Form Ref. No. 216121

ADUR DISTRICT COUNCIL

Application For Planning Permission

TOWN AND COUNTRY PLANNING ACT, 1990

4 copies of this form required, together with plans and appropriate fee.
All measurements are to be given in metric.
If site relates to Lancing or Sompting, please submit 5 copies.

FOR OFFICIAL USE ONLY
Appl. No. A/0/a316/7
Date Received 05 MAR 2007
Fee 6360
Rem. List

Applicant's Details

Title	
Forenames	
Surname or Company/ Organisation	Abbey Care Investments Ltd
Telephone	
Email	

Do you have an agent? Yes

Address	First Floor
	PO Box 36
	37 Broad Street
	St Helier
	Jersey
Postcode	JE4 9NU

Agent's Details

Title	Mr
Forenames	Andrew
Surname	Jenkins
Telephone	01904544400
Email Address	

Address	39 Blossom St
	York
	North Yorkshire
Postcode	YO24 1AQ

Application Type

(a) Full planning permission (including changes of use) Yes

(b) Outline planning permission

If 'Yes', state those matters to which this application relates (tick where appropriate)

- (i) Layout ☐
- (ii) Scale ☐
- (iii) External Appearance ☐
- (iv) The means of access ☐
- (v) Landscaping of the site ☐

(c) Renewal of a temporary permission

If 'Yes', state the Date

and Permission Application

and the Condition Number

(d) Permission for retention of building or continuance of use without complying with a condition imposed on a planning permission

If 'Yes', state the Date

and Permission Application

and the Condition Number

(e) Permission to develop land without complying with a condition imposed on a planning permission

If 'Yes', state the Date

and Permission Application

and the Condition Number

Land Details

Full address or location of the land to which this application relates

12-18 Old Shoreham Road
Shoreham By Sea
BN43 FT5

Does the applicant own or control any adjoining land? Yes

If 'Yes', this land must be edged blue on the location plan

Area of site (Hectares) 0.25

Dimensions of the application site and distances from the new buildings to boundaries must be clearly indicated on plans

Proposal Details

For Residential Developments, please enter the number of units (flats, bungalows, houses)
- *for a* Change of Use that REDUCES the number of units, please enter a negative(-) number. 24

Description of proposed development: Proposed residential development - flats

(If residential development, state type if known, e.g. houses, bungalows, flats)

State whether the proposal involved:-

(i) New building(s) or structure(s) Yes

(ii) Alteration or extension of building(s) No

(iii) Construction of a new *vehicular* access to a highway No

Construction of a new *pedestrian* access to a highway No

(iv) Alteration of an existing *vehicular* access to a highway Yes

Alteration of an existing *pedestrian* access to a highway No

(v) Closure of existing access No

(vi) Change of use only No

Is there to be any 'furniture' placed on a street/highway? No

Use of Land

Particulars of **Use** of Building or Land: Please State

Present use: Vacant Site

If vacant, the last use: Car lot

Additional Information

(a) Is the application for industrial, office warehousing, storage, shopping, commercial purposes or places of public assembly? No

(b) Is the application for the winning or working of minerals? No

(c) Is the application for an agricultural dwelling or building? No

(d) Does the proposed development involve the demolition of any residential units? No

If 'Yes', how many units? ____ Please indicate their position on plans

(e) Does the proposed development involve the felling of any trees? Yes If 'Yes', indicate their position on plans

(f) Does the proposed development involve any public right of way within the site? No If 'Yes', indicate their position on plans

(g) Does the proposed development involve demolition or alteration of a building or Special Architectural or Historic interest or demolition within a Conservation Area? No

If 'Yes', a separate application for **Listed Building Consent** or **Conservation Area Consent** may be necessary

(h) (i) How will surface water be disposed of? Mains

(ii) How will foul sewage be disposed of? Mains (e.g. mains, cesspit, etc.)

(i) Is there to be any 'furniture' placed on the street/highway? No

Process Description

Additional information required in respect of applications for Industrial, Office, Warehousing, Storage, Shopping, Rest and Nursing Homes, Commercial Purposes or Places of Public Assembly.

In the case of industrial development, give a description of the processes to be carried on and of the end products, and the type of plant or machinery to be installed. Please relate your answer to the 'Floor Areas & Uses' section.

Details of Proposal

Is the proposal related to an existing use on or near the site? ____

If 'Yes', please explain the relationship ____

Is this a proposal to replace existing premises in this area or elsewhere which have become obsolete, inadequate or otherwise unsatisfactory? ☐

If 'Yes', please give details including gross floor area of such premises and state your intentions in respect of those premises.

Details of Floor Areas and Uses - please specify in square metres

	Existing Floor Space or use (if any)	**Proposed New Floor Space or use**	**Total Floor Space** (Allow for any space lost)
What is the amount of industrial floor space?			
What is the amount of office floor space?			
What is the amount of retail floor space?			
What is the amount of storage or warehousing floor space?			
Other Use 1 (please specify)			
Other Use 2 (please specify)			
TOTALS			

Other Uses 1 or Comments/Information

Details of Staff	**Office**		**Industrial**		**Other**	
	Male	Female	Male	Female	Male	Female
(i) **Number of staff in existing premises on the site**						
(ii) **How many new staff will be employed on the site as a result of the development?**						
(iii) **If you propose to transfer staff from other premises, please give details of the numbers involved***						

*and details of the premises affected.

Premises Details

In the case of restaurants, hotels, public houses, theatres, cinemas, meeting halls, Rest and Nursing homes, etc., please specify:

Type of Business

Public floor space (Total)

Seating capacity

Bar floor area (sq.m)

Single bedrooms

Double bedrooms

Parking & Traffic

What provisions have been made for parking, loading and unloading of vehicles within the curtilage on the site?

State number of car spaces

and Lorry spaces

What is the estimated vehicular traffic flow to the site during a normal working day?
Please include all vehicles

Separately specify those used by employees driving to work:

Waste

What is the nature of disposal of any trade effluents or trade refuse?

What is the volume of any trade effluents or trade refuse?

and the proposed means of disposal of any trade effluents or trade refuse?

Will the proposed use involve the use or storage of any hazardous substances?

If 'Yes', please indicate

Plans

List of drawings and plans submitted as part of the application - indicate drawing numbers and scales.
4 sets of all drawings are required.
Additional copies in respect of major applications will assist in determination of such applications.
All measurements are to be given in metric (89/617 EEC Directive).

Plan / Drawing	Number	Scale

Fees

If a fee is submitted, please give the amount £6,360.00 Calculated Fee £6,360.00

I/WE APPLY FOR PLANNING PERMISSION AS DETAILED ABOVE ☑ Tick to agree to this statement.

Signed:  Abbey Care Investments Ltd

On behalf of: (Insert applicant's name if signed by agent)

Certificate

Certificate under Section 65 of the Town and Country Planning Act 1990 (Article 7 of the T & CP (General Development Procedure) Order 1995. **N.B.** A signed certificate MUST accompany this application. If the applicant is the sole owner (a) the following certificate should be completed and signed.
'Owner' means a person having a freehold interest or tenancy the unexpired term of which was not less than 7 years

Certificate A

I certify that:
on the day 21 days before the date of the accompanying application nobody, except the applicant, was the owner of any part of the land to which the application relates.
None of the land to which the application relates is or is part of an agricultural holding.

Do you agree to these statements? Yes

OR

[ ] given requisite notice to every person other than [ ] who, on the day 21 days before the date of the application was a tenant of an agricultural holding on all or part of the land to which the application relates, as follows

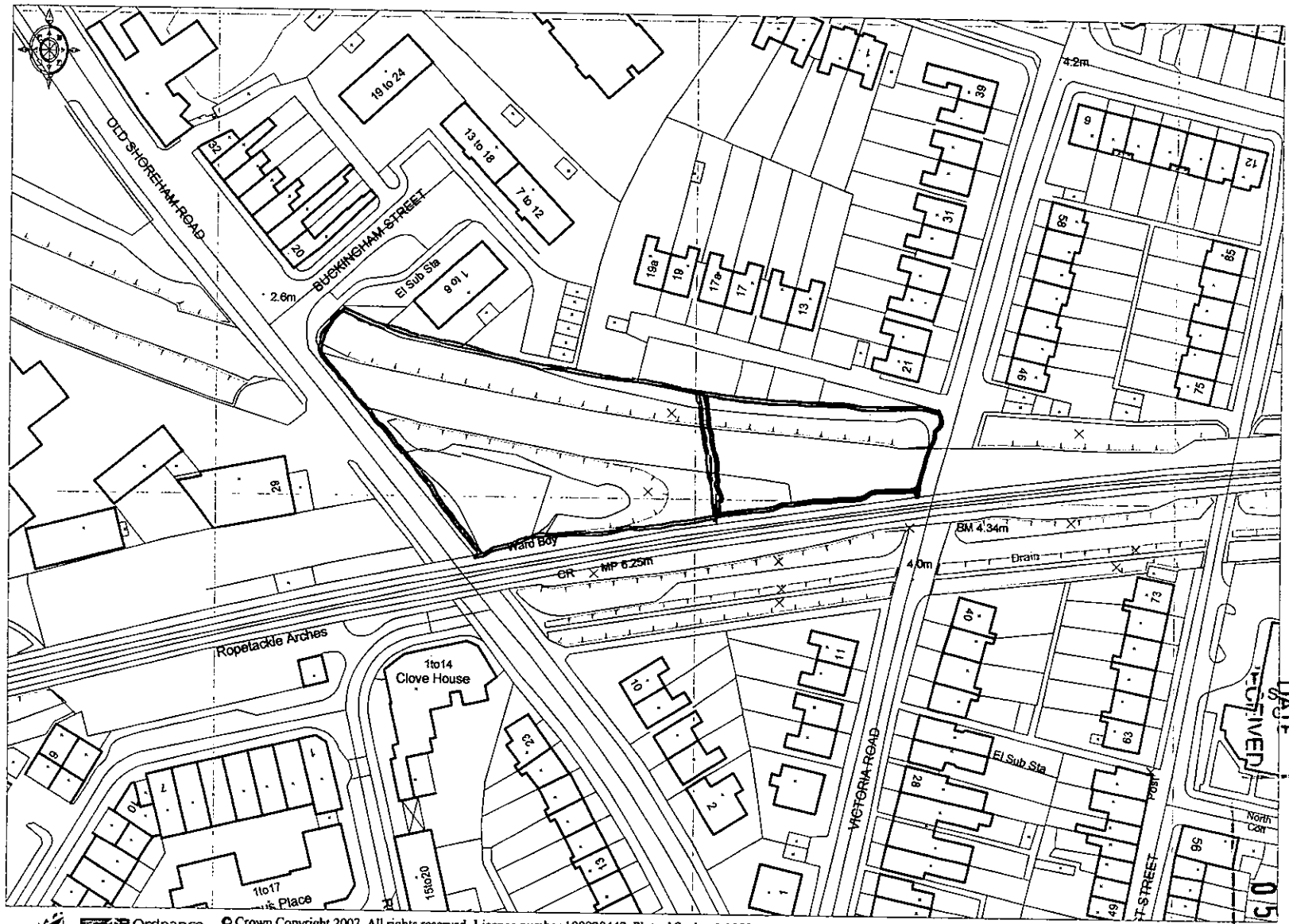
Name of Tenant	Address at which Notice was served	Date on which Notice was served

Do you agree to these statements?

Signed:  Date: 26-2-07

On behalf of: ABBEY CARE INVESTMENTS LTD

12-18 Old Shoreham Road, Shoreham-By-Sea



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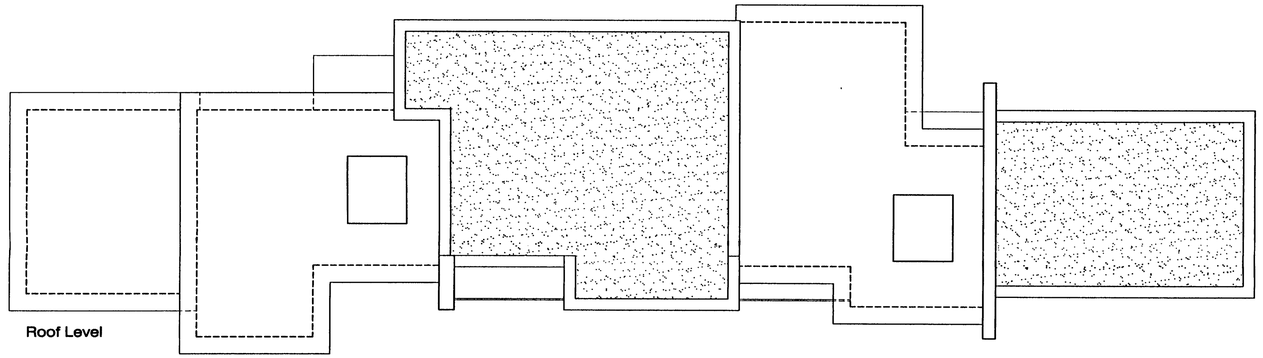

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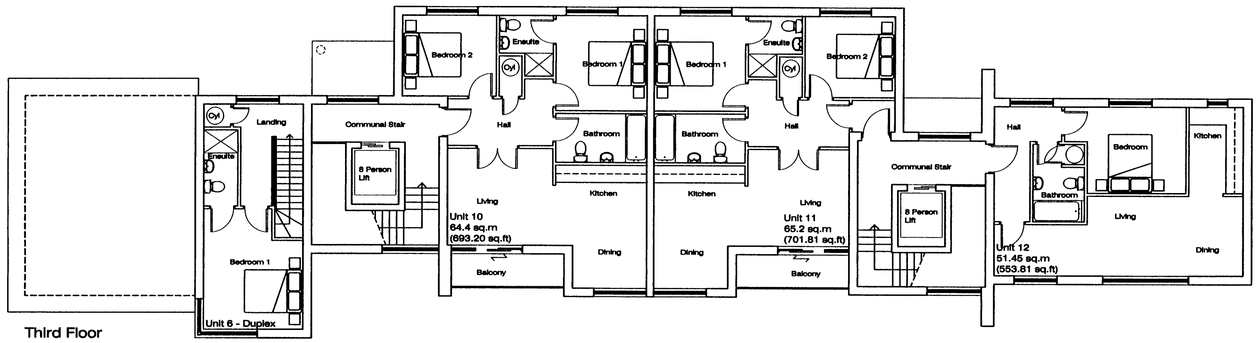

Third Floor

Notes

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Ao/013167
05 MAR 2007

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ISO 9001 REGISTERED FIRM

INVESTOR IN PEOPLE

Client

Abbeycare Investments Ltd

Project

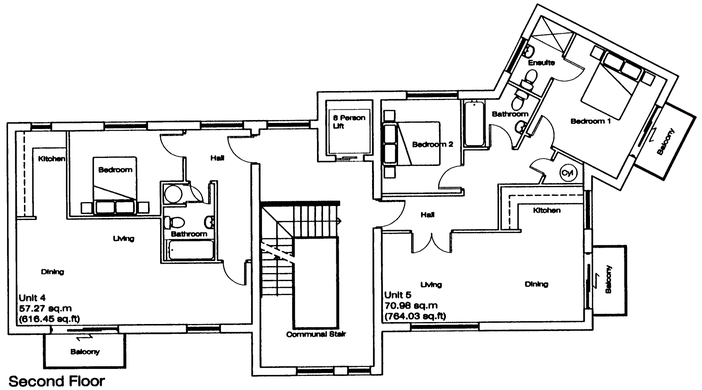
Proposed Residential Dev.
12-18 Old Shoreham Road
Shoreham-By-Sea

Drawing Title

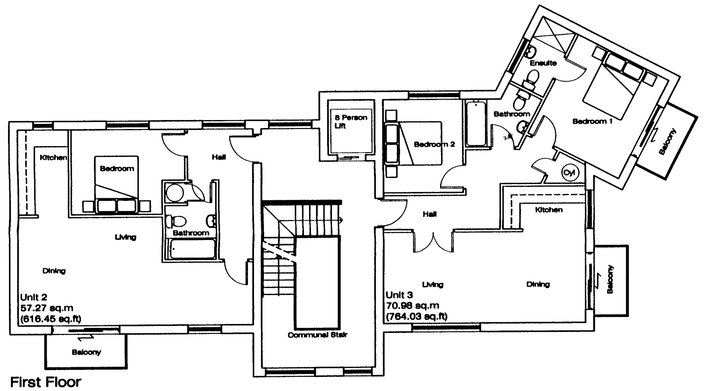
Proposed Third Floor & Roof Plan
Block A

Scale	Date
1:100 @ A1	26/01/2007
Drawn by	Checked by
BDC	

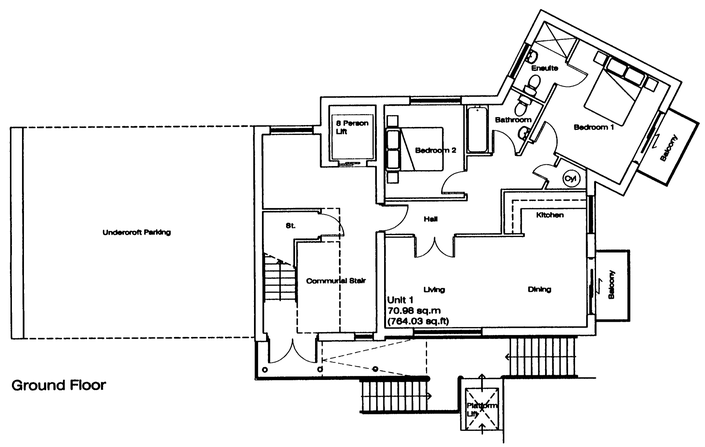
Job No.	Drawing No.	Rev.
L3049	AL(0)02	-



Second Floor



First Floor



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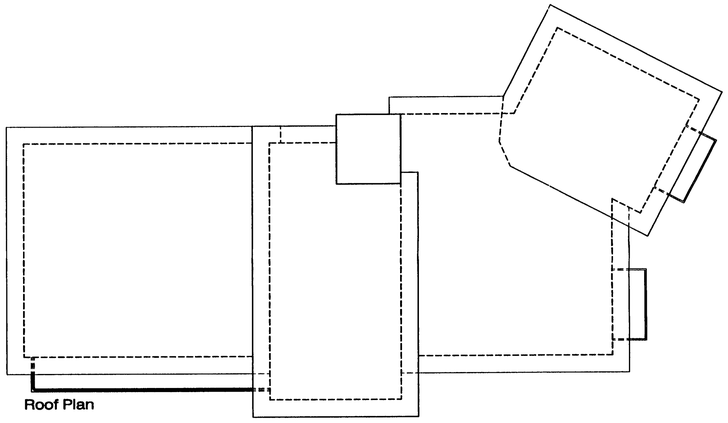
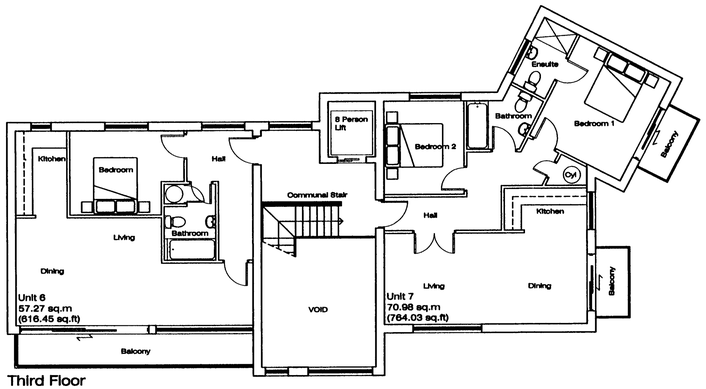


Roof Plan



Third Floor

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Client

Abbeycare Investments Ltd

Project

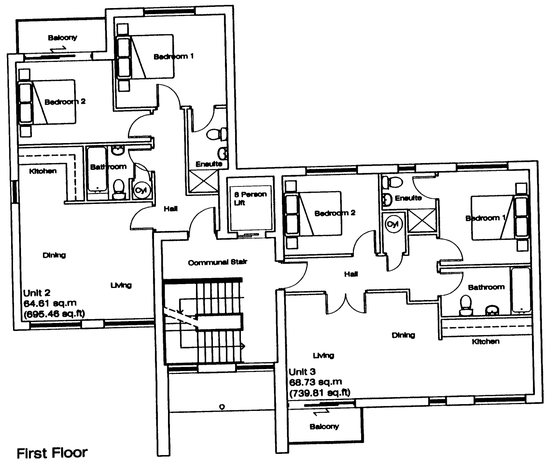
Proposed Residential Dev.
12-18 Old Shoreham Road
Shoreham-By-Sea

Drawing Title

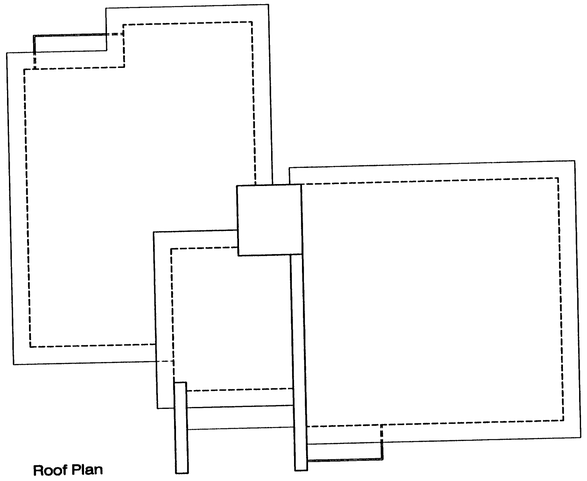
Proposed Floor Plans & Roof Plan
Block B

