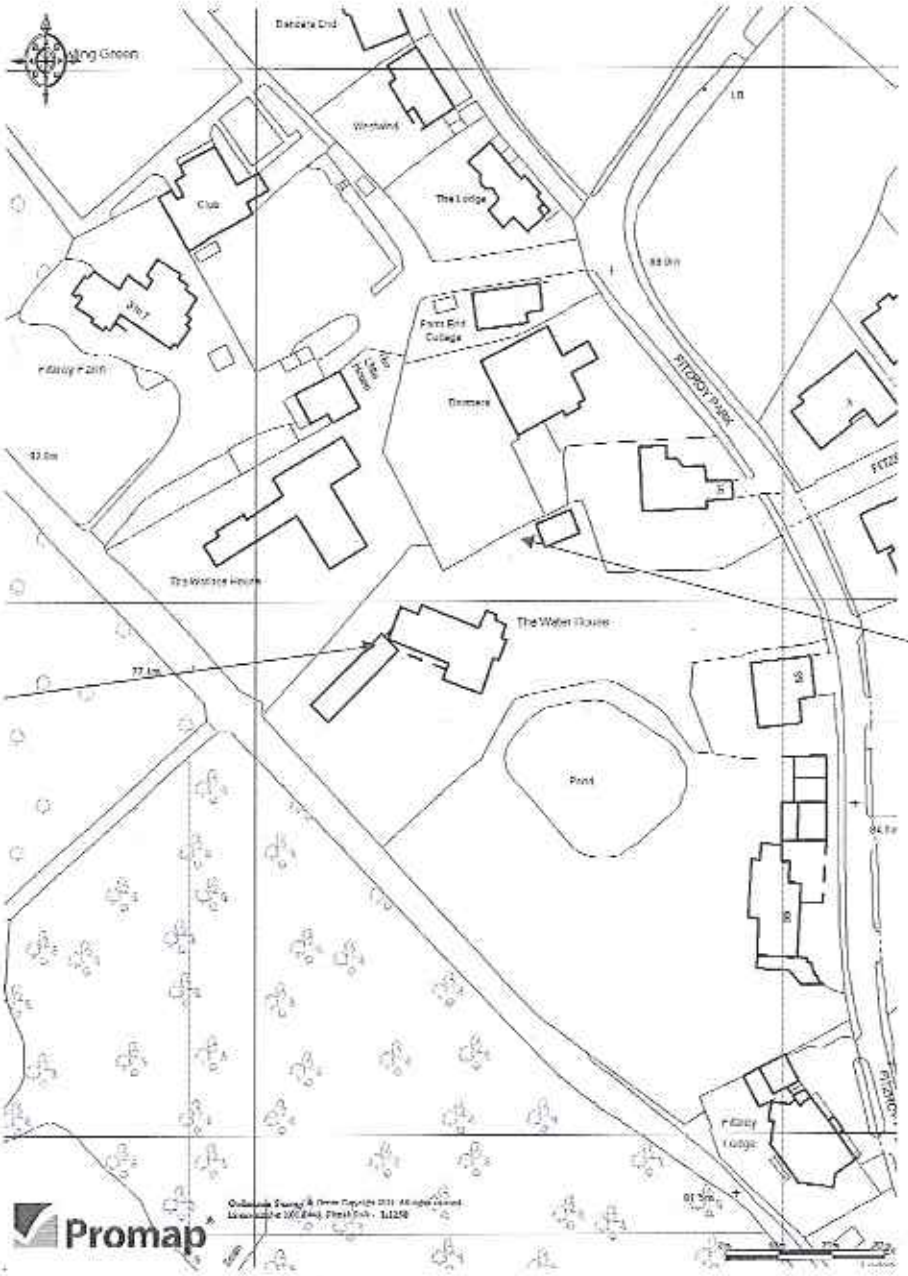


7.0 Conclusions

A detailed environmental noise survey has been undertaken to determine the underlying ambient and background noise level climate.

Appropriate external criteria have been identified on the basis of Local Authority noise policy and predictions of the proposed mechanical plant noise emissions have been undertaken. Using the proposed plant noise levels detailed herein the predictions indicate that the Local Authority derived noise limits will be maintained. On this basis, reservations are not expected from the planning authority on the grounds of noise.