Scale	Date
1:100 @ A1	02/02/2007
Drawn by: BDO	Checked by:

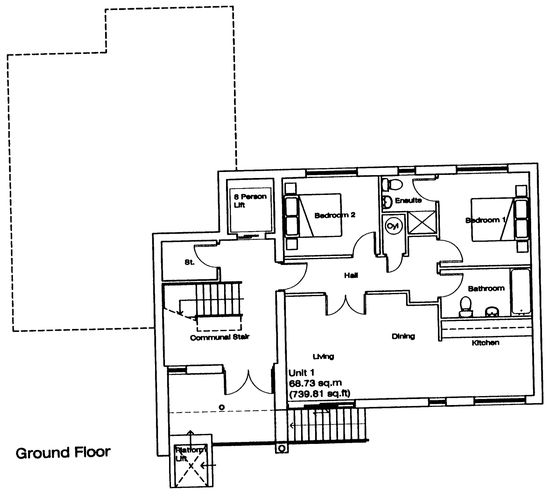
Job No.	Drawing No.	Rev.
L3049	AL(0)03	-



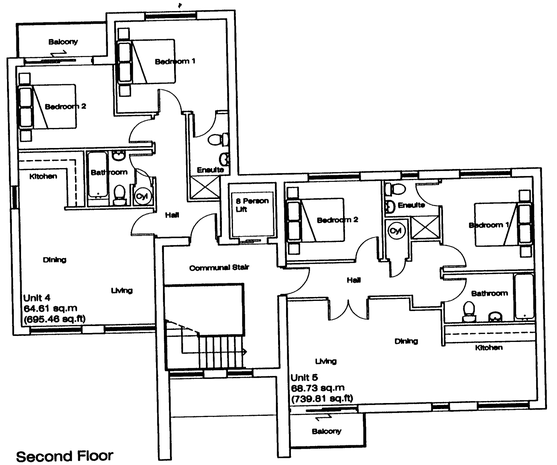
First Floor



Roof Plan



Ground Floor



Second Floor

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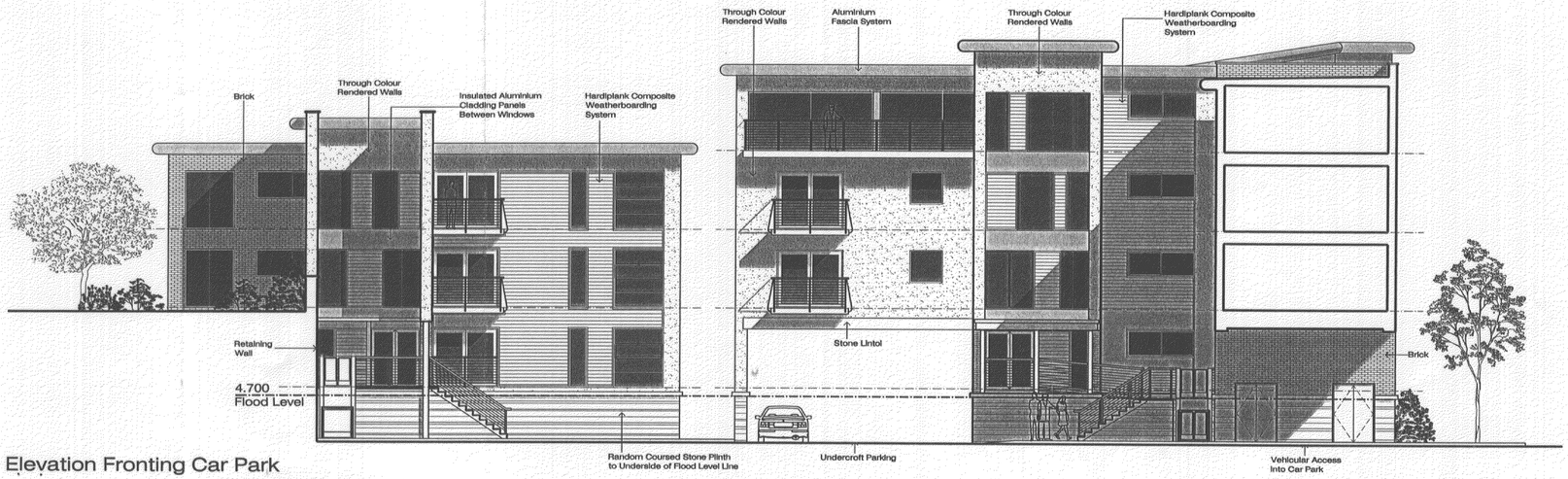

Elevation Fronting Car Park



Elevation Fronting
Old Shoreham Road

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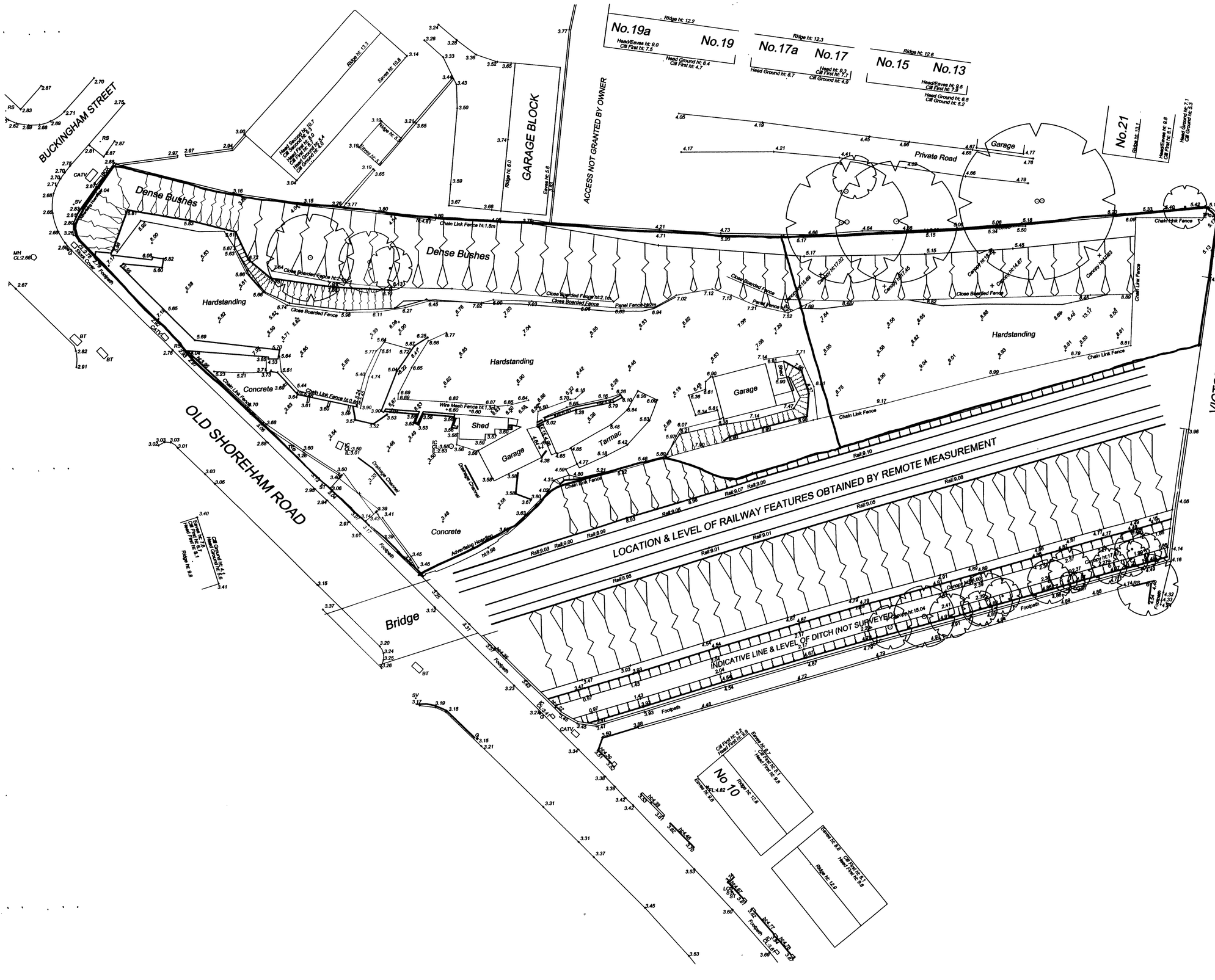

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Received
05 MAR 2007

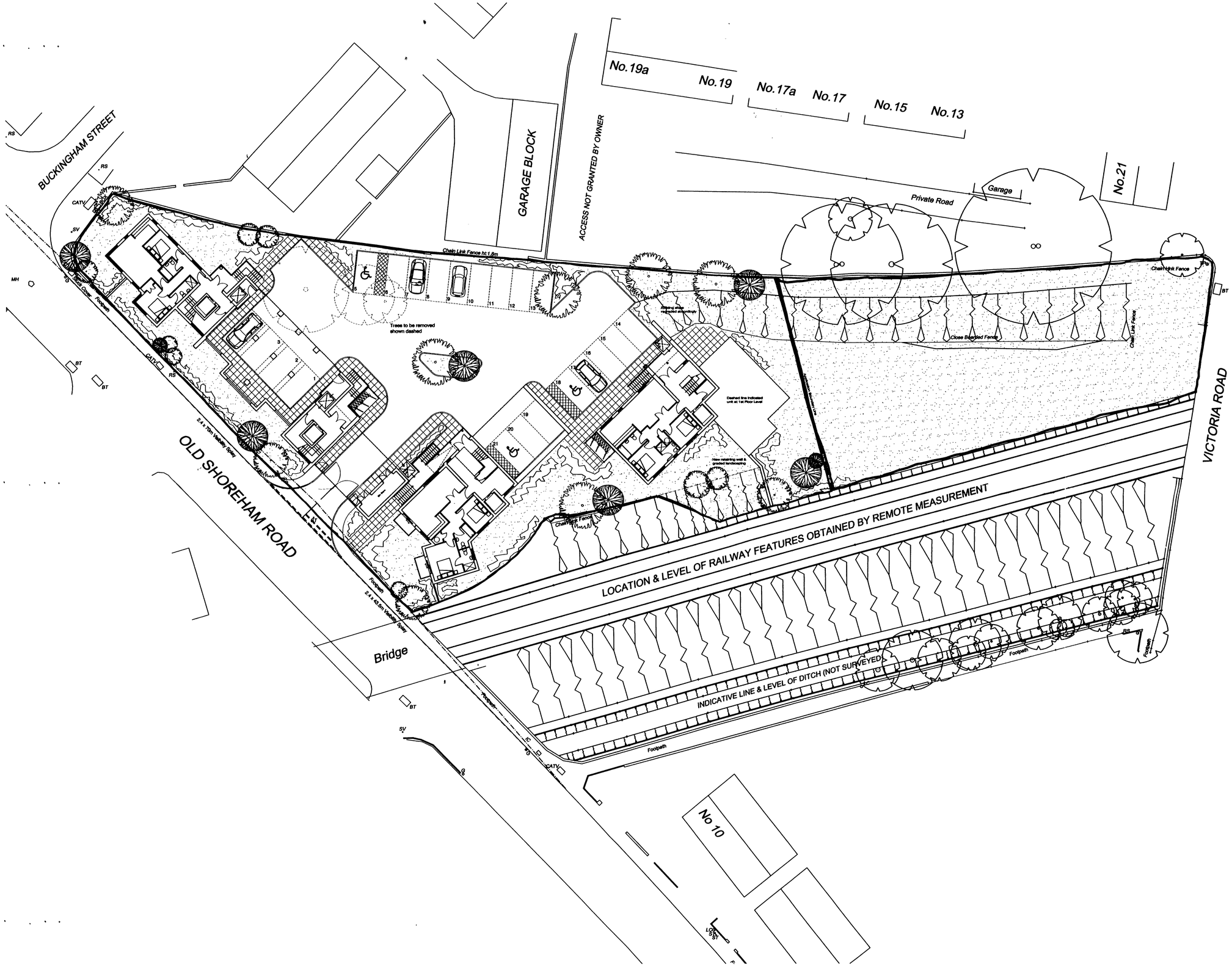
Client
Abbeycare Investments Ltd

Project
Proposed Residential Dev.
12-18 Old Shoreham Road
Shoreham-By-Sea

Drawing Title
Site Plan
As Existing

Scale	Date
1:200 @ A1	26/01/2007
Drawn by	**Checked by**
BDC	

Job No.	Drawing No.	Rev.
L3049	AL(9)900	-



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DWA ARCHITECTS

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Client

Abbeycare Investments Ltd

Project

Proposed Residential Dev.
12-18 Old Shoreham Road
Shoreham-By-Sea

Drawing Title

Site Plan
As Proposed

Scale	Date
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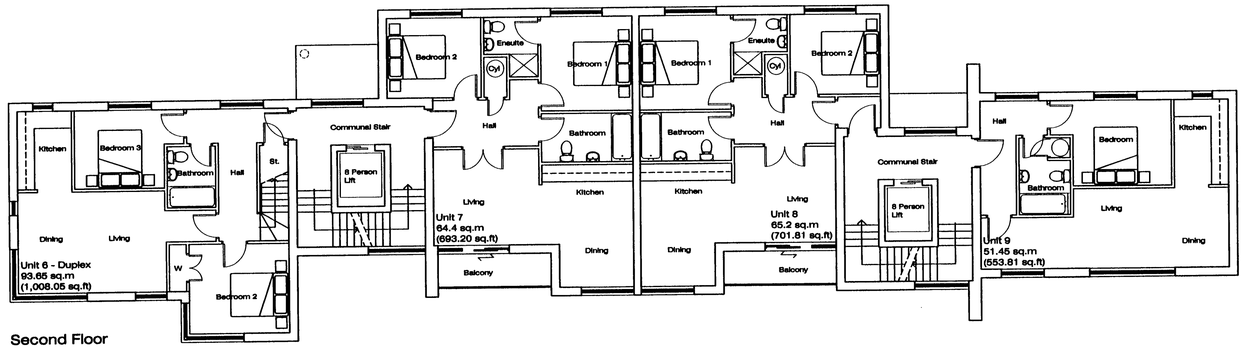
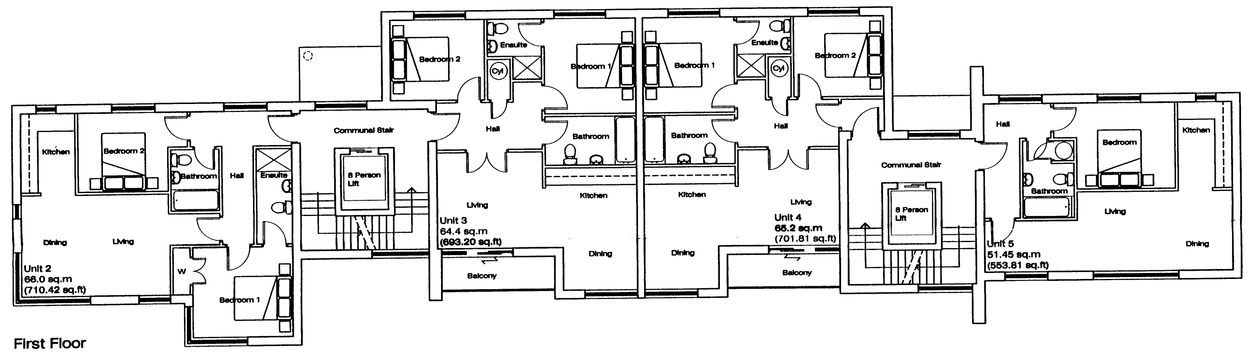
Drawn by	Checked by
BDO	

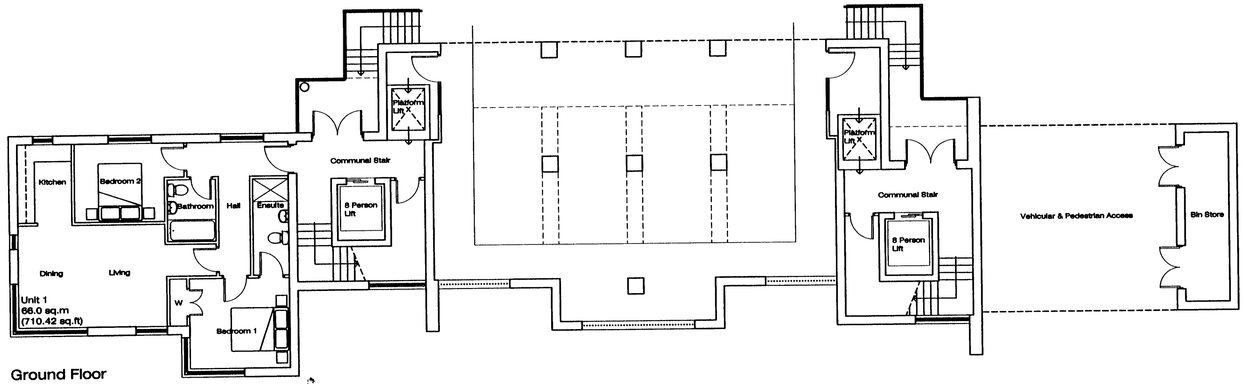
Job No.	Drawing No.	Rev.
L3049	AL(9)901	-



Second Floor



First Floor



Ground Floor

Notes

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INVESTOR IN PEOPLE

Client

Abbeycare Investments Ltd

Project

Proposed Residential Dev.
12-18 Old Shoreham Road
Shoreham-By-Sea

Drawing Title

Proposed Ground, First & Second Floor Plans
Block A

Scale	Date
1:100 @ A1	26/01/2007
Drawn by	Checked by
BDC	

Job No.	Drawing No.	Rev.
L3049	AL(0)01	-

OUR DISTRICT COUNCIL
PLANNING DIVISION
AN
Ar2/0131/07.
DATE
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Proposed Residential Scheme at Old Shoreham Road, Shoreham by Sea

Design & Access Statement

To Accompany Planning Application

Prepared by DWA Architects Limited
39 Blossom Street, York YO24 1AQ
February 2007
Ref L3049

Design Statement Contents Page

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1.0 INTRODUCTION

This design statement is being submitted as part of a planning application to Adur District Council. The report goes through the site, surrounding area, and any relevant influencing factors. It then explains how these factors have influenced the resulting design, and how the final design philosophy has been adopted, including an explanation of the planned workings of the development.

DWA Architects Limited was formed in 1988 and is a multi disciplinary design practice specialising in Care Home design. DWA Architects has gained a well deserved reputation for original and creative design and have gained extensive knowledge and expertise in all aspects of the design and construction of Residential Homes.

DWA Architects always develop each project design from first principles, with this development being no exception to this. It is our objective to exceed all the latest standards of good practice, whilst providing the most viable and efficient design necessary in the development of modern Residential Homes.

2.0 SITE ANALYSIS

2.1 Site

2.1.1 Landscape

The site includes a number of trees which are essentially self seeded on the existing embankment area to the northern section of the site set between the site and properties in Victoria Road. As part of the development a few of these will be removed but others will be retained where they are not affected in order to keep a good proportion of the established green wedge of land which attracts wildlife (mainly birds). Otherwise there is no other significant landscaping on the site.

2.1.2 Ecological Features

There are no known noteworthy ecological features present on the site.

2.1.3 Buildings

No buildings exist on the site other than some small garages, sheds and a small office which was used for car sales none of which are of any architectural interest or significance.

2.1.4 Physical Features

The site has direct access off Old Shoreham Road and is effectively a wedge of land which was the sidings and an old Branch line of the Railway network. The site is effectively broken into 3 separate distinctive parts being:

- A lower ground level with direct access off Old Shoreham Road bounded by the railway bridge support structure which crosses Old Shoreham Road and the old redundant railway line.
- A raised level which was the redundant railway line which is approximately 3m above the lower level. The existing railway is set at this same raised level.
- A steeply sloping embankment to the north towards Victoria Road with self seeded trees.

2.1.5 Infrastructure

There are various known infrastructure constraints on the site that will affect the design including:

- The need to set the level of all habitable rooms above 4.96 OD as a consequence of future predicted (2052) flood levels (from the sea) established with the Environment Agency. A full flood risk assessment has been carried out with details prepared and forwarded to the Environment Agency 14 November 2005. (Refer appendix 6)
- The position of the site access onto the site is dictated by the achievement of sight lines as prescribed by the Highways Authority which are fully achieved.
- The need to make new drainage connections to the existing sewage without overburdening the existing systems.
- The need to carefully deal with the ground so that areas of contamination if found can be properly dealt with to ensure that there is no compromising of the local environment and ground water.
- The need to design the development so that it is set adequate distances from the existing railway line and address satisfactorily issues related to sound.

2.1.6 Viewpoints in/out of Site

The upper part of the site is visible from the existing railway, but views out of the site from this level are restricted by a number of factors including trees to the north, the railway and new buildings to the south on the opposite side of Old Shoreham Road. From the lower level the existing railway bridge structure crossing Old Shoreham Road restricts views out of the site in this direction.

2.2 Surrounding Area

2.2.1 Street Pattern

Buildings around the site are generally semi detached residential buildings in medium sized plots in and around Victoria Road and both semi detached and terraced properties along Old Shoreham Road. In addition there are some new homes mainly in 3 and 4 storey flats on the old Ropetackle site which have only recently been completed and some older 3 storey flats set in large blocks with separate garage blocks in Buckingham Street (immediately adjacent to the site) all of which tend to maximise the available developable land, which is the norm for recent developments and in line with Government Planning Guidance.

2.2.2 Character of Surroundings

The buildings surrounding the site are generally of a traditional nature with some two storey semi detached residential properties but also with some long blocks of terraces. The redevelopment of the Ropetackle site diagonally opposite the site mainly comprises buildings of 3 and 4 storeys in blocks but there are some even higher. The character of the area is of a typically mixed developed suburban nature using a variety of styles and materials reflecting the style and age when they were built and typified by the Ropetackle development, which reflects the traditional nature of the area.

The more recent developments have tended to utilise a variety of styles and materials but with a traditional background by utilising details which are common to the area and effectively being of a local vernacular. This is also seen as being an appropriate basis upon which to base the redevelopment of this site.

2.2.3 Design of Neighbouring Properties

The houses closest to the site in Victoria Road and Old Shoreham Road are typical of the era in which they were built being constructed of brick, render and with tiled roofs and of quite simple straightforward design.
An exception is the apartment buildings directly across from the site in Buckingham Street which is a rather non-descript three storey set of flats with separate garages. There is a new substantial housing development diagonally opposite the site (former Ropetackle site) which is of three and four storeys in blocks and terraces with brick and tiled roofs which as indicated above has been modelled on typical details from the area resulting in a fragmentation of styles giving some individuality to these properties. Directly opposite the site in Old Shoreham Road there are Car showrooms and a semi derelict dwelling which is ripe for redevelopment.

2.2.4 Proximity of Neighbouring Properties

To the north of the site the residential properties are at least 22m away from the site boundary with gardens, driveway and land between Old Shoreham Road lines the west boundary. The property to the west is very close to the boundary with some windows facing the site but at an angle to it.

2.3 General Planning Guidance and Consultations with the Planning Authority

2.3.1 Consultations with the Planning Authority

Comments were made previously in relation to Application SU/20/06/TP and are summarised as follows:-

- A flood risk survey would be required
- A full site contamination survey would be required.
- Full consideration of noise and appropriate sound mitigation measures to be undertaken.
- Achievement of Highways prescribed sight lines.
- Full substantiation of car parking numbers and manoeuvring.
- General design issues relating to the size, height, bulk and appearance of the proposal.
- Need to retain as many trees as possible.
- Clear demonstration of relationships with adjoining properties to ensure that overlooking was not a problem.

2.3.2 Relevant National and Local Planning Policies

Relevant policies set out in the National Planning Guidance Structure Plans and Local Plan applicable to the proposed development include:-

Reuse of previously developed land by infill:

LOC1 and ERA1 Policies in the adopted Structure Plan (2001 – 2016) encourage the reuse of previously developed land by infill redevelopment and conversion at higher densities on the proviso that the impact on the area and environment is acceptable.

Quality of Development

Policy DEV1 of the adopted Structure Plan requires new development of a high quality taking into account:-

- The need to integrate with and where possible enhance adjoining land uses, and minimise potential conflicts between land uses and activities.
- To create a sense of place
- To create a high quality socially inclusive and adaptable environment which meets the long term needs of users.
- To create a safe, well cared for environment where opportunities for crime and anti social behaviour are minimised.
- To ensure energy efficiency
- To give a priority to pedestrians, people with impaired mobility, cyclists, users of passenger transport.
- To reduce the dominance of cars and roads PPS1 and PPG3 echo these requirements.

2.3. Cont

New Dwellings

Policy AH2 relates to new dwellings. In these policies reference is made to new buildings being designed so that their appearance, character and scale create a pleasant place in which to live as well as being in keeping with and enhancing the local existing environment with attention paid to architectural form, height, materials, density and layout and not having an unneighbourly effect due to loss of privacy, daylight/sunlight, outlook or open space.

Amenity Space

In policies AH10 and AH2 of the District Local Plan reference is made to the provision of adequate standards of amenity for residents in terms of garden space daylight outlook and privacy.

Site Designation in the Local Plan

The site is not identified for any particular use or development in the Local Plan. The site lies within the 'built-up' area of Old Shoreham.

Infill

The proposal represents an infill development which is as allowed for in the Structure and Local Plan policies which would support in principle residential development (including a Care Home) in this location.

Flood Risk

PPG25 sets out Government advice that a Flood Risk Assessment should be carried out by the applicant (which has been carried out – refer Appendix 6).

3 Evaluation of Constraints and Opportunities

The main recognised constraints on development are:

3.1 Guarding against possible future flooding

The revised development proposes that the floor level of habitable rooms ie. those at first floor level be set at 7.850 OD above sea level (with other ancillary accommodation on the ground floor set at a level of 5.0 OD so that even this is set above the predicted flood levels.) all of which is fully in line with the earlier recommendations of the Environment Agency and is therefore considered to be compliant.

3.2 Guarding against noise pollution from external sources

A sound survey was undertaken between 14 and 17 May 2005 and following dialogue with the Environmental Health Officer a further sound survey has been undertaken on the site (refer appendix 3) and its findings are that the site is in category B and therefore there are no acoustic requirements to deal with. The survey however recommends that various sound insulation measures and recommendations are followed in respect of the construction (mainly in respect of the glazing specification of windows). The recommendations of the report will be rigidly followed as part of the construction of the project and therefore it is concluded and considered that possible sound issues are not a concern.

3.3 Dealing with contamination issues

A desk top Phase I Risk Assessment has been undertaken of the site which recommended further specific on site investigation (refer appendix 4) and this has been supplemented by the carrying out of a full geotechnical and contamination survey of the site (refer appendix 4) by recognised specialists. The detailed report identifies only one sample exceeded the stated thresholds by a very minimal amount. As stated this ground will be removed during construction to an approved and licensed tip. There is no risk due to contamination and therefore nil migration from the site during construction activities.

3.4 **Traffic Impact Study and Highways Requirements**

A traffic impact study has been undertaken relating to the proposed development of the site (refer appendix 5). The conclusions of the study are that adequate car parking levels are proposed for the development and that there will not be any increased burden upon the highway infrastructure as there is unlikely to be any increase in traffic generation as a consequence of the development in comparison with the previous use of the site (second hand car sales). The proposed development will also incorporate increasing the width of the public footpath on Old Shoreham Road to the full length of the site and also a much improved site access arrangement for vehicles as well as sightline improvements at the junction of Buckingham Street with Old Shoreham Road. A speed test survey has been undertaken of traffic using Old Shoreham Road in order to establish, justify and agree sight lines with the Highways Authority It is therefore considered and concluded that traffic and highways matters are not issues of concern to this application as a consequence of them having been resolved during the pre application negotiations.

3.5 **Proximity of adjacent properties**

Proximity of the adjacent properties in Victoria Road to the west will mean that any new development will have to be certain minimum distances away or not have any windows facing onto the adjacent properties. This has been considered carefully in the design and layouts and as such complies with standards advised.

4 The Proposal

4.1 Overview

The proposal is for the redevelopment of the front of the site and will consist of a 3 / 4 storey development of flats giving a total of 24 units. The majority of the flats are on the Old Shoreham Road frontage with an element to the rear of the main block backing onto the railway line but facing into the site essentially forming an 'L' shape.

4.2 Design Principles

The design of the flats is essentially contemporary in its form with its strongly defined fenestration flat roofs and parapets and the use of balconies but also utilising materials that reflect the character of the area and surrounding buildings. We consider that the proposed range of materials would sit easily with the existing buildings and new developments along Old Shoreham Road. The use of balconies, different coloured renders, and replica cedar boarding captures, we believe, the spirit of a well established resort on the English Channel. The layout has been carefully planned to avoid any overlooking of the existing flats off Buckingham Street with the nearest now being 33m away with facing habitable room windows and 12m away where a habitable room window faces a blank cable end.

The main front elevation runs parallel with Old Shoreham Road and creates interest by avoiding a flat elevational treatment and creating, on plan a stepped footprint which, together with the variations in height across the frontage, creates the appearance of several smaller interconnected buildings, something which is an existing feature of the area. Access into the development is via remote control gates for vehicles which will be set back from the road edge allowing vehicles to pull in off the street and not obstruct the public footpath. Pedestrian access is produced to both sides of the vehicular access and is through keypad operated gates.

Parking for 21 vehicles is provided, an element of which is under the buildings making use of the raised ground level which is set above the anticipated 200 year flood line. Three disabled parking bays are provided as part of the 21 spaces and these are spread across the car park. Although the car parking area is reasonably substantial (to allow for manouvering of refuse and emergency vehicles) there is an excellent provision of green space. Both to the road frontage and throughout the site.The existing mature trees to the northern boundary are retained as part of this development and suplimented with additional trees creating a screen between the adjoining existing flats and the development. New shrub and tree planting is in place around the site and all other areas of soft landscaping are predominantly laid to grass.

4.3 Transportation

Parking for 21 vehicles on site has been included in the proposal (this incorporates the necessary turning areas for delivery, emergency and refuse vehicles and also incorporates three disabled parking spaces which we feel is more than adequate in this location as it equates to 1 space for every 1.4 units. 16 cycle spaces are provided in two covered sheds of 8 bays each which are divided across the development.

4.4 Access

The existing site rises quite steeply front to rear and as a consequence the front area of the site will have a large area of banking removed in order to make the site flat across the front two thirds. In addition, because the site is susceptible to flooding the ground floor level accommodation is raised to a level of 4.850m above OSD which is 150mm above the assumed 200 year tide level thereby putting the ground floor approximately 2.000m above natural ground level at the rear of the footpath on Old Shoreham Road.

Access into the flats is via stair/lift enclosures these are in turn accessed via a short flight of stairs/designed to accord with the requirement of approved document M or via a platform lift that will be large enough to accommodate a wheel chair. Access thereafter to all upper levels is via either an 8 person lift or a staircase designed in accordance with approved document M. Access into each flat is over a level threshold. Access from a disable parking space within the car park will be via a 1200m wide footpath with disabled crossing points at places where necessary.

5 Conclusion

In line with Planning Guidance it is appropriate for the site to be redeveloped at a higher density than the area around as its impact upon the area is minimal. The precedent for higher development of 3 and 4 storeys has recently been established by virtue of the Ropetackle site.

The most crucial aspect of redevelopment of the site is to provide a development which is one of high quality, which this one will be by virtue of its careful detailed design which respect the area around it utilising features and character which are fully in keeping with its immediate neighbourhood.

The design of the apartments has been carefully undertaken so that it is internally planned to create an appropriate living environment for its residents and those who will work in the building with particular attention given to provision of a safe area for parking with cycle and motorcycle parking integrated to separate areas and with a separate pedestrian and vehicular entrance.

The apartments will follow all prescribed requirements in respect of its building fabric so that it is an energy efficient building and where possible these will be exceeded so that it makes a positive contribution.

Care has been taken in developing the plan form of the building to ensure that it is a neighbourly redevelopment of the site by ensuring that minimum prescribed distances to adjoining properties are respected, achieved and exceeded where possible and thereby not affecting privacy, daylight/sunlight outlook or open space of existing dwellings.

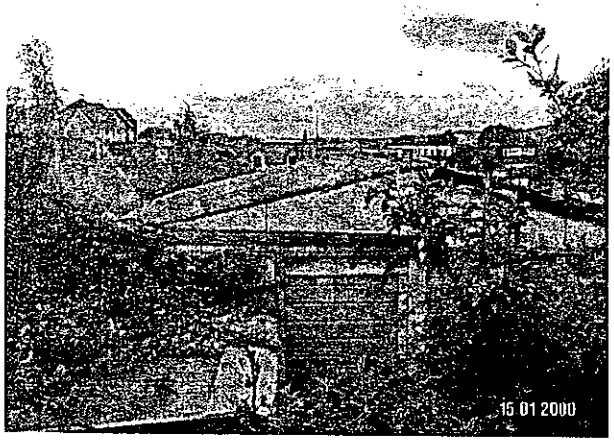
Adequate amenity space will be provided for the residents of the apartments.

In conclusion we believe that the design of the building is entirely appropriate to this site and will make a positive contribution to the general townscape and street scene of the area. The proposed building and site redevelopment will enhance the experience of residents, and will benefit the local community in many ways.

Appendix 1 Application Drawings

Drawings:	L3049/AL (9)	900	Site Survey
	AL (9)	901	Site Plans As Proposed
	AL (O)	01	Ground, First and Second Floor Plans as proposed (Block A).
	AL (O)	02	Third Floor and Roof Plans As Proposed (Block A).
	AL (O)	03	Proposed Floor Plans and Roof Plan (Block B).
	AL (O)	04	Proposed Floor Plans and Roof Plan (Block C).
	AL (O)	40	Elevations as Proposed.