Appendix A: Site Drawings



Appendix B: Measurement Data

1st day	LAeq	LAFmax	L10	L90
07:00				
07:15				
07:30				
07:45				
08:00				
08:15				
08:30				
08:45				
09:00				
[2011/02/14 09:04:01.00]	52.00	82.20	55.20	44.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 09:49:04.00]	47.20	63.60	51.60	43.90
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 10:14:07.00]	47.00	66.10	42.70	42.20
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 10:44:13.00]	47.40	62.30	50.20	41.40
[2011/02/14 10:59:12.00]	46.40	65.60	47.20	41.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 11:29:14.00]	48.30	70.00	45.30	41.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 11:59:18.00]	46.20	53.50	48.30	41.30
[illegible]	46.90	54.50	48.90	43.10
[illegible]	45.30	58.20	47.40	[illegible]
[illegible]	44.40	58.50	47.20	41.70
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	47.20	64.40	50.50	46.20
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 13:44:27.00]	45.40	55.60	48.20	42.70
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 14:14:30.00]	53.40	65.20	57.20	45.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 14:44:34.00]	51.10	66.20	55.00	43.70
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/14 15:14:37.00]	51.60	65.00	52.70	45.00
[illegible]	49.90	57.20	52.40	41.90
[illegible]	50.00	59.20	52.10	43.10
[illegible]	48.00	55.50	51.20	41.10
[illegible]	47.20	52.10	50.70	42.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	46.00	65.30	48.50	41.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	51.50	65.10	56.00	42.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.70	53.70	44.00	40.20
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	46.60	81.30	42.30	41.00
[illegible]	43.30	59.60	44.40	42.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.40	65.20	42.50	41.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.00	57.10	45.20	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.70	65.50	46.80	41.20
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	44.50	59.20	42.20	40.10
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.00	52.50	41.30	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	43.60	70.60	50.70	40.70
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	42.10	51.00	43.20	40.90
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.30	53.30	41.40	41.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.10	50.10	43.10	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	40.10	49.70	41.10	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	35.40	51.00	40.40	33.10
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	35.70	50.50	37.30	33.40
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	45.50	65.00	31.30	32.40
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	35.70	50.00	33.70	31.10
[illegible]	37.60	55.60	38.30	33.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	38.50	51.60	37.30	35.40
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	36.10	53.30	37.30	35.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	36.60	51.40	39.60	37.10
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	35.10	51.10	40.10	37.50
[illegible]	40.10	51.50	41.50	39.20
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41.70	55.10	41.20	39.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	43.60	59.20	51.50	41.70
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	43.30	52.00	[illegible]	42.50

2nd day	LAeq	LAFmax	L10	L90
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/15 07:19:12.00]	53.00	78.30	57.70	44.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/15 07:49:13.00]	53.50	63.30	53.70	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/15 08:19:18.00]	[illegible]	65.00	53.10	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/15 08:49:19.00]	46.80	61.20	50.40	45.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/15 09:19:21.00]	43.10	65.00	50.00	44.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[2011/02/15 09:49:25.00]	54.00	73.00	52.00	[illegible]
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Appendix C: Calibration certificates

Calibration Report

Certificate number 4796

Norsonic Type : 118 Serial no : 31990

Customer:	Paragon Acoustic Consultants
Department:	Woodley House
Place:	65-73 Crockhamwell Road
City:	Woodley, Reading RG5 3JP
Order No:	1900/10
Contact Person:	Phil Duffield
Phone/Mail:	0118 944 8444

Microphone :	Norsonic	Type : 1225	Serial no : 47088	Sens:-25.44dB
Pre amplifier	Norsonic	Type : 1206	Serial no : 30356	
Calibrator :	Norsonic	Type : 1251	Serial no : 31051	Level:114.16dB

Measured with Pre Amplifier RS232 cable was included

This sound level meter has been calibrated as specified in BS 7580, PART 1 : 1997.
Measurement Results:

Noise test - BS 7580 #5.5.2
Level Linearity Test - BS 7580, #5.5.3
Frequency weightings: A Network - BS 7580 #5.5.4
Frequency weightings: C Network - BS 7580 #5.5.4
Time weightings F and S - BS7580 #5.5.5
Peak response - BS7580 #5.5.6

RMS accuracy - BS7580 #5.5.7	Passed
Time weighting I - BS7580 #5.5.8	Passed
Integrating Test : Time averaging - BS7580 #5.5.9	Passed
Integrating Test : Pulse range - BS7580 #5.5.10	Passed
Integrating Test : Sound exposure level - BS7580 #5.5.11	Passed
Overload SPL Test - BS 7580 #5.5.12	Passed
Overload Leq Test - BS 7580 #5.5.12	Passed
Acoustic tests - BS 7580 #5.4 and 5.6	Passed
Summation of acoustic tests - BS 7580 #5.6.4	Passed

The overall frequency response of the sound level meter including case reflections, microphone response and wind screen has shown to confirm with the requirements in #6 of the BS EN 60651 and #5.5.4 in BS 7580 Part 1.

Comment :
Correct level with associated calibrator is 114.1dB(A)

Environmental conditions:

Pressure :	Temperature :	Relative humidity :
102.108 kPa	23.9 °C	40 %RH

Date of calibration: 21/02/2009
Date of issue: 24/02/2009
Supervisor:
Engineer:

Ian Campbell MSc MIOA

Campbell Associates
www.campbell-associates.co.uk