Appendix 2 Site Photographs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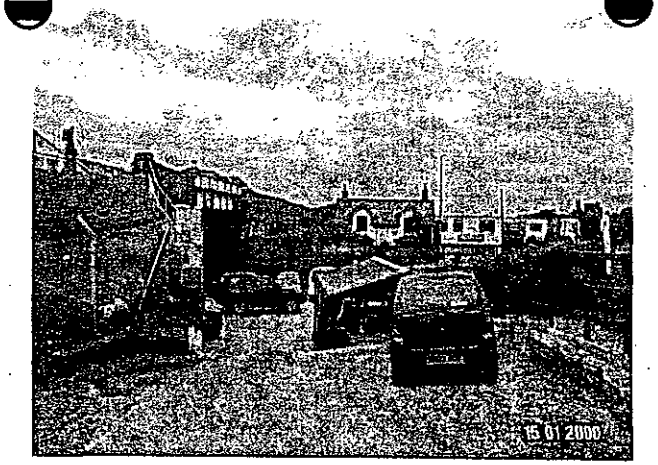
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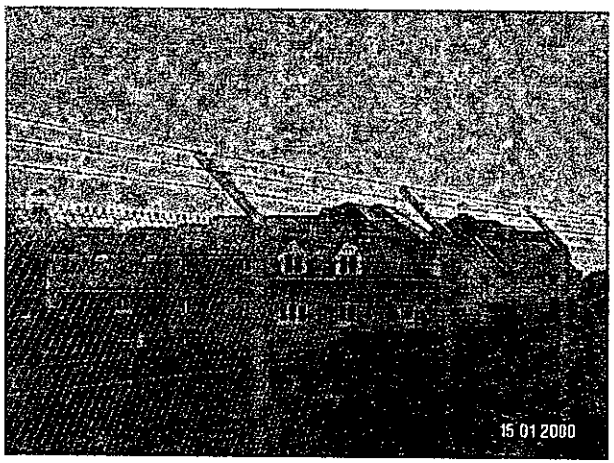
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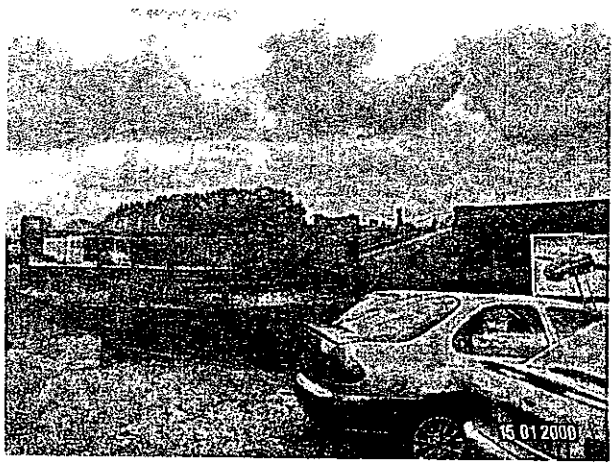
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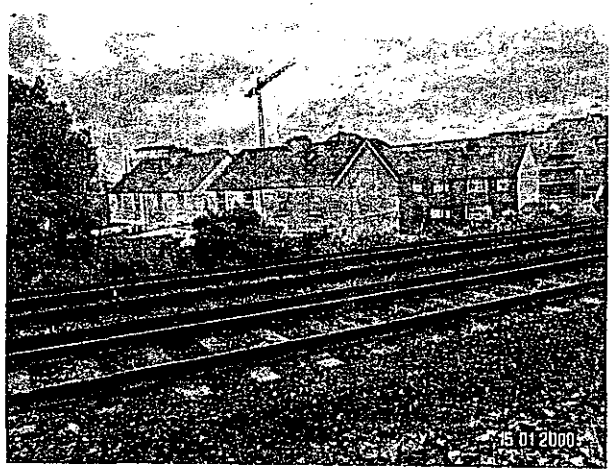
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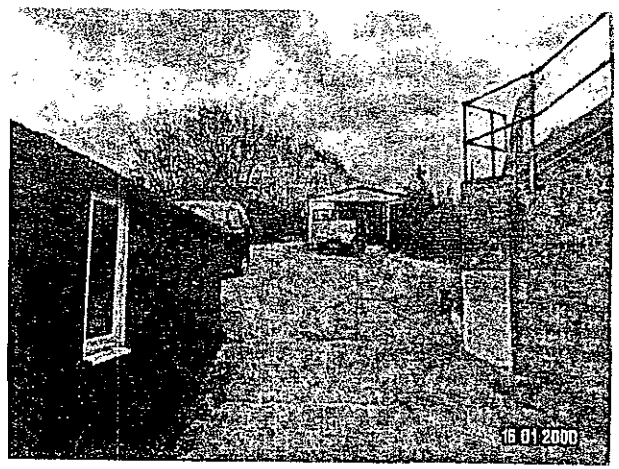
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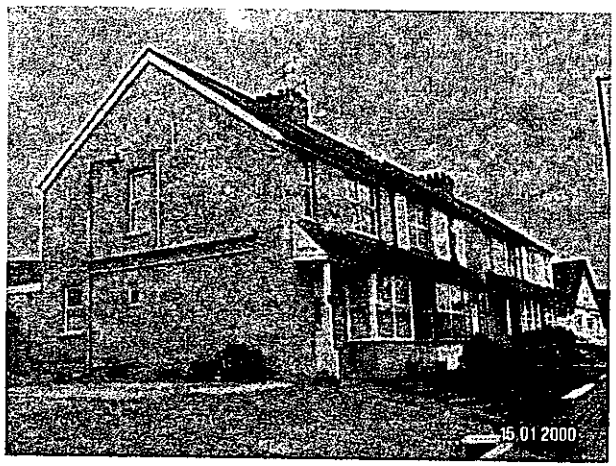
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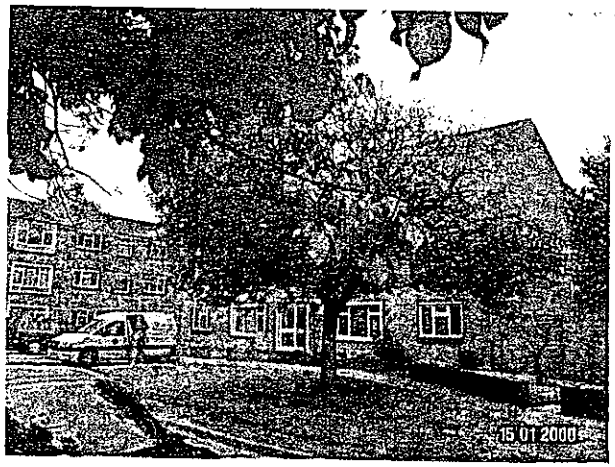
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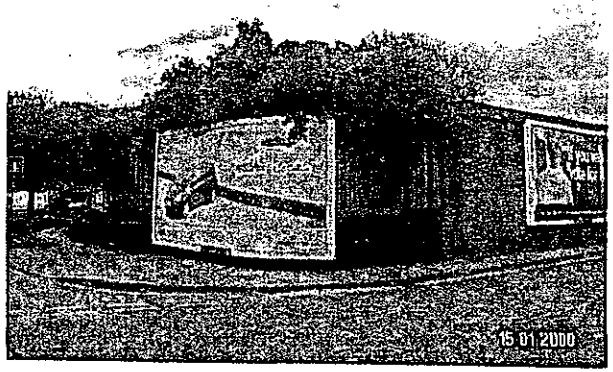
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M&S CAR SALES
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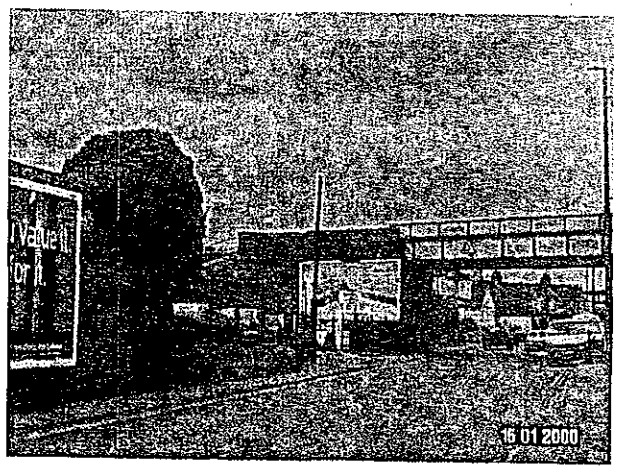
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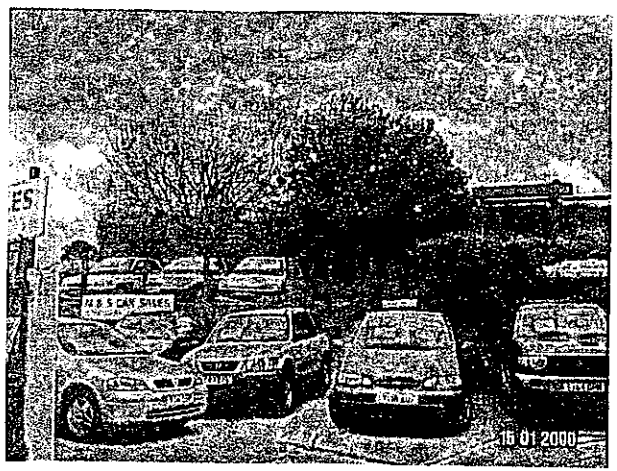
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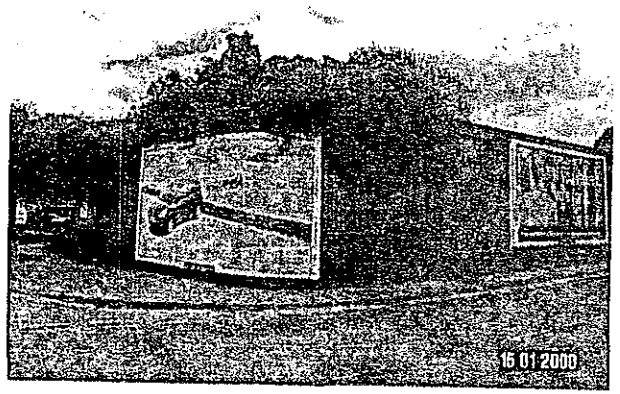
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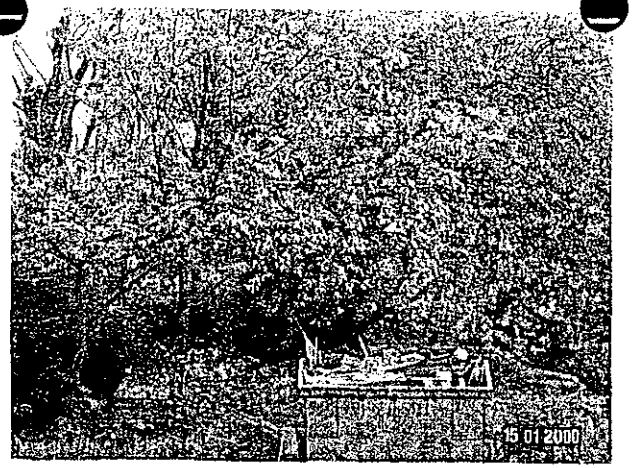
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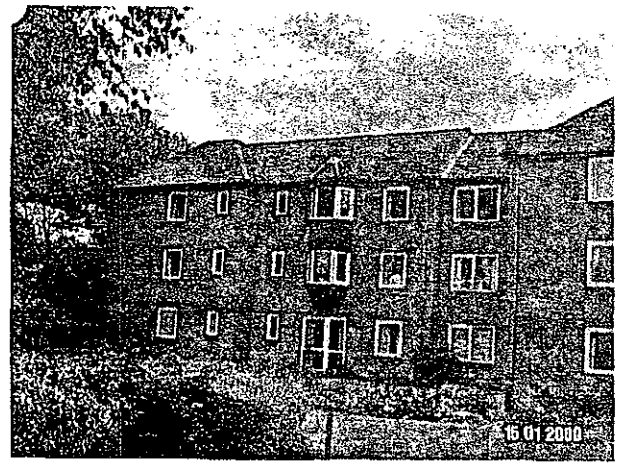
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Imagine
5 more years
of him
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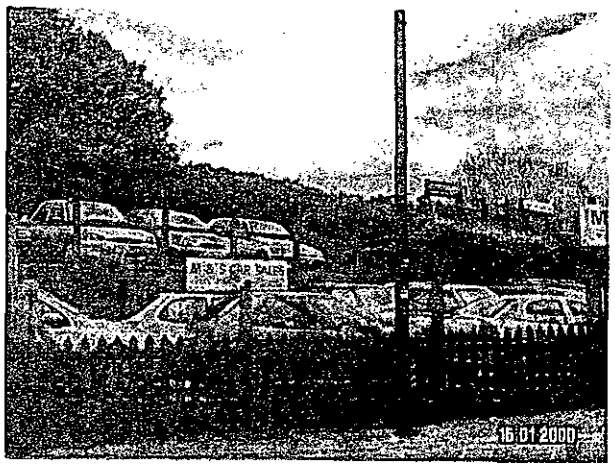
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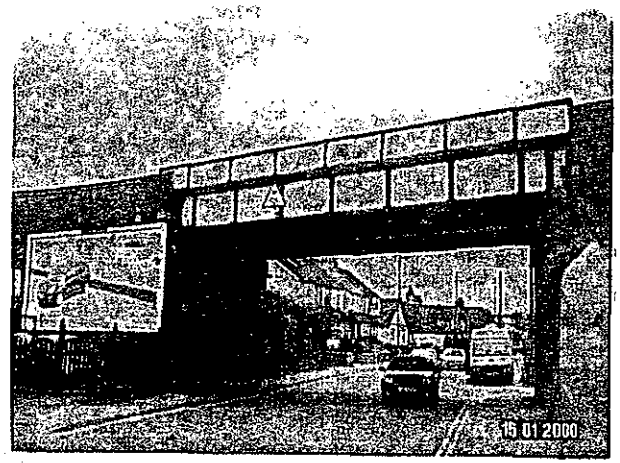
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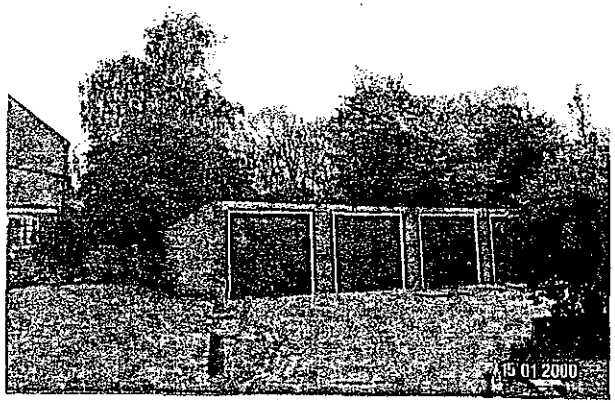
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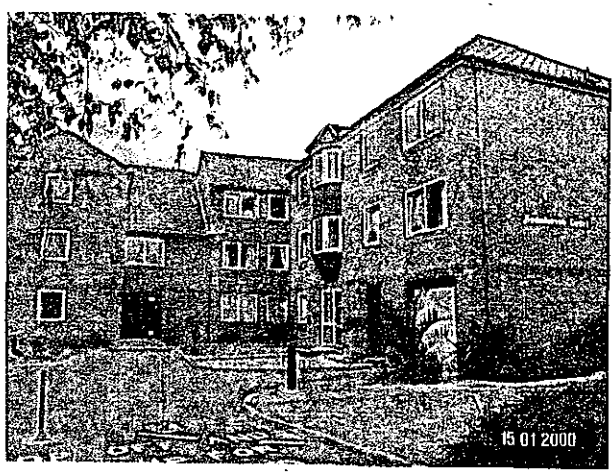
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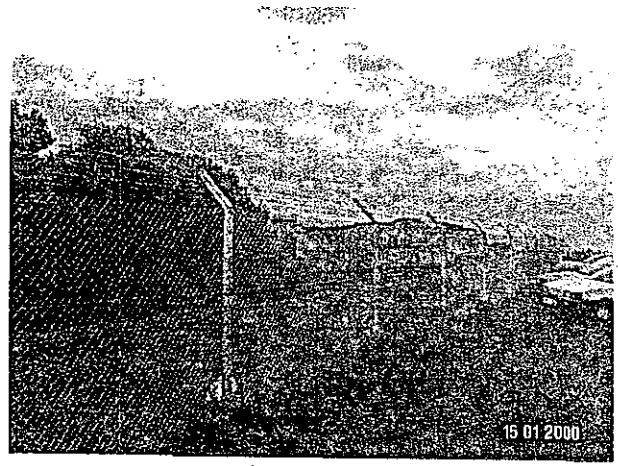
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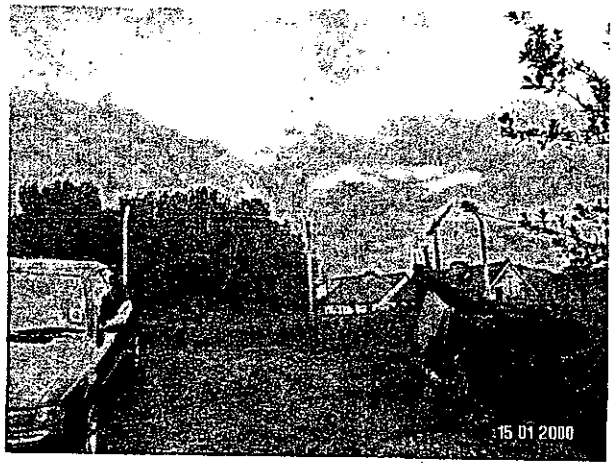
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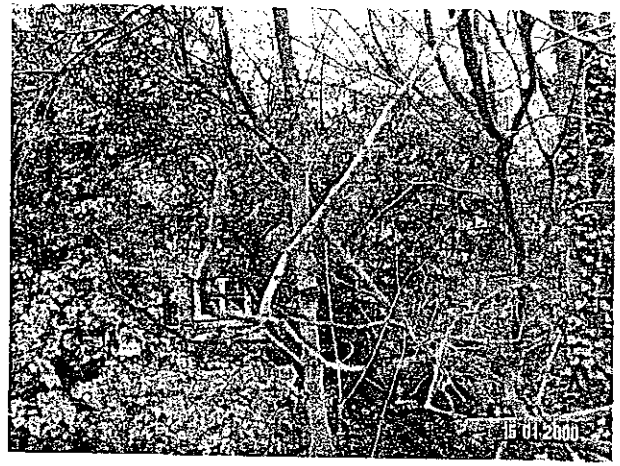
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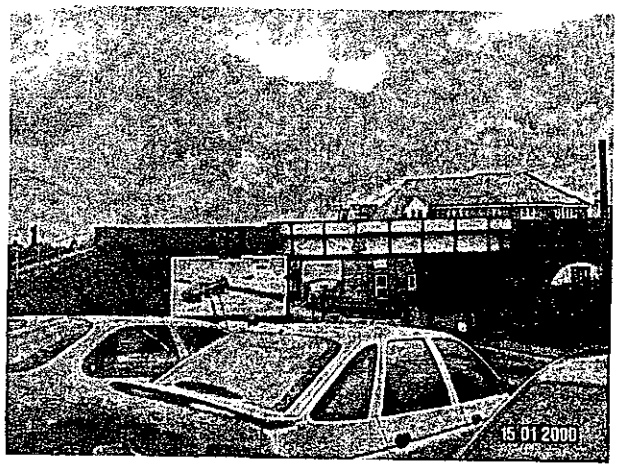
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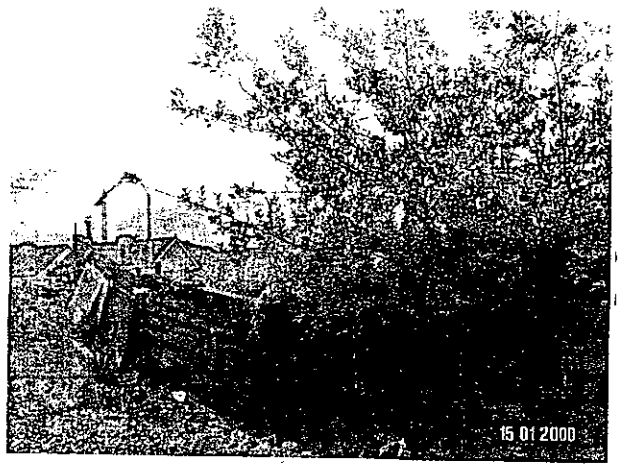
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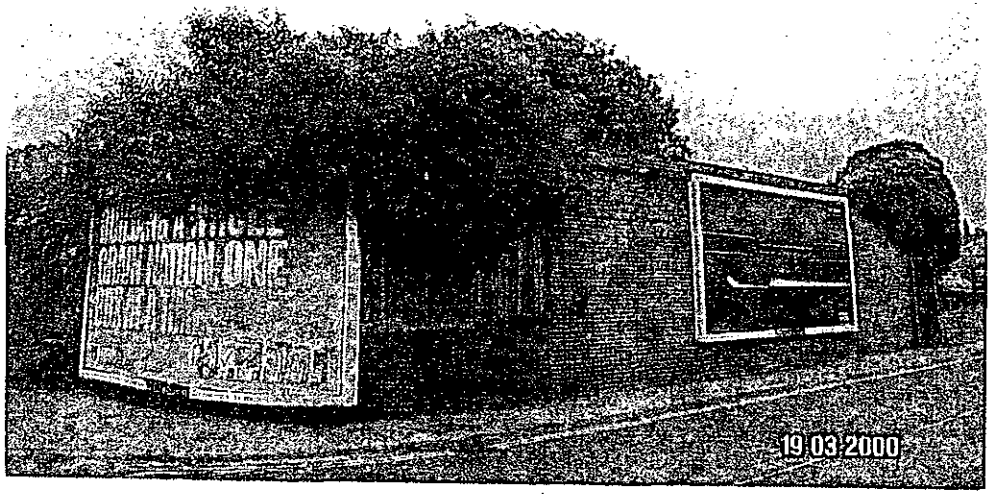
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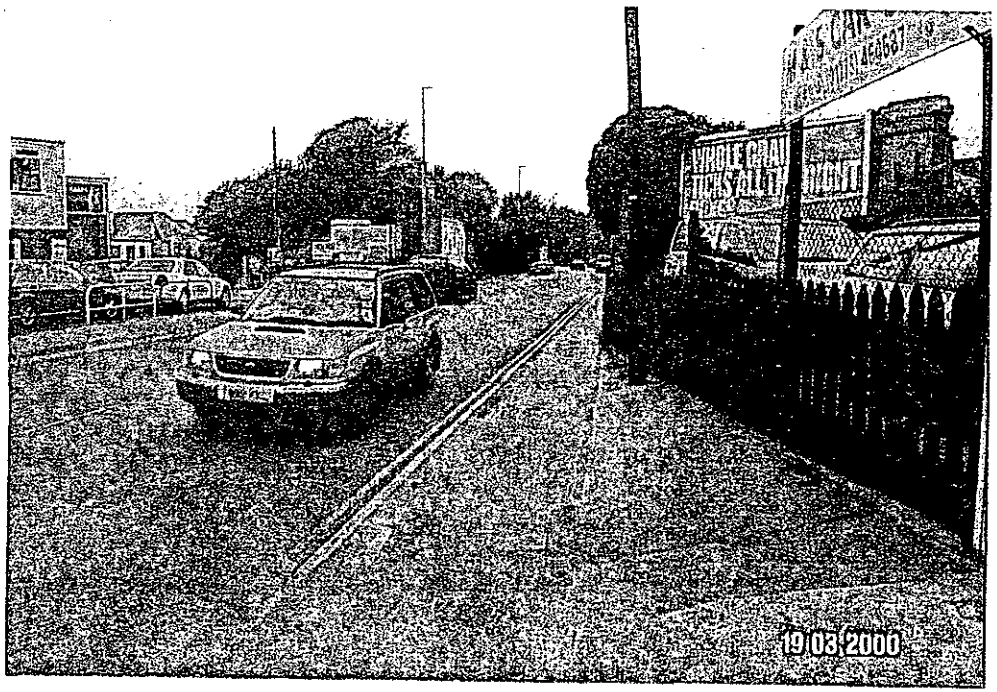
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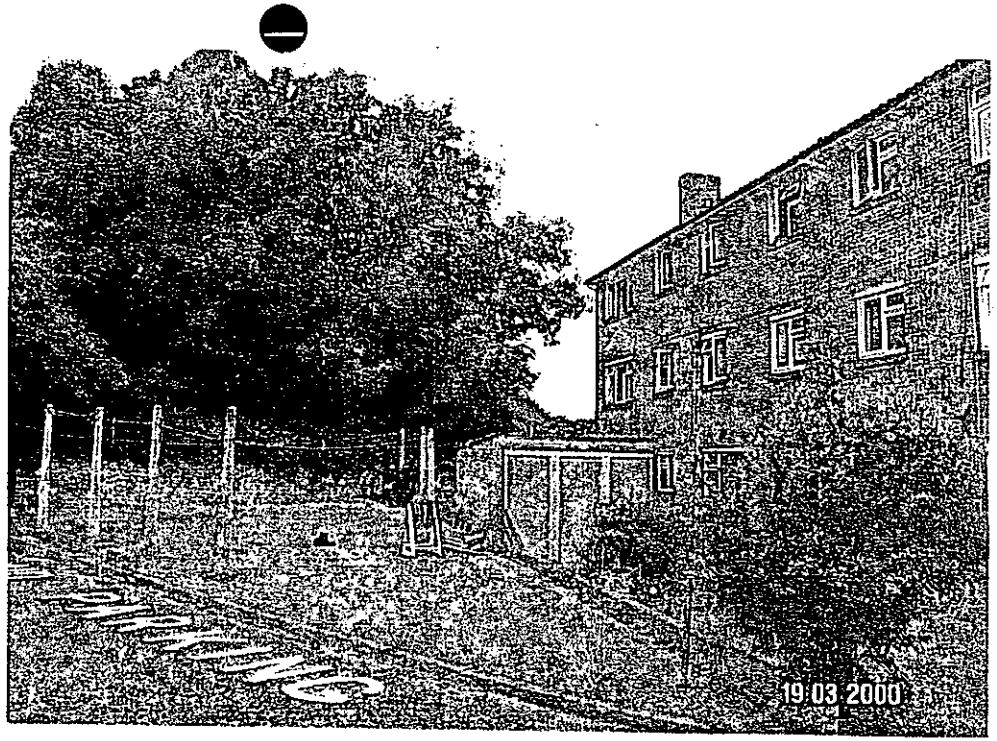
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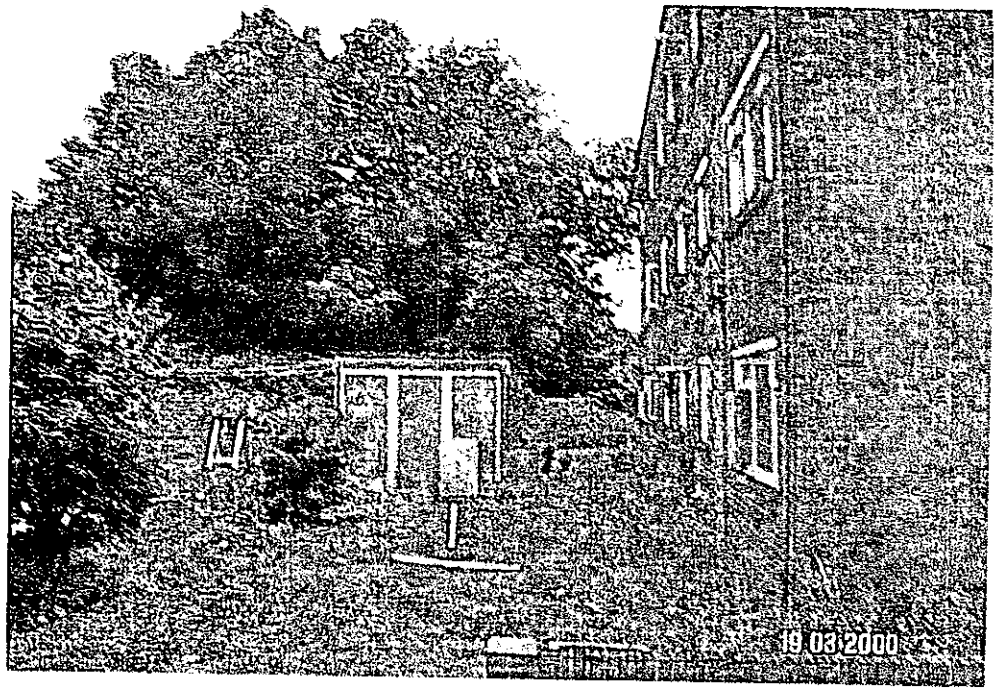
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Appendix 3 Noise Surveys

- Original Report dated 24 May 2005
- Addendum Report dated 18 January 2006

DWA ARCHITECTS LTD
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RECEIVED 27 MAY 2005
ACTION | JOB NO. L3040

Report No. R2419-1
Issued on 24th May 2005

An Assessment of the Impact of Noise on the Proposed New Care Home Development at Shoreham-by-the-Sea

***

For a Planning Application

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1. Introduction

DWA Architects are making a planning application for a New Care Home Development at 12-18 Old Shoreham Road, Shoreham-by-the-Sea, West Sussex.

Noise and Vibration Engineering Limited (NVE) has been commissioned by DWA Architects to perform an assessment of the impact of noise on the proposed development and prepare a report in accordance with PPG 24 "Planning and Noise".

2. The site

The development site under consideration is approximately triangular-shaped. On the south-west side it is adjacent to A283 Old Shoreham Road, on the south-east side to the railway line, and on the north side to the blocks of flats in Buckingham Street, see Figure 1. There is Victory Road (local cul-de-sac) to the east of the site.

The site is currently occupied by M & S Car Sales, which consists of two garages and a shed, see Figure 2.

It is proposed to erect a nursing home for elderly people on the site. There are no details, at present, about the exact size and position of the building or the layout of the rooms. However, we were informed that there will be bedroom windows facing the railway line. The nearest façade of the building is expected to be situated approximately 10m away from the railway line, see Figure 2.

3. PPG24 Recommended Noise Exposure Categories

When determining planning applications for development which will be exposed to an existing noise source, local planning authorities should consider both the likely level of exposure at the time of the application and any increase that may reasonably be expected in the foreseeable future.

Planning Policy Guidance Note 24 – Planning and Noise gives guidance on noise levels and noise exposure categories and these are used as basis for the most local authorities' standards. Local authorities are concerned to ensure that development proposals do not give rise to unacceptable noise conditions. Local authorities will therefore make careful assessment of likely noise levels before determining planning applications where noise is likely to be present.

When assessing a proposal for residential development near a source of noise, local planning authorities should determine into which of the four noise exposure categories (NECs) the proposed site falls, taking account of both day and night-time noise levels. Local authorities should then have regard to the advice in the appropriate NEC, as below:

NEC	Description
A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

RECOMMENDED NOISE EXPOSURE CATEGORIES FOR NEW DWELLINGS NEAR EXISTING NOISE SOURCES

NOISE LEVELS(0) CORRESPONDING TO THE NOISE EXPOSURE CATEGORIES FOR NEW DWELLINGS $L_{Aeq,T}$ dB				
	NOISE EXPOSURE CATEGORY			
Noise Source	A	B	C	D
Road traffic 07.00-23.00 23.00-0700 (1)	<55 <45	55-63 45-57	63-72 57-66	>72 >66
Rail traffic 07.00-23.00 23.00-0700 (1)	<55 <45	55-66 45-59	66-74 57-66	>74 >66
Mixed sources (2) 07.00-23.00 23.00-0700 (1)	<55 <45	55-63 45-57	63-72 57-66	>72 >66

Notes:

0) Noise levels: the noise level(s) ($L_{Aeq,T}$) used when deciding the NEC of a site should be representative of typical conditions.

1) Night-time noise levels (23.00-07.00): site where individual noise events regulary exceed 82 dB L_{Amax} (slow time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq,8\text{-}h}$ (except where the $L_{Aeq,T}$ already puts the site in NEC D).

2) Mixed sources: this refers to any combination of road, rail, air and industrial noise sources. The "mixed source" values are based on the lowest numerical values of the single source limits in the table, The "mixed source" NECs should only be used where no individual noise source is dominant. If the contribution of the individual noise sources to the overall noise level cannot be determined by measurement and/or calculation, then the overall measured level should be used and the site assessed against the NECs for "mixed sources".

4. Design Criteria

Limits for good conditions and reasonable conditions are given in Table 5 "Indoor ambient noise in spaces when they are unoccupied" of BS 8233: 1999 "Sound insulation and noise reduction for buildings".

The main criteria on this project are reasonable sleeping conditions in bedrooms and reasonable listening conditions in other rooms, i.e. 35 and 40 $L_{Aeq,T}$ respectively.

In addition to the above, for reasonable standard in bedrooms at night, individual noise events (measured in F time-weighting) should not normally exceed 45 dB L_{Amax}.

5. The Noise Survey

The noise survey was carried out between 1pm on Saturday, 14th and 7pm on Tuesday, 17th of May 2005.

Since the current occupiers of the site did not allow the noise survey to be carried out from their premises, the measurement was made from one location just beyond the site. A microphone was positioned one metre in front of the rear window of a second-floor flat in Buckingham Street, see Figure 2 and Photograph 1.

The noise monitoring location was situated approximately 50m from the railway line. The nearest façade of the proposed building is expected to be situated approximately only 10m from the railway line.

In order to be able to compare the results with the recommended Noise Exposures Categories (NECs), it is required that the measurements be corrected for a distance attenuation. For a line source such as a train the equivalent continuous noise level Leq

varies at 3 dB per doubling of distance, irrespective of the distance of a train from the monitoring location.

For the purpose of this survey the following noise monitoring instrumentation was used:

A 01dB type SIP95 sound level meter (Serial No. 010468), a half-inch microphone type MK250 (Serial No. 2943), a preamplifier type PRE 12 N (Serial No. 002213), and a type B&K 4231 calibrator (Serial No. 2084931) to check calibration levels. Both the meter and calibrator were laboratory calibrated by AVI Ltd in October 2003.

The meter was also checked for calibration, just before and after the measurements. There was a drift of -0.3 dB, however, this is within an acceptable range of +/- 0.5 dB.

It was mostly dry, cool and there were moderate breezes throughout the survey.

6. The Results

The results of the survey are presented in Tables 1 and 2, and consist of the NECs for a typical day during a weekend and a typical weekday respectively.

Since the noise boundaries of the recommended NECs are in terms of free-field levels, the measured façade levels of noise were reduced by 3 dB, (i.e. façade levels should be assumed to be 3 dB higher than levels measured away from any buildings).

Since the nearest façade of the proposed building is to be situated approx. 10m away from the railway line, the free-field levels of noise from rail traffic will be 7 dB higher than the respective levels of noise measured at the monitoring location, which was situated 50m away from the railway line.

The results are summarised below:

	Weekend		Weekday	
Time Period T (h)	16h Day	8h Night	16h Day	8h Night
Noise Level LAeq, T (dB)	**61**	**55**	**60**	**56**

Note: The recorded readings are rounded up.

All the above noise levels fall within the NEC B for road, rail and mixed sources of noise, see paragraph 3.

During the night of Sunday/Monday and Monday/Tuesday (23:00-07:00) there were only 2 and 4 trains respectively that would exceed 82 dB L_{Amax}. These trains occurred in different hour during each night. See footnote [1] in paragraph 3.

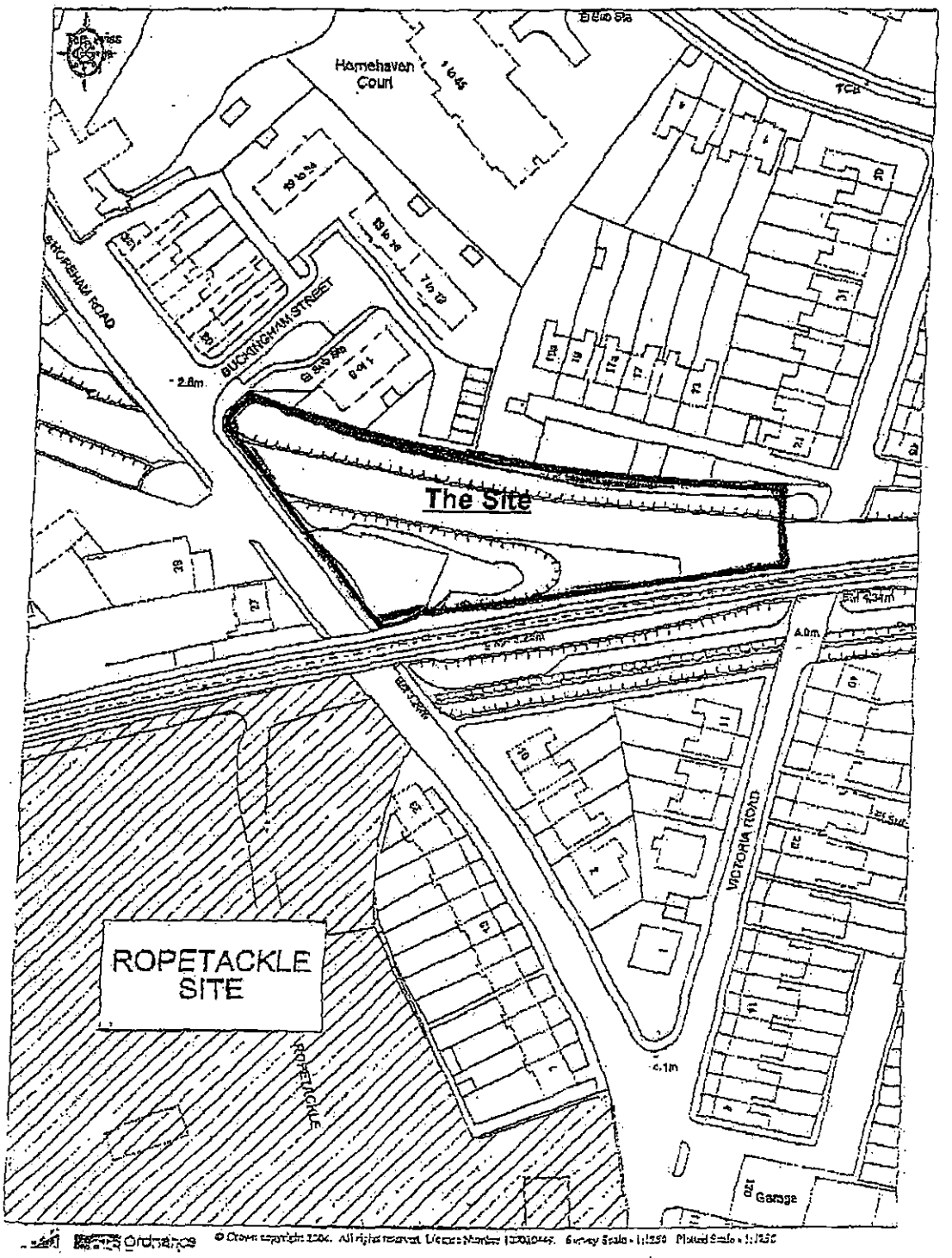
We can, therefore, conclude that the proposed site falls into the Noise Exposure Category B, which means that noise should be taken into account when determining planning applications, and where appropriate, conditions imposed to ensure an adequate level of protection against noise.

7. Recommendations

In order to meet the design criteria, we recommend the following:

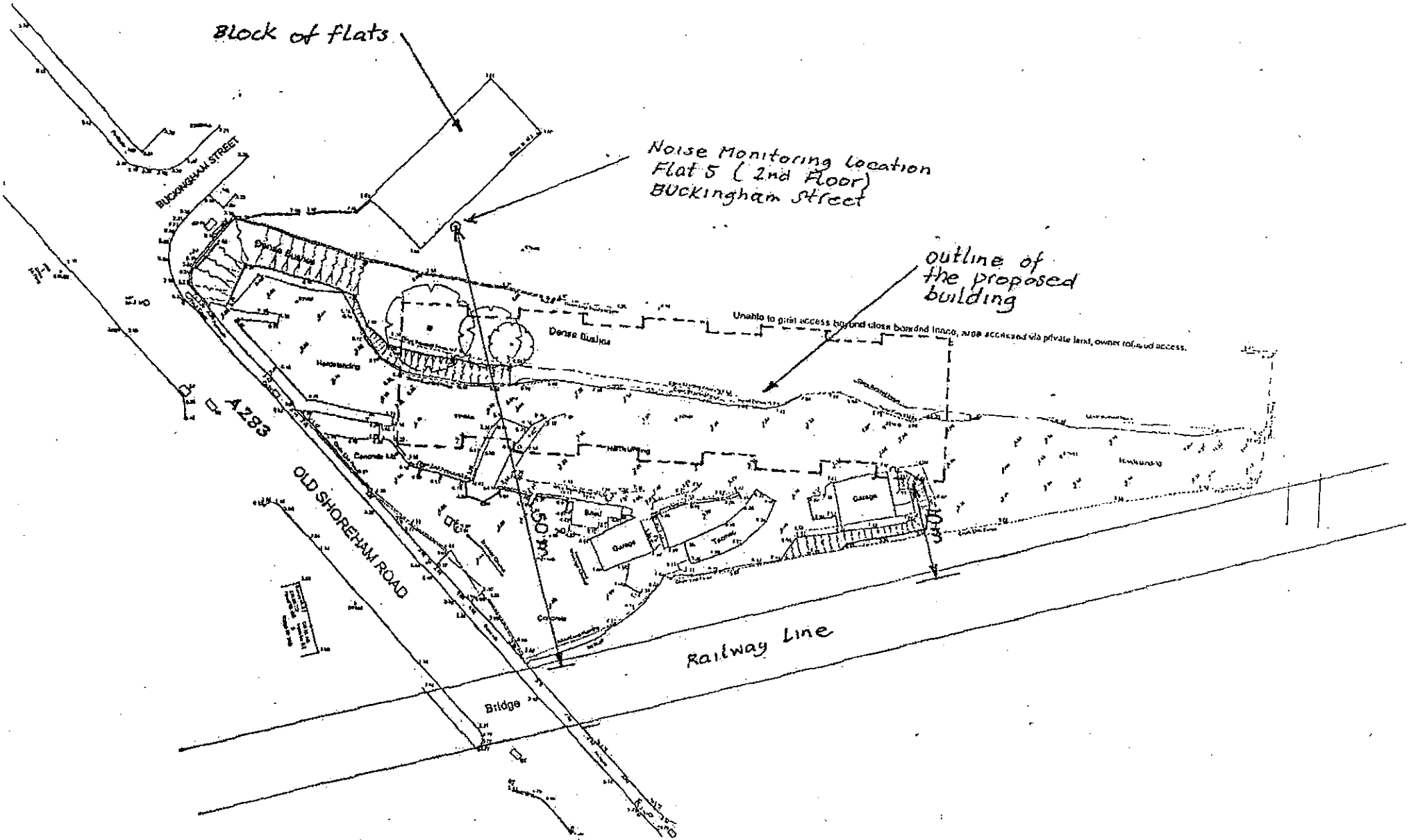
- All windows of habitable rooms should be fitted with minimum 6mm glass/12mm air cavity/6mm glass thermal insulating double glazing units. All open-able windows should have pressure seals fitted all round the frames. The sides and top of the window reveal should be lined with sound absorbent material.

- Ventilation requirements may conflict with both the thermal and the sound-insulation requirements of windows. However, we recommend that sound attenuating type natural ventilators such as Greenwood MA3051 Acoustic Wall Ventilator or similar be fitted in all habitable rooms. For details see attached Technical Sheet in Appendix A.



Location Plan of the Site
(Scale: 1 : 1250)

FIGURE 1



Plan Showing the Proposed Building and Noise Monitoring Location
(N.T.S)

FIGURE 2

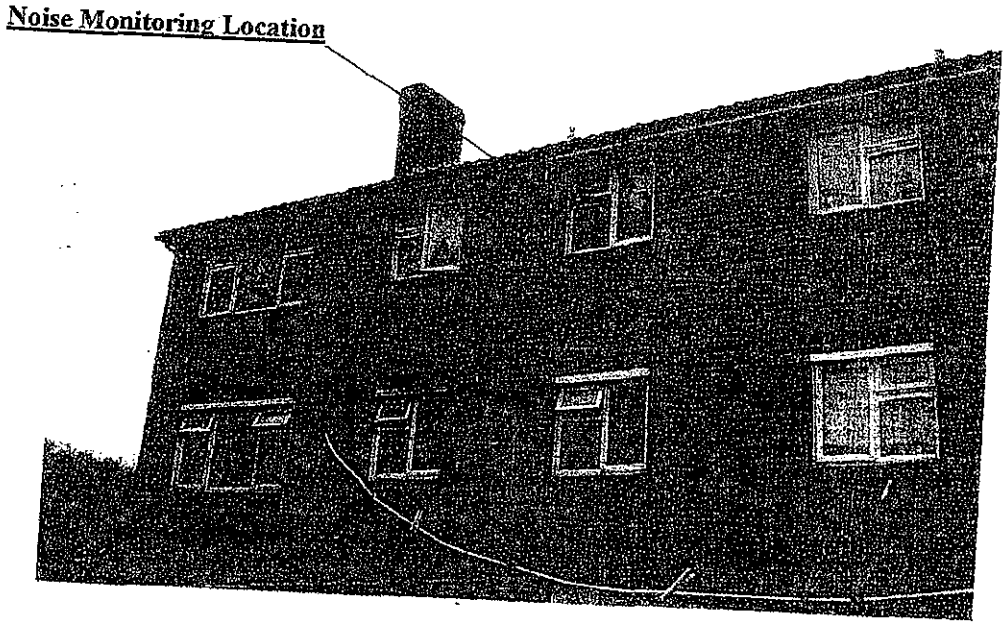


Photo Showing the Noise Monitoring Location at Block of Flats in Buckingham Street

PHOTO 1

RESULTS

Sunday/Monday, 15/16 May 2005 (weekend) measurement according to PPG24

Noise monitoring location: one metre in front of the rear window of the second-floor flat in Buckingham Street

Time Period	**Daytime**	
Start	15/05/2005 07:00	
End	15/05/2005 23:00	
Periods	1h	
Weighting	A	
Data type	Leq	Max
Unit	dB	dB
Period start	**Leq**	**Lmax**
15/05/2005 07:00	52.3	69.3
15/05/2005 08:00	53.9	69.4
15/05/2005 09:00	56.4	76.5
15/05/2005 10:00	57.3	78.5
15/05/2005 11:00	58.6	78.6
15/05/2005 12:00	58.3	74.6
15/05/2005 13:00	60.4	91.1
15/05/2005 14:00	58.2	78.8
15/05/2005 15:00	57.7	81.1
15/05/2005 16:00	58.3	74.6
15/05/2005 17:00	57.1	76.2
15/05/2005 18:00	56.9	74.5
15/05/2005 19:00	55.6	76.5
15/05/2005 20:00	54.2	74.7
15/05/2005 21:00	53.5	77.1
15/05/2005 22:00	52	73.9
LAeq, 16h façade	**56.9**	
LAeq, 16h free-field	**53.9**	

Time Period	**Night-time**	
Start	15/05/2005 23:00	
End	16/05/2005 07:00	
Periods	1h	
Weighting	A	
Data type	Leq	Max
Unit	dB	dB
Period start	**Leq**	**Lmax**
15/05/2005 23:00	51.6	72.7
16/05/2005 00:00	44.3	65.5
16/05/2005 01:00	38.1	60.5
16/05/2005 02:00	38.4	61.5
16/05/2005 03:00	39	63.9
16/05/2005 04:00	52.5	68.6
16/05/2005 05:00	54.7	77.5
16/05/2005 06:00	56	77.9
LAeq, 8h façade	**51.2**	
LAeq, 8h free-field	**48.2**	

At a distance of 10m away from the railway line, the levels of noise can be expected to be 7 dB higher, i.e.

LAeq, 16h free-field **60.9**

LAeq, 8h free-field **55.2**

Table 1

RESULTS
Monday/Tuesday, 16/17 May 2005 (weekday) measurement according to PPG24

Noise monitoring location: one metre in front of the rear window of the second-floor flat in Buckingham Street

Time Period	**Daytime**	
Start	16/05/2005 07:00	
End	16/05/2005 23:00	
Periods	1h	
Weighting	A	
Data type	Leq	Max
Unit	dB	dB
Period start	**Leq**	**Lmax**
16/05/2005 07:00	59.8	80.4
16/05/2005 08:00	56.6	70.6
16/05/2005 09:00	56.3	72.5
16/05/2005 10:00	56.7	72
16/05/2005 11:00	56.7	75.7
16/05/2005 12:00	56.1	69.2
16/05/2005 13:00	56.4	81.7
16/05/2005 14:00	55.1	69.5
16/05/2005 15:00	55.4	69.4
16/05/2005 16:00	55.3	69.5
16/05/2005 17:00	55.6	72.5
16/05/2005 18:00	55.8	74
16/05/2005 19:00	56.5	74.6
16/05/2005 20:00	53.5	72.4
16/05/2005 21:00	52.8	73.4
16/05/2005 22:00	50.8	72.5
LAeq, 16h façade	**56**	
LAeq, 16h free-field	**53.9**	

Time Period	**Night-time**	
Start	16/05/2005 23:00	
End	17/05/2005 07:00	
Periods	1h	
Weighting	A	
Data type	Leq	Max
Unit	dB	dB
Period start	**Leq**	**Lmax**
16/05/2005 23:00	52.9	78.8
17/05/2005 00:00	50.1	78.7
17/05/2005 01:00	44.9	72.2
17/05/2005 02:00	40.9	63.6
17/05/2005 03:00	38.6	59.3
17/05/2005 04:00	52.5	69.8
17/05/2005 05:00	54.2	78
17/05/2005 06:00	55.8	77.3
LAeq, 8h façade	**51.6**	
LAeq, 8h free-field	**48.2**	

At a distance of 10m away from the railway line, the levels of noise can be expected to be 7 dB higher, i.e.

LAeq, 16h free-field **60.9**

LAeq, 8h free-field **55.5**

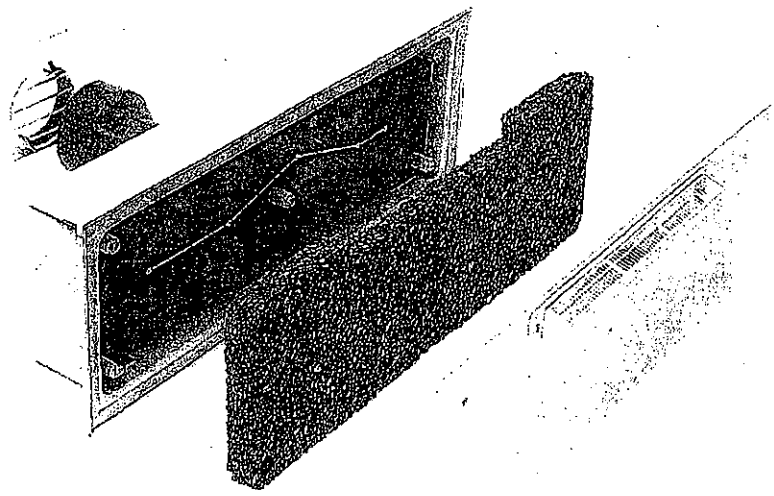
Table 2

APPENDIX A

APPENDIX A
APPENDIX A
APPENDIX A

MA3051 Acoustic Wall Ventilator

GREENWOOD AIRVAC
Environmental



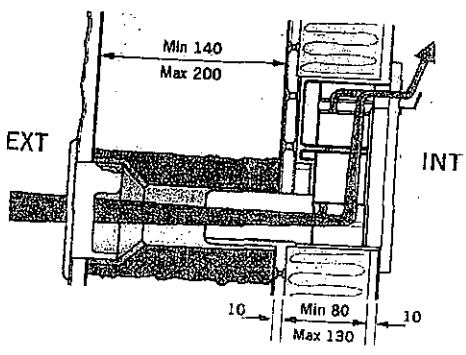
- *Acoustic self-regulating background ventilator*
- *Tested and conforms to Noise Insulation Regulations 1975*
- *Suitable for external walls of thickness 140mm and above*
- *Internal wall constructions of between 100mm and 150mm*
- *Meets the requirements of Building Regulation England & Wales Part F & E*

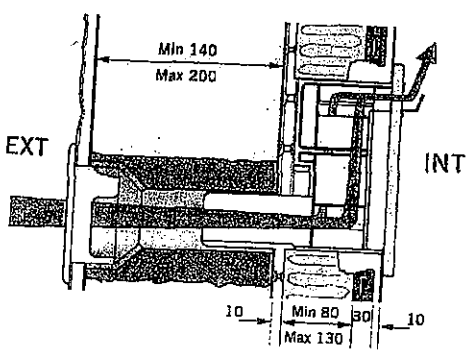
Greenwood's MA3051 acoustic wall ventilator provides 30m³/hr air flow and offers excellent acoustic attenuation, for areas where noise is a problem, providing fresh air into buildings situated near to industrial sites, busy road and airports.

The ventilator is fixed into the wall internally and vented through the external leaf of the building via a plastic sleeve. A clip-fit grille provides external weather protection and noise transfer is reduced via a convoluted air path through sound absorbing material in the acoustic box. Air entering the dwelling is controlled via a self-regulating mechanism supplied with the unit.

Easy to install and aesthetically pleasing, the MA3051 is supplied as a complete unit and available with a white or brown external grille, other colours available on request.

Typical Installation





MA3051 Acoustic Wall Ventilator | technical data sheet

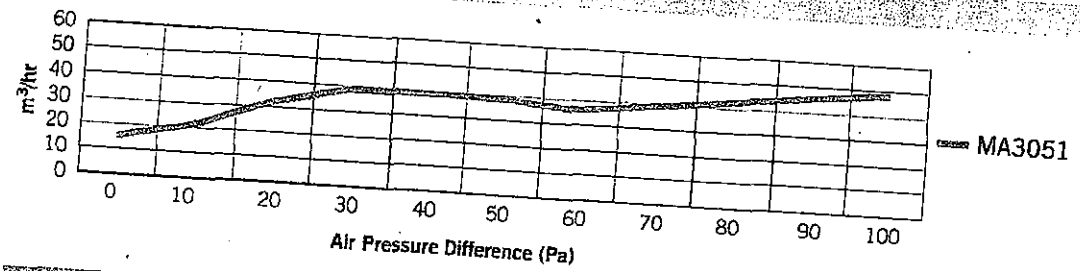
an Etex GROUP company

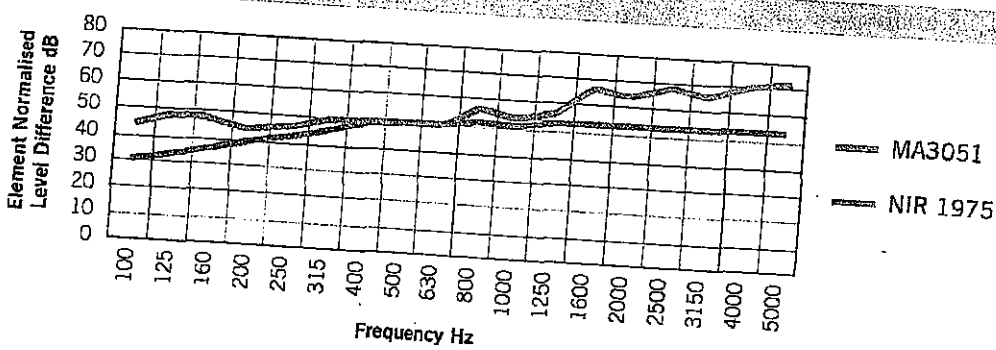
Greenwood Air Management Ltd Brookside Industrial Estate, Rustington, West Sussex BN16 3LH.
Tel: (01903) 771021 Fax: (01903) 782398 Web: www.greenwood.co.uk Email: info@greenwood.co.uk

MA3051 Acoustic Wall Ventilator

GREENWOOD AIRVAC
Environmental

Test Information





Model and Physical Specification

A: External weather grille, available in white and brown

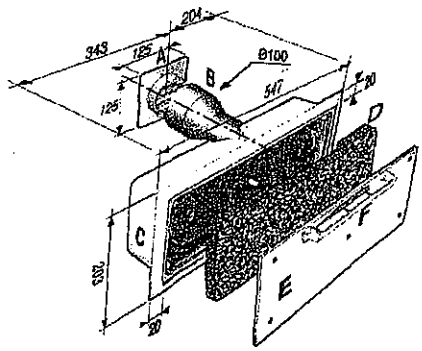
B: External connection sleeve

C: Acoustic box

D: Sound absorbing material

E: Internal facade

F: Self-regulating ventilator



MA3051	30m³/hr	See above	White, Brown

For further information, please contact Greenwood Customer Services on:

01903 777130

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Greenwood Air Management Ltd Brookside Industrial Estate, Rustington, West Sussex BN16 3LH.

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L3040

Addendum to Report No. R2419-1

Issued on 18th January 2006

Addendum

An Assessment of the Impact of Noise on the Proposed New Care Home Development at Shoreham-by-the-Sea

***

For a Planning Application

For:
Abbey Care Investments Limited
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P O Box 36
37 Broad Street
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1. Introduction

Noise & Vibration Engineering Ltd (NVE) has prepared Report No. R2419-1, issued on 24th May 2005, entitled "An Assessment of the Impact of Noise on the Proposed New Care Home Development at Shoreham-by-the-Sea" for a planning application.

Adur District Council's Environmental Health Officer stated that "there is sufficient uncertainty in the measurements and calculations to require the applicants to carry out a further assessment on the site itself in order to remove any arguments".

At the request of DWA Architects NVE has, therefore, carried out an additional sound survey on the site.

This addendum briefly describes the survey, presents the results and evaluates them against the original noise measurements.

2. The Additional Noise Survey

The additional noise survey was carried out on Thursday, 12th of January 2006 between the hours of 1100 and 1400.

The new assessment location was chosen to reflect the nearest bedroom window and the direct line of site with the railway line. The actual monitoring position was approx. 5m to the east from the proposed window because there is a garage building in its place and the land is sloping down towards Old Shoreham Road, see Figure 1a and Photo 1a. A microphone was positioned approx. 1.6m above ground level, (i.e. approx. 1.2m above the railway tracks), and approx. 12m away from the centre line of the tracks, see Figure 2a.

For the purpose of this additional survey the same noise monitoring instrumentation was used as before, i.e. A 01dB type SIP95 sound level meter (Serial No. 010468), a half-inch microphone type MK250 (Serial No. 2943), a preamplifier type PRE 12 N (Serial No. 002213), and a type B&K 4231 calibrator (Serial No. 2084931) to check calibration levels.

The meter was also checked for calibration, just before and after the additional measurements. There was a drift of -0.3 dB, however, this is within an acceptable range of +/- 0.5 dB.

Throughout the measurements it was overcast, dry, cool and there were light westerly breezes.

3. The Results

The results of the survey are presented in tables 1a and 2a. Table 1a gives noise level measurements of all individual train pass-by's in terms of $L_{Aeq,T}$ and the L_{Amax} in dB. There were on average 15 trains an hour, i.e. a train every four minutes.

Table 2a gives hourly noise level measurements in terms of $L_{Aeq,1\text{-}h}$ and the L_{Amax} and also an overall three-hourly noise level measurement. All the above measurements are free-field.

The overall three-hourly reading was found to be at 59.7 dB, $L_{Aeq,3\text{-}h}$. From the original measurements, it can be expected that the actual $L_{Aeq,16\text{-}h}$ would be in the order of 58 dB. This implies that the predicted $L_{Aeq,16\text{-}h}$ measurement of 60.9 dB was, in fact, just overestimated.

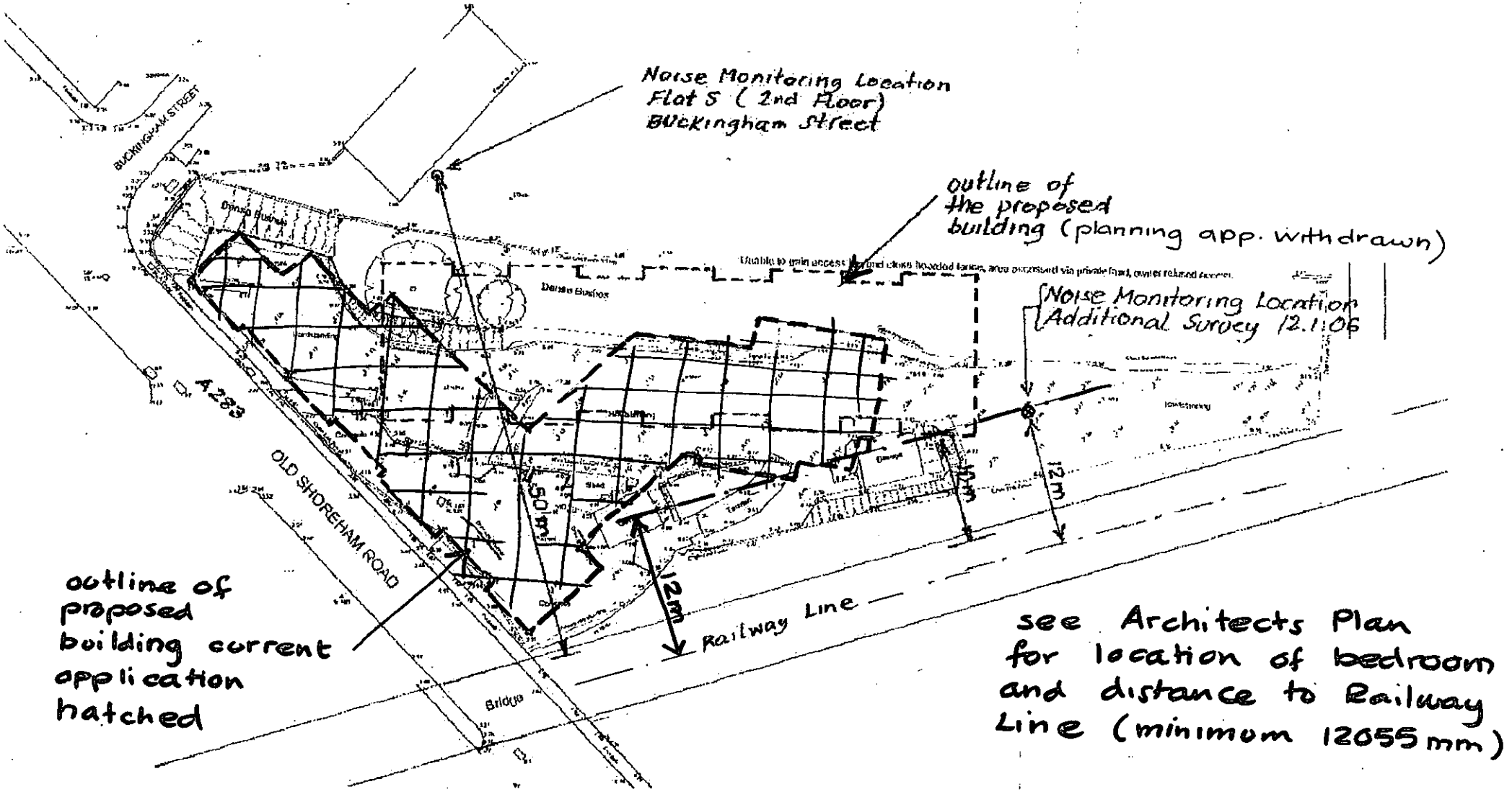
In spite of the fact that the actual predicted noise level is approx. 3 dB lower that initially estimated, the site still falls into Noise Exposure Category B.

4. Recommendations

In order to meet the design criteria, as before, we recommend the following:

- All windows of habitable rooms should be fitted with minimum 6mm glass/12mm air cavity/6mm glass thermal insulating double glazing units. All open-able windows should have pressure seals fitted all round the frames.

- Ventilation requirements may conflict with both the thermal and the sound-insulation requirements of windows. However, we recommend that sound attenuating type natural ventilators such as Greenwood MA3051 Acoustic Wall Ventilator or similar be fitted in all habitable rooms. For details see attached Technical Sheet in Appendix A.



PLAN SHOWING THE PROPOSED BUILDING AND NOISE MONITORING LOCATION
(N.T.S.)

FIGURE 2a

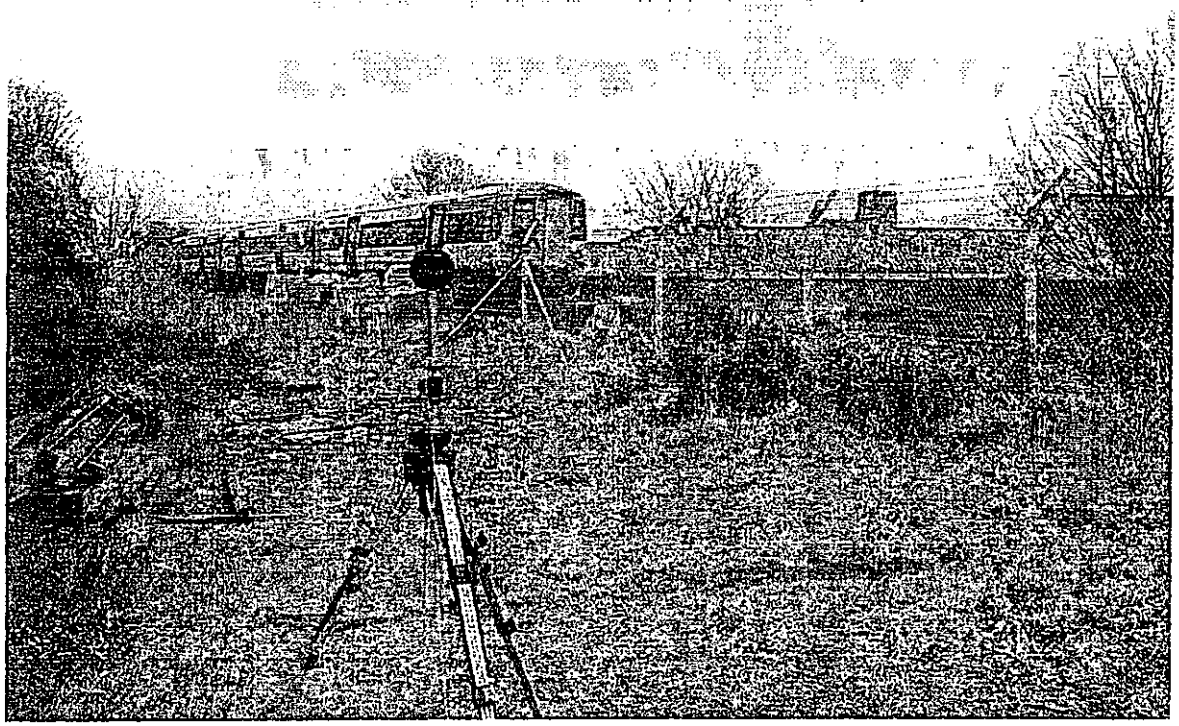
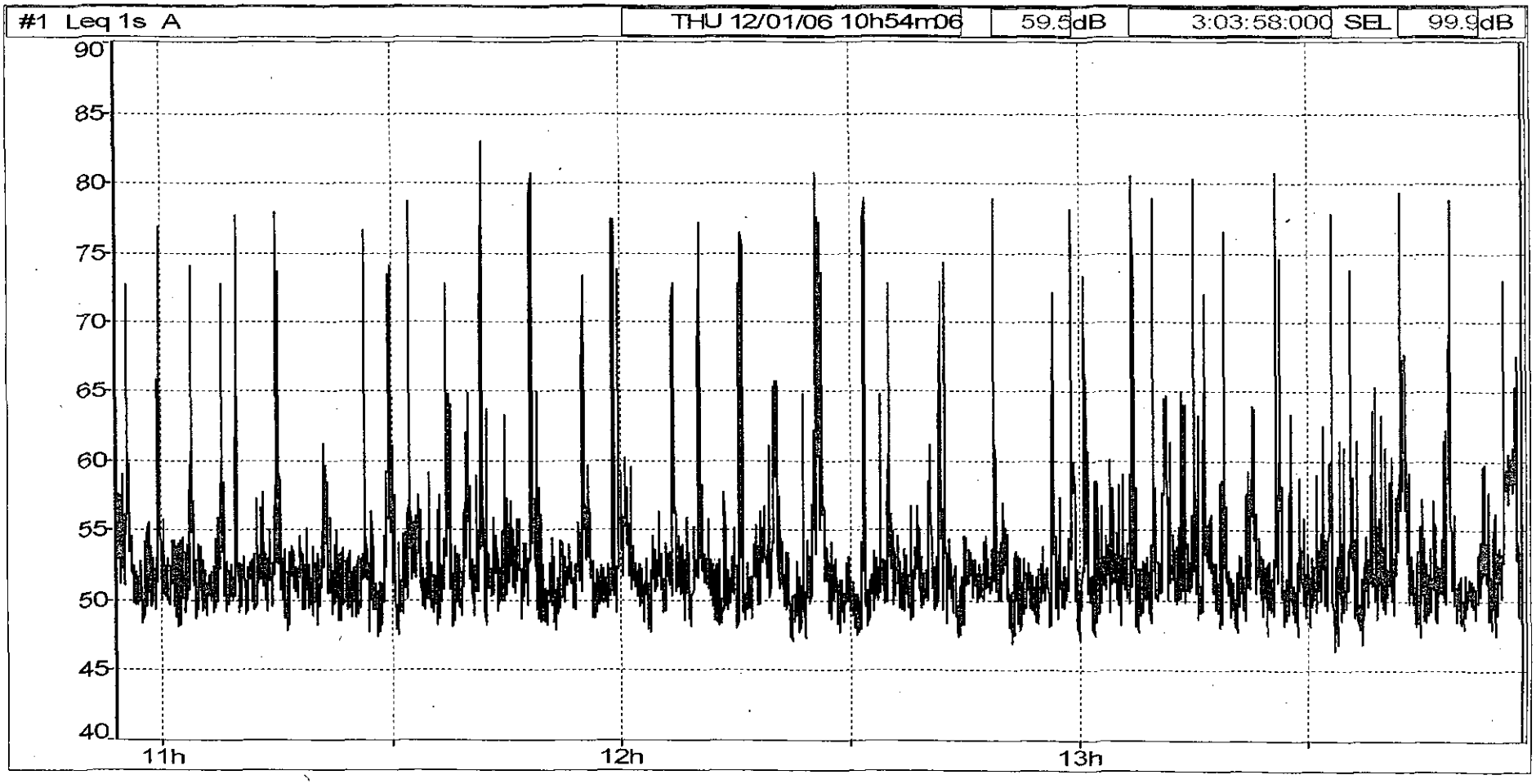


Photo 1a – Noise Monitoring Location, Survey of 12th January 2006

RESULTS



Noise Time History

Chart 1a

No.	Time (hh:mm)	Train Operator	No. of Cars	Direction	Pass-by Time (s)	$LAeq_{,T}$ (dB)	LAmax (dB)	Comments
1	10:55	S	3	W	7	69.1	73.4	
2	11:00	S/W	4	E	7	74.3	77.5	
3	11:04	S	4	W	8	70.9	75.2	
4	11:08	S/W	4	W	8	70.7	74.1	
5	11:10	S	4	E	10	73.8	79.3	
6	11:15	S	3	E	7	74.2	78.7	
7	11:16	S	3	W	6	70.6	74.4	
8	11:27	S	3	E	8	72.8	77.5	
9	11:30	S	4	W	7	72.3	74.6	
10	11:33	S	3	E	7	75	79.6	
11	11:38	S	3	W	6	69.5	73.4	
12	*11:43*	*S*	*4*	*E*	*12*	*77.1*	*83.5*	Passed simultaneously
13	*11:43*	*S*	*3*	*W*	*12*	*77.1*	*83.5*	
14	11:48	S	4	E	8	76.3	81.3	
15	11:55	S	3	W	7	70.3	73.8	
16	11:59	S/W	4	E	9	71.9	77.9	
17	12:00	S	4	W	12	69.1	74.5	
18	12:07	S/W	4	W	8	70.1	74.5	
19	12:10	S	4	E	8	74.1	77.6	
20	12:16	S	4	W	8	69	73.9	
21	12:16	S	3	E	8	72.6	76.9	
22	12:26	S	3	E	7	76.3	82.1	
23	12:26	S	4	W	8	70.5	74.4	
24	12:32	S	3	E	7	74.8	80.2	
25	12:35	S	3	W	8	68.8	73.5	
26	12:42	S	4	W	11	68.8	73.5	
27	12:43	S	4	E	10	71.6	74.9	
28	12:49	S	3	E	8	74.5	79.6	
29	12:57	S	3	W	6	69.3	73.1	
30	12:59	S/W	4	E	7	75.5	78.8	
31	13:01	S	8	W	11	71.3	74.1	

No.	Time (hh:mm)	Train Operator	No. of Cars	Direction	Pass-by Time (s)	$LAeq_{,T}$ (dB)	LAmax (dB)	Comments
32	13:07	S/W	2	W	7	75.3	81.5	
33	13:10	S	4	E	7	76.1	79.4	
34	13:15	S	3	E	8	75.5	80.9	
35	13:16	S	3	W	7	69.4	73	
36	13:17	M	2	W	6	72.7	77.2	
37	13:26	S	3	E	7	75.6	82.4	
38	13:26	S	4	W	8	71.3	75.1	
39	13:34	S	3	E	7	74.1	78.8	
40	13:36	S	4	W	6	70.6	74.3	
41	*13:42*	*S*	*4*	*W*	*11*	*74.9*	*79.8*	Passed
42	*13:42*	*S*	*4*	*E*	*11*	*74.9*	*79.8*	simultaneously
43	13:48	S	3	E	7	75.6	79.3	
44	13:56	S	3	E	6	70.2	73.7	

Legend:

S	Southern Trains
S/W	South West Trains
M	Maintenance Train

Table 1a

RESULTS
Additional measurments in terms of hourly readings

File	Care Home 12.01.06.CMG
Periods	1h
Start	12/01/06 11:00:00:000
End	12/01/06 14:00:00:000
Location	12m away from the nearest track (Free-field)
Weighting	A
Data type	Leq
Unit	dB

Period start	Leq	Lmax
12/01/06 11:00:00:00	59.6	83.5
12/01/06 12:00:00:00	59.1	82.1
12/01/06 13:00:00:00	60.4	82.4
Overall	59.7	83.5

Table 2a

Appendix 4 Ground Investigation and Contamination Survey

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APPENDICES

A	Borehole and Trial Pit Records
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OLD SHOREHAM ROAD
SHOREHAM BY SEA
SUSSEX

Geoenvironmental investigation

Synopsis

A ground investigation has been carried out at a site fronting Old Shoreham Road on the instructions of DWA Architects Limited, professional advisors to Abbeycare Investments Limited.

A Phase 1 Risk Assessment [1] has previously been conducted which concluded there is a medium to high risk of potential contamination beneath the site as a results of commercial use of the site and its surroundings.

The purpose of this investigation was therefore twofold: firstly to determine the ground conditions and to provide recommendations in respect of foundation design and other geotechnical matters for the proposed residential care home, and secondly to confirm the significance of any contamination found in the soil or groundwater.

This report describes the work carried out for the intrusive phase of investigation and presents our recommendations. Four boreholes and five trial pits were carried out, supported by a programme of in situ and laboratory testing. The results indicate that piled foundations will be acceptable and appropriate design data is provided. Laboratory testing did not reveal the presence of significant contamination in either soil or groundwater.

1

Site description

Reference should be made to the Phase 1 Risk Assessment which contains a detailed description of the site and its surroundings. In essence, the site comprises a triangular plot of land, the bulk of which is the embankment which once carried the railway line over the Old Shoreham Road. The southern boundary of the site is formed by the embankment carrying the present live rail lines and there is a small area at road level sandwiched between the two.

The general layout of the site is shown at Figure 1 of Appendix D herein.

2

Development proposals

Figure 2 of Appendix D illustrates the proposals for the new care home.

No details of the proposed loadings were available during preparation of this report. However, it is understood that car parking will be provided at ground level (3.1 m OD) with two floors of accommodation above. Structural loads are thus expected to be moderate.

The proposed layout and ground level for the car park implies that the old rail embankment will be removed to provide a sensibly flat and level site.

3

Geology

Published records of the British Geological Survey indicate the site to lie on Superficial deposits of Head which is underlain by the solid geology of undivided Upper and Middle Chalk. Marine and Estuarine Alluvium is mapped immediately west of the site.

The rail embankments consist of fill material of unknown origin.

4

Field work

The extent of the field work was agreed with the Architect and comprised four boreholes drilled by light percussive rig, two each to 18 and 21 m depth, supplemented by five trial pits excavated by conventional wheeled backhoe machine to 3.1 - 4.0 m depth. The locations of these exploratory positions are shown on Figure 1 of Appendix D.

Representative samples were recovered for subsequent laboratory examination and testing; whilst Standard Penetration Tests (SPT) were carried out as appropriate. Details of the strata encountered are provided on the Borehole and Trial Pit Records at Appendix A; together with particulars of the samples recovered, groundwater observations and SPT results. The SPT data is also shown graphically at Figure 3 of Appendix D.

Standpipes were installed in BHs 1, 3 & 4 to permit monitoring of the groundwater and ground gas régimes. These have been read on three occasions and the results are presented at Appendix B.

The Risk Assessment highlighted the potential for contamination and NRA clean drilling techniques were therefore adopted. In essence, the boreholes were drilled at 200 mm diameter through the fill and a bentonite seal placed just above the interface with the natural ground. Drilling then continued at 150 mm diameter. The drill string was cleaned with high pressure washer between boreholes. Except where standpipes were installed, all boreholes were backfilled with bentonite.

Ground levels quoted in this report have been interpolated from spot levels given on the topographical survey drawing[2]. However, relative levels for the top of the three standpipes have been established by specific survey. It is assumed these use Ordnance Datum.

5

Laboratory testing

The following laboratory tests were conducted on samples recovered during the field work:-

Geotechnical

- Particle size distribution: by sieve analysis to classify granular soils and extended by sedimentation techniques for fine particles.
- California Bearing Ratio: for the structural design of paved areas.
- Dry density and saturation moisture content: to classify chalk into behavioural groups.
- Soluble sulphate concentration and pH value: for the specification of buried concrete.

Environmental

Potential contaminants indicated by the Phase 1 Risk Assessment:-

- Metals and semi - metals: arsenic, cadmium, chromium, lead, mercury, copper, nickel, zinc, barium, beryllium and vanadium.

- Free cyanide.
- Total petroleum hydrocarbons.
- pH
- Total sulphate
- Asbestos
- Polyaromatic hydrocarbons

Results of these tests are presented at Appendix C.

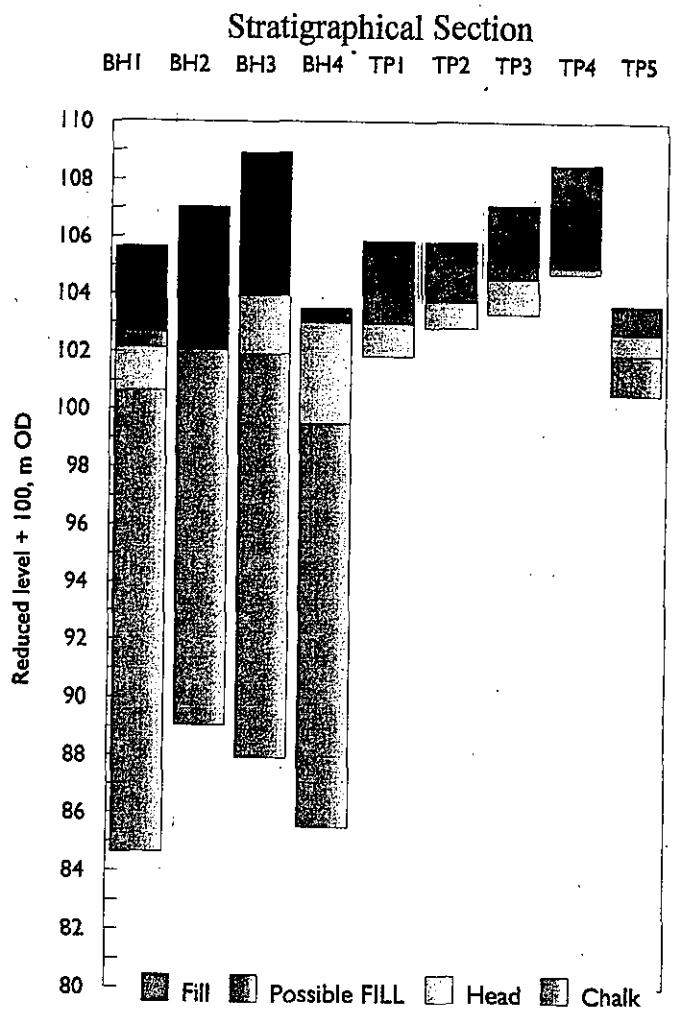
6

Ground conditions

6.1

Stratigraphy

The stratigraphy revealed by the investigation is given in detail at Appendix A. It is illustrated in general terms in the section at right and described hereafter.



6.1.1

Fill material

Boreholes 1 - 3 and trial pits 1 - 4 were all located on the old rail embankment and encountered between 2 and 4½ m of chalk fill.

The samples produced by light percussive drilling only permit basic descriptions since the fabric is destroyed by the action of drilling. However, the trial pit excavations provided good exposures and showed the fill to be a structureless mélange of gravel and cobble, occasionally boulder, size fragments of intact chalk in a sand and silt matrix.

The base of the chalk fill rose from about 3.6 m OD in BH 1 and TP 1 at the western end of the site to almost 5 m OD in TP 4 at the eastern end.

Other horizons of fill were observed beneath the chalk in BHs 1 - 3 and TP 1. The brick and chalk mixture in BH 1 and the ash, clay, chalk and gravel in BH 2 were obviously fill. However, BHs 2 & 3 and TP 1 encountered material similar to the Head deposits described below but containing rare small brick fragments. This is therefore thought to be reworked material of local origin.

Borehole 4 and TP 5 were excavated in the paved yard at road level. Borehole 4 proved 300 mm of concrete on a 200 mm thick brick and clay sub - base. In contrast, TP 5 only encountered 100 mm of concrete, followed by 900 mm of clay with sand lenses, brick and chalk fragments.

6.1.2
Head

Typically for superficial deposits such as Head, the investigation found considerable differences in both thickness and composition of this stratum across the site. Gravelly and cobbley clays were found in BHs 1 & 3 and TPs 3 & 4 and cobbles in TP 1. Elsewhere, the Head was predominantly clay/silt mixtures or fine sands although subordinate gravels were also present at times.

6.1.3
Chalk

Chalk was found in all boreholes and in TP 5 at between 2.03 and -0.53 m OD and continued to the base of investigation at -15.4 m OD.

As previously stated, little direct indication of the character of chalk can be obtained from the borehole samples. Nevertheless, the SPT results give a good indication of its condition. Figure 3 shows a wide variation in the penetration resistance to about -11 m OD to indicate differences in the degree of weathering. Fairly constant resistance was measured below -11 m OD with N values in the range 40 - 50.

The natural chalk was revealed in the base of TP 5 and excavated to a depth of 1.4 m. This showed the upper horizons of this stratum to consist of comminuted chalk in sand and silt size particles with cobble size fragments of intact chalk, indicating a high degree of weathering. As noted on the Trial Pit Record, the chalk surface varied by 1 m depth between the two ends of the pit.

6.2
Groundwater

Slow to moderate inflows of groundwater were encountered during drilling between about zero and -2 m OD, rising 300 to 600 mm during the subsequent observational pause. Deeper and much faster inflows were observed between about -3.5 and -6.9 m OD, rising to between zero and about -1.5 m OD.

Full details of all groundwater observations are given on the Borehole Records at Appendix A.

All trial pits remained dry during excavation.

Standpipe readings are given at Appendix B and show groundwater at about 1 m OD. Comparison of the depth to groundwater with accurate levelling of the top of the standpipes suggests groundwater flow during the monitoring period has been to the south or south south east.

7
Discussion

7.1
General

It is understood that car parking for the new care home will be provided at 3.1 m OD, approximating to the level of the public footway to Old Shoreham Road. The bulk of the old railway embankment will thus be removed but some fill and the underlying Head will remain. The Phase 1 investigation has shown the site to have previously carried development and other deposits of fill material should therefore be expected; perhaps deeper, of different character or associated with underground construction; which have not been revealed by the investigation.

Fill material does not represent a reliable bearing stratum since it is inherently variable in both composition and compaction and is therefore prone to large and unpredictable settlement. Similarly, the Head is variable in thickness and composition and will also be

unreliable as a bearing stratum. Structural loads for the development should therefore be carried into the natural chalk. This was found between about 2 and -0.5 m OD whilst groundwater lies at about 1 m OD. Piled foundations are therefore recommended as discussed in the following section.

7.2
Foundations

Either driven or bored piles could be used but consideration of the various advantages and disadvantages of the different pile types suggests CFA piles to be preferred. They avoid many of the installation difficulties that would be otherwise be experienced; particularly the need for casing to support the bore and to control vigorous groundwater inflows. Driven piling should be avoided as it generates greater ground - borne vibrations which could jeopardise the stability of the existing live rail embankment and bridge, or any other nearby structures.

Parameters for the preliminary design of CFA piles are provided in Tables 1 & 2.

Table 1: Preliminary design parameters for CFA piles - Shaft friction

Stratum	Level, m OD	Ultimate unit shaft friction
All material	g.l. to -0.5	Ignore
Chalk	-0.5 to -3.5	Increases linearly from 25 to 40 kPa
	-3.5 to -10.0	Increases linearly from 40 to 120 kPa
	-10.0 to -15.0	Constant at 120 kPa

Table 2: Preliminary design parameters for CFA piles - End bearing capacity

Stratum	Level, m OD	Ultimate unit end bearing capacity
Chalk	-9.0 to -12.0 -12.0 to -15.0	Increases linearly from 2000 to 4500 kPa Constant at 4500 kPa

Table 1 has been derived in accordance with guidance provided by the Federation of Piling Specialists[3]. In the absence of successful load tests, this recommends shaft friction be derived by the method proposed in CIRIA Report PG6[4] for SPT N values less than 10. Above this value, the recommendations of CIRIA PR11[5] and PR86[6] should be followed which suggest an adhesion factor of 0.8. However, this yields a marked step in the design line at -3.5 m OD which has been smoothed by adopting a gradual increase in adhesion factor between -3.5 and -10.0 m OD.

It is assumed that no significant shaft friction will be developed in the fill material or the Head.

Factors of safety must be applied to derive the allowable working load from the ultimate values calculated from the table. A value of 2.5 is commonly adopted for both shaft friction and end bearing resistance.

Tables 1 & 2 predict that a 450 mm diameter CFA pile installed to -9.0 m OD will have an allowable load capacity of approximately 415 kN, rising to some 770 kN at -12.0 m OD.

Evidently it would be possible to utilise other pile types and different geometries. Further advice could be given on the load capacity for any other configuration which may be under consideration.

The actual load capacity achieved in practice depends upon the precise installation procedures. Advice should therefore be sought from specialist contractors to verify the load capacity and settlement characteristics of their particular piles in the ground conditions revealed by this investigation. In any event, and especially in respect of the current state of knowledge surrounding the shaft friction in chalk, it is recommended that the chosen pile configuration be confirmed by load tests conducted at an early stage in the development, preferably before installation of the contract piles.

7.3
Excavations

All fill should be regarded as inherently unstable whilst the Head rarely contained sufficient cohesive material to provide a reliable measure of stability. All excavations in these materials should therefore be supported at all times. Any apparent stability that may be present immediately on excavation should not be relied upon. In any event, excavations over 1.2 m depth should be supported at all times for the safety of personnel working within or nearby. Alternatively, excavations could be battered to a safe angle of repose.

The natural chalk may be able to maintain vertical excavated of moderate height although some spalling may be expected from the face. Stability will be reduced where weathered to a structureless mélange. However, the investigation showed that it would not be encountered at less than 1.2 m below the finished ground level over much of the site and would thus require support regardless.

It should be ensured that excavations do not jeopardise the stability of the live rail embankment, the overbridge or any other nearby structure. Temporary and permanent works

should therefore be designed to resist the lateral earth pressures generated by superimposed loadings in addition to those from the soil itself without significant deformation.

Observations during the investigation suggest that groundwater lies at about 1 m OD. However, it is likely to be affected by both river and sea levels in addition to normal climatic variations and high groundwater levels may be experienced during construction. In addition, a perched water table may be established in the fill or Head where underlain by less permeable soils which may give rise to high level inflows.

Excavations that are required to penetrate the water table will require appropriate control measures. Trench sheets would serve the dual purpose of supporting the excavation and hindering groundwater flow by extending the seepage path, although no acquiclude is present. The reduced flow into excavations could perhaps be controlled by conventional pumping from a shallow sump. In granular soils, care should be taken to ensure the rate of pumping was not so great that fines are removed or that boiling occurs in the base of the excavation, leading to major settlement of the surrounding ground. No attempt should be made to lower the general groundwater of the area. This is unlikely to be successful and the increase the effective stress in the soil could cause settlement and distress to surrounding structures.

7.4
Pavement construction

The proposed car park level of 3.1 m OD implies a construction level of about 2½ m OD. The investigation has revealed a wide variety of soils at this level such as fill, reworked clay Head, cobbles, silt or gravelly clay. A highly variable sub - grade should therefore be expected. Many of these materials would be regarded as unsuitable and should therefore be replaced

with suitable imported fill. However, this may prove impractical and the sub - grade should then be carefully inspected on exposure. Locally unsuitable material should be replaced. Proof rolling would give a more uniform surface for construction but will not improve the properties at depth.

California Bearing Ratios were determined on two samples of silt Head, recompacted at the "as received" moisture content. CBR values of 1.0 to 2.4 % were obtained at 15 % moisture content. Silts are extremely susceptible to loss of strength on increase in moisture content. It is known that drainage conditions often deteriorate beneath the finished pavement as the years go by, resulting in an increase in the sub - grade moisture content. The CBR of silt and fine sand may therefore fall dramatically in service, perhaps to a value of about ½ % in service.

Consideration should therefore be given to the use of a capping layer or geotextile reinforcement unless some post - construction deformation can be accepted. It is recommended that flexible pavement construction be adopted, such a wholly bituminous material or block paviors as these are more accommodating to small deformations and can be more readily realigned should movement become unacceptable.

7.5
Contaminant analysis

7.5.1
Solid Phase

Testing was undertaken on nine soil samples for a comprehensive suite of potential contaminants suggested by the Risk Assessment. The results are presented at Appendix C and

have been compared with Soil Guideline Values published by CLEA[7]. Where not yet available, reference has been made to other established guidelines and to generally accepted precedence. Soil Guideline Values for residential use with plant uptake (the most stringent) are appended to the data sheets and it is seen that only one sample, for lead, exceeded the thresholds, and then by only 10 mg/kg (460 mg/kg *cf.* 450 mg/kg). However, this material lies within or immediately below the old rail embankment between 2.9 and 3.5 m OD and is likely to be removed during construction.

All other tests on soil samples confirmed concentrations to be either below the limit of detection for the test or well within allowable levels.

No asbestos has been identified.

Notwithstanding the results, some determinands were present at detectable concentrations and appropriate health and safety precautions, such as detailed in HS(G)66[8] and elsewhere, must be followed by the construction workforce and others who may come into contact with the soil. These should be agreed with the Health and Safety Executive and are likely to include, but not be restricted to, the following:-

- maintain good standards of personal hygiene.
- wear personal protective clothing that is changed and cleaned frequently to eliminate skin contact.
- prevent ingestion by using washing and changing facilities at all break times.
- not eating, drinking or smoking between break times.
- control the spread of dust and airborne mists to prevent inhalation.

All material removed from site should be transported to a suitable licenced tip. A series of Waste Acceptance Criteria tests should be conducted to classify the spoil accordingly.

7.5.2
Liquid phase

Purged groundwater samples were obtained from the standpipe in BH 4 and subjected to a comparable suite of tests to the soil samples.

No UK standard exists for groundwater quality and the results have been compared with accepted precedent. None of the results are considered to prejudice the development proposals, most again being below the limit of detection.

7.5.3
Gas phase

The three standpipes installed at the site have been monitored for flow rate and concentrations of oxygen, methane and carbon dioxide on three occasions. The results are presented at Appendix B.

They show no detectable methane and only small concentrations of carbon dioxide, reaching a maximum of 0.8 % in BH 1 in association with slightly depressed oxygen. Otherwise, oxygen levels were close to the free air condition. Slightly elevated carbon dioxide concentrations are not unusual at chalk sites.

For comparison, an upper limit of 1½ % is given for carbon dioxide in Waste Management Paper 27[9]. In conjunction with the very low initial flow rates which quickly decayed to zero, the results do not indicate the need for gas protection to the new development.

7.6

Buried concrete

Laboratory tests yielded a maximum soluble sulphate concentration of 0.28 g/l which results in a Design Sulphate Class[10] of DS-1 for the site. The highest total sulphate concentration of 650 mg/kg recorded during contaminant testing does not warrant a higher classification.

Groundwater tests produced a highest concentration of 110 mg/l which also falls within class DS-1. Groundwater conditions must be considered mobile and both soil and water were slightly alkaline. These results indicate the aggressive chemical environment for concrete, ACEC, is class AC-1. However, underground concrete supplied to the site should also be capable of resisting brackish groundwater since the water table is assumed to be in hydraulic equilibrium with the tidal River Adur.



A W Parr
AP GEOTECHNICS LTD.
20 January 2006

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PROCEDURAL NOTES for GROUND INVESTIGATIONS

General

This report is based upon data obtained from field descriptions of the strata and examination of the samples by an engineer, together with the results of in situ and laboratory tests as appropriate. Responsibility cannot be accepted for variations in ground conditions between and around any of the exploratory points that is not revealed by the data. Whilst the report may offer an opinion on the ground conditions between exploratory points and below the depth of investigation, this is for guidance only and no liability is accepted for its accuracy.

Drilling procedure

Boring by light cable percussion drilling allows the ground conditions to be reasonably well established. However, a certain amount of disturbance is inevitable and some mixing of soils can occur.

Sampling procedure

"Undisturbed" samples of predominantly cohesive soils are taken with a 100mm diameter open tube sampler, generally in accordance with BS 5930: 1999.

Where appropriate, or where an undisturbed sample is unsuccessful, disturbed samples are recovered and sealed into polythene bags.

Groundwater samples are taken when water is encountered in sufficient quantity.

Standard penetration tests

The test is conducted generally in accordance with BS 1377: Part 9: 1990. The sampler tube is subject to a seating drive of 150mm into the soil at the base of the borehole. Results are given on the Borehole Records as the number of blows required to drive the sampler tube a further 300mm and this is known as the "N" value. Where the driving resistance is such that full penetration is not achieved, the test is generally terminated after 50 blows and the actual distance penetrated is recorded.

Groundwater

Groundwater observations necessarily reflect the conditions encountered at the time of the exploratory work. Long term monitoring of standpipes is usually required to establish an equilibrium water level since the normal rate of boring is too fast to permit steady state conditions to be achieved.

Groundwater levels are subject to variations caused by changes in drainage conditions and seasonal climatic changes.

Water may necessarily be added to advance the bore whilst casing may be required to maintain an open hole. These can both mask subsequent groundwater observations and are therefore noted on the individual Borehole Record.

APPENDICES

A Borehole and Trial Pit Records

Symbols and Abbreviations
Borehole Records
Trial Pit Records

B Standpipe Records

Gas Emissions and Water Levels

C Laboratory Test Results

Summary of Geotechnical Tests
Particle Size Distribution
California Bearing Ratio

D Figures

Figure 1	Borehole and Trial Pit Location Plan
Figure 2	Outline of Development Proposals
Figure 3	SPT Profile

APPENDIX A

BOREHOLE AND TRIAL PIT RECORDS

SYMBOLS and ABBREVIATIONS

Samples

Undisturbed

U	Standard open drive "undisturbed" 102mm dia. in boreholes 38mm dia. in trial pits, window sampler and hand auger
T	Thin wall open drive
P	Piston
C	CBR mould

Disturbed

D	Small
B	Bulk
C	Contaminants: plastic tub
J	brown glass jar
W	Water

In situ tests

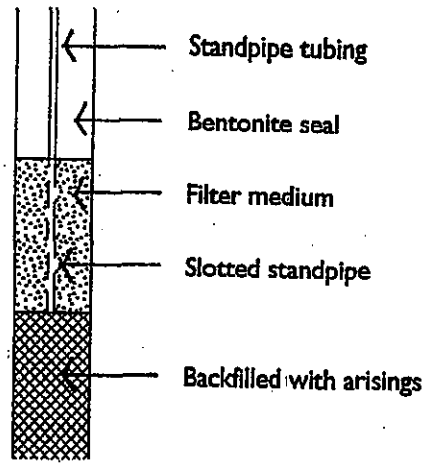
SPT	Standard Penetration Test, open shoe
CPT	solid cone
	N value is number of blows for 300mm penetration. Blow count also given as seating drive followed by four increments of 75mm.
V ( )	Vane test (c_u kPa)
P ( )	Hand penetrometer (c_u kg/cm^2)
M ( )	Mexe probe (CBR %)

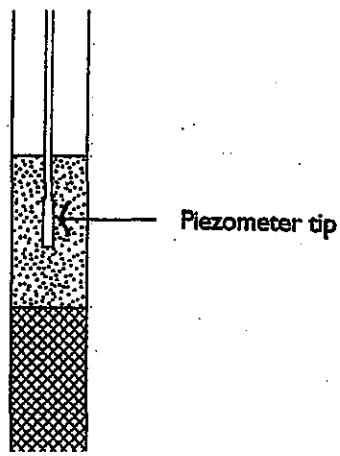
Water records

∇_1	Standing level
∇_1	Depth encountered

suffix identifies separate strikes

Standpipes





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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH1
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 4.00m 150mm cased to 19.00m	**Ground Level (mOD)** 5.62	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 13/10/2005	**Engineer** DWA Architects	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.50	D1						FILL: Chalk			
0.50	C1									
1.00-1.45	SPT N=10		DRY	2,2/3,2,3,2		(2.00)				
1.00	C2									
1.00	D2									
1.00-1.50	B1									
1.50	D3									
2.00	C3									
2.00	D4				3.62	2.00	FILL: Brick and chalk			
2.50	D5									
2.50-3.00	B2					(1.00)				
2.80-3.25	SPT N=19		DRY	1,2/5,5,6,3						
3.00	D6				2.62	3.00	Possible FILL: Brown gravelly clay			
3.00	C4					(0.50)				
3.50	D7				2.12	3.50	Firm orange brown sandy gravelly cobbly CLAY. Gravel and cobbles are irregular flints			
4.00-4.45	SPT N=13	4.00	DRY	2,1/2,3,5,3						
4.00	C5									
4.00	D8					(1.50)				
4.00-4.50	B3									
4.50	D9									
5.00	C6									
5.00	D10				0.62	5.00	Off white CHALK with silt size particles and clay			
5.50-5.95	SPT N=9	5.50	DRY	2,1/2,2,3,2						
5.50	D11									
6.00	D12									
7.00-7.45	SPT N=7	7.00	6.50	slow(1) at 7.00m, rose to 6.50m in 20 mins, not sealed. 2,1/2,2,1,2						
8.80-9.25	SPT N=7	8.50	7.00	2,1/1,2,2,2						
10.00-10.45	SPT N=8	10.00	8.50	1,2/3,2,1,2						

Remarks
Pressure wash drill string: ½ hour.
Swelling time for bentonite seal: 2 hour
Reducing diameter: ½ hour
Clearing spoil: ½ hour
Excavating from 0.00m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH1

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH1
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 4.00m 150mm cased to 19.00m	**Ground Level (mOD)** 5.62	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 13/10/2005	**Engineer** DWA Architects	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(7.00)	Off white CHALK with silt size particles and clay			
11.80-12.25	SPT N=9	11.80	10.30	2,1/2,2,3,2						
					-6.38	12.00	White CHALK			
				fast(2) at 12.50m, rose to 7.50m in 20 mins, not sealed.					▽2	
13.00-13.45	SPT N=13	13.00	7.30	2,3/2,3,4,4						
14.50-14.95	SPT N=15	14.50	8.00	2,2/3,4,4,4						
16.00-16.45	SPT N=27	16.00	8.30	4,4/5,6,8,8						
17.80-18.25	SPT N=50	17.50	7.50	10,12/12,12,13,13						
19.00-19.45	SPT N=48	19.00	8.00	7,9/10,12,14,12						

Remarks

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH1

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH1
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 4.00m 150mm cased to 19.00m	**Ground Level (mOD)** 5.62	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 13/10/2005	**Engineer** DWA Architects	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
20.50-20.95	SPT N=46	19.00	8.10	5,8/10,10,12,14		(9.00)	White CHALK			
					-15.38	21.00	Complete at 21.00m			

Remarks

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH1

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH2
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 5.00m 150mm cased to 17.00m	**Ground Level (mOD)** 7.03	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 10/11/2005	**Engineer** DWA Architects	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							FILL: Chalk			
0.50	D1									
1.00-1.45	SPT N=7		DRY	1,2/2,1,2,2						
1.00	C1									
1.00	D2									
1.00-1.50	B1					(2.60)				
1.50	C2									
2.00	C3									
2.00	D3									
2.50-2.95	SPT N=2		DRY	1/1,,,1						
2.50	C4									
2.50-3.00	B2				4.43	2.60	FILL: Ash, clay, chalk, flint gravel and cobbles			
3.00	D4									
3.00	C5									
3.50	C6					(1.40)				
4.00-4.45	SPT N=4		DRY	1,2/1,,1,2						
4.00	C7				3.03	4.00	FILL: Soft to firm brown gravelly cobbly silty clay with rare brick fragments. Gravel and cobbles are angular flint			
4.00	D5									
4.00-4.50	B3									
4.50	C8					(1.00)				
5.00	C9									
5.00	D6				2.03	5.00	Off white becoming white CHALK			
5.50-5.95	SPT N=24	5.50	DRY	4,6/6,6,6,6						
5.50	D7									
5.50	C10									
7.00-7.45	SPT N=24	7.00	DRY	3,5/6,7,6,5					▼1	
8.50-8.95	SPT N=27	7.50	DRY	2,4/5,6,7,9					▽1	
				slow(1) at 9.00m, rose to 8.70m in 20 mins, not sealed.						
10.00-10.45	SPT N=26	10.00	9.50	3,4/4,6,8,8						

Remarks
Backfilled with bentonite and surface reinstated with mass concrete
Pressure wash drill string: ½ hour.
Swelling time for bentonite seal: 2 hour
Reducing diameter: ½ hour
Clearing spoil: ½ hour
Backfilled with bentonite and surface reinstated with mass concrete

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH2

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH2
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 5.00m 150mm cased to 17.00m	**Ground Level (mOD)** 7.03	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 10/11/2005	**Engineer** DWA Architects	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
11.50-11.95	SPT N=28	11.50	9.70	4,4/6,6,7,9		(13.00)	Off white becoming white CHALK			
13.00-13.45	SPT N=37	13.00	8.70	5,7/8,9,10,10						
14.50-14.95	SPT N=45	14.50	9.00	5,8/9,9,13,14						
16.00-16.45	SPT N=42	16.00	9.50	4,7/9,10,11,12						
17.50-17.95	SPT N=46	17.00	10.00	4,6/10,11,13,12						
					-10.97	18.00	Complete at 18.00m			

Remarks

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH2

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH3
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 6.00m 150mm cased to 19.50m	**Ground Level (mOD)** 8.91	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 10/12/2005	**Engineer** DWA Architects	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							FILL: Old roadstone and gravel			
0.50	C1					(0.50)				
					8.41	0.50	FILL: Chalk			
1.00-1.45 1.00 1.00 1.00-1.50 1.50	SPT N=10 C2 D1 B1 C3		DRY	1,2/3,3,2,2						
2.00 2.00	C4 D2									
2.50-2.95 2.50 2.50-3.00	SPT N=3 C5 B2		DRY	1/1,1,,1		(4.00)				
3.00 3.00	C6 D3									
3.50	C7									
4.00-4.45 4.00 4.00 4.00-4.50 4.50	SPT N=5 C8 D4 B3 C9	4.00	DRY	1,1/1,2,2						
					4.41	4.50	FILL: Dark greyish brown silty clay with silt and gravel size chalk fragments and rare brick fragments			
5.00 5.00	C10 D5					(0.50)				
					3.91	5.00	Firm orange brown slightly gravelly CLAY. Gravel is intact chalk fragments			
5.50-5.95 5.50 5.50 5.50-6.00 6.00	SPT N=10 C11 D6 B4 D7	5.50	DRY	1,2/2,3,2,3		(2.00)				
7.00-7.45 7.00 7.00-7.50	SPT N=20 D8 B5	7.00	DRY	2,3/4,6,5,5	1.91	7.00	Off white CHALK with silt			
8.00	D9									
8.50-8.95	SPT N=20	7.50	DRY	2,4/5,5,5,5						
10.00-10.45	SPT N=19	7.50	DRY	2,3/4,4,5,6						

Remarks
Pressure wash drill string: ½ hour.
Swelling time for bentonite seal: 2 hour
Reducing diameter: ½ hour
Clearing spoil: ½ hour

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH3

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Site: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			Borehole Number: BH3
Boring Method: Cable Percussion	Casing Diameter: 200mm cased to 6.00m, 150mm cased to 19.50m	Ground Level (mOD): 8.91	Client: Abbeycare Investments Limited
	Location: see site plan	Dates: 10/12/2005	Engineer: DWA Architects
			Job Number: 2681
			Sheet: 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(5.00)	Off white CHALK with silt			
11.50-11.95	SPT N=16	7.50	DRY	2,1/2,4,5,5						
					-3.09	12.00	White CHALK			
				fast(1) at 12.50m, rose to 9.00m in 20 mins, not sealed.					▽1	
13.00-13.45	SPT N=10	13.00	9.50	2,1/2,3,2,3						
14.50-14.95	SPT N=9	14.50	9.00	1,2/2,2,3,2						
16.00-16.45	SPT N=13	16.00	9.80	2,3/3,4,3,3						
17.50-17.95	SPT N=27	17.50	11.70	2,4/8,8,5,6						
19.00-19.45	SPT N=41	19.00	10.00	5,7/9,10,10,12						

Remarks

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH3

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH3
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 6.00m 150mm cased to 19.50m	**Ground Level (mOD)** 8.91	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 10/12/2005	**Engineer** DWA Architects	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(9.00)	White CHALK			
20.50-20.95	SPT N=44	19.50	9.00	5,9/8,9,11,16						
					-12.09	21.00	Complete at 21.00m			

Remarks

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH3

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Site	Borehole Number
OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX	BH4

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	200mm cased to 1.80m 150mm cased to 17.50m	3.47	Abbeycare Investments Limited	2681
	Location	**Dates**	**Engineer**	**Sheet**
	see site plan	14/10/2005	DWA Architects	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.30)	CONCRETE			
					3.17	0.30				
0.50	C1					(0.20)	FILL: Brick and clay			
					2.97	0.50				
1.00-1.45	SPT N=10		DRY	1,2/2,3,2,3			Firm orange brown slightly gravelly clayey fine SAND. Gravel is fine to medium flint			
1.00	D1									
1.00	C2									
1.00-1.50	B1									
1.50	C3									
						(2.50)				
2.00	D2									
2.00	C4									
2.50-2.95	SPT N=8	2.50	DRY	2,1/2,2,2,2						
2.50	C5									
2.50-3.00	B2									
3.00	D3									
3.00	C6				0.47	3.00	Soft to firm very pale orange brown clayey SILT. Silt is comminuted chalk			
3.50	C7								▽1	
						(1.00)				
4.00	D4									
4.00	C8			moderate(1) at 4.00m, rose to 3.40m in 20 mins, sealed at 5.00m.	-0.53	4.00	Off white CHALK with silt		▽1	
4.00-4.45	SPT N=13	4.00	3.40	1,2/3,3,4,3						
									▽2	
5.50-5.95	SPT N=10	5.50	DRY	1,2/3,2,3,2						
				fast(2) at 7.00m, rose to 5.00m in 20 mins, not sealed.					▽2	
7.00-7.45	SPT N=7	7.00	5.00	2,2/1,2,2,2						
8.50-8.95	SPT N=15	8.50	5.50	2,2/4,3,4,4						
10.00-10.45	SPT N=19	10.00	6.70	2,3/4,4,5,6						

Remarks
Pressure wash drill string: ½ hour.
Swelling time for bentonite seal: 2 hour
Reducing diameter: ½ hour
Clearing spoil: ½ hour
Clean yard area: 1½ hour

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH4

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Borehole Number** BH4
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 1.80m 150mm cased to 17.50m	**Ground Level (mOD)** 3.47	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 14/10/2005	**Engineer** DWA Architects	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							Off white CHALK with silt			
						(14.00)				
11.50-11.95	SPT N=28	11.50	7.00	4,6/4,6,8,10						
13.00-13.45	SPT N=30	13.00	6.80	3,5/5,6,9,10						
14.50-14.95	SPT N=47	14.50	7.20	7,13/12,12,11,12						
16.00-16.40	SPT 50/245	16.00	7.50	9,10/13,14,17,6						
17.50-17.95	SPT N=50	17.50	8.00	5,10/10,12,13,15						
					-14.53	18.00	Complete at 18.00m			

Remarks

Scale (approx)	Logged By
1:50	

Figure No. 2681.BH4

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Trial Pit Number** TP 1
Excavation Method Trial Pit	**Dimensions**	**Ground Level (mOD)** 5.83	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 10/11/2005	**Engineer** DWA Architects	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15)	FILL: Pea shingle over grey black old roadstone fragments		
				5.68	0.15			
0.50 0.50	J1 C1					FILL: Structureless CHALK composed of sandy silty subangular COBBLES. Cobbles are weak, low density, off white. Matrix is grey white.		
					(2.15)			
1.50 1.50	J2 C2							
				3.53	2.30	FILL: Very dark brown clayey silt with rare brick fragments		
2.50 2.50	J3 C3				(0.60)			
2.80 2.80	J4 C4			2.93	2.90	Orange brown slightly clayey COBBLES of subrounded rinded flint		
3.00	J5				(1.10)			
				1.83	4.00			

Plan

Remarks

Pit dry
Chalk very unstable below 1.5m
Backfilled with spoil arising.

Scale (approx)	Logged By	Figure No.
1:25		2681.TP 1

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Excavation Method Trial Pit	**Dimensions**	**Ground Level (mOD)** 6.00	**Site** OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX	**Trial Pit Number** TP 2
	Location see site plan	**Dates** 10/11/2005	**Client** Abbeycare Investments Limited	**Job Number** 2681
			Engineer DWA Architects	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				5.85	(0.15) 0.15	FILL: Dark grey and black fragments of old roadstone, very dark brown clay, rounded flint gravel and roots		
					(1.35)	FILL: Structureless CHALK composed of white BOULDERS with gravel size voids. Boulders are moderately strong, medium to high density.		
1.60 1.60	J1 C1			4.50	1.50 (0.60)	FILL: Structureless CHALK composed of sandy silty GRAVEL and COBBLES. Gravel and cobbles are subangular, moderately weak, low to medium density off white. Matrix is off white.		
2.20 2.20 2.40	J2 C2 C3			3.90 3.70	2.10 (0.20) 2.30 (0.90)	Firm dark brown clayey SILT Firm orange brown with vertical grey veins slightly clayey gravelly fine SAND. Gravel is subrounded flint.		
				2.80	3.20	Complete at 3.20m		

Plan

Remarks

Pit terminated on collapse of chalk
Pit dry
Backfilled with arisings

Scale (approx)	Logged By	Figure No.
1:25		2681.TP 2

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Site	Trial Pit Number
OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX	TP 3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit		7.10	Abbeycare Investments Limited	2681
	Location see site plan	**Dates** 10/11/2005	**Engineer** DWA Architects	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						FILL: Roadstone fragments and very dark brown clay with roots		
				6.90	(0.20) 0.20			
0.50 0.50	J1 C1					FILL: Structureless CHALK composed of off white cobbly sandy SILT. Cobbles are weak, low density off white and subangular. Occasional irregular rinded flint cobbles		
1.00 1.00	J2 C2					roots to c. 1m		
					(2.40)			
1.50	B1					brown staining 1.5 - 1.7m		
						subangular chalk boulders below 1.7m		
2.00 2.00	J3 C3							
				4.50	2.60			
2.70 2.70 2.70	J4 D1 C4					Firm brown slightly gravelly CLAY. Gravel is subangular medium flint		
					(0.60)			
				3.90	3.20	Firm orange brown SILT		
3.30 3.30	J5 C5							
3.50	B2				(0.60)			
				3.30	3.80	Complete at 3.80m		

Plan

Remarks

Pit dry
Chalk unstable below 1.7m
Backfilled with spoil arising

Scale (approx)	Logged By	Figure No.
1:25		2681.TP 3

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Excavation Method Trial Pit	**Dimensions**	**Ground Level (mOD)** 8.52	**Site** OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX	**Trial Pit Number** TP 4
	Location see site plan	**Dates** 10/11/2005	**Client** Abbeycare Investments Limited	**Job Number** 2681
			Engineer DWA Architects	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50 0.50	J1 C1				(1.50)	FILL: Structureless CHALK composed of off white cobbly sandy SILT. Cobbles are weak, low density off white and subrounded.		
1.70	B1			7.02	1.50	FILL: Structureless CHALK composed of sandy silty subrounded and subangular COBBLES and BOULDERS. Cobbles and boulders are moderately weak, medium density off white. Matrix is off white.		
3.70 3.70	J2 C2			4.92	(2.10) 3.60	Firm brown very cobbly CLAY. Cobbles are rounded, subrounded and subangular flint		
				4.72	(0.20) 3.80	Complete at 3.80m		

Plan

Remarks

Pit dry
Chalk fragments spalling badly from face
Backfilled with spoil arising

Scale (approx)	Logged By	Figure No.
1:25		2681.TP 4

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Site OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX			**Trial Pit Number** TP 5
Excavation Method Trial Pit	**Dimensions**	**Ground Level (mOD)** 3.60	**Client** Abbeycare Investments Limited	**Job Number** 2681
	Location see site plan	**Dates** 10/11/2005	**Engineer** DWA Architects	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				3.50	0.10	Mass CONCRETE		
0.30 0.30	J1 C1				(0.90)	FILL: Firm brown and dark brown clay with orange brown sand lenses, brick and chalk fragments		
0.60 0.60	J2 C2							
1.00 1.00 1.00	J3 C3 B1			2.60	1.00	Yellow with dark brown spots very sandy SILT		
					(0.70)	slightly gravelly below c. 1.5m. Gravel is irregular rinded flint cobbles and boulders		
2.00	C4			1.90	1.70	Structureless CHALK composed of sandy silty subrounded and subangular COBBLES. Cobbles are moderately weak, low to medium density, off white with frequent black specks. Matrix is very light brown and off white. (Grade Dc)		
					(1.40)	chalk boundary at 1.7 m in south end of pit, 2.7m in north		
3.00 3.00	J4 C5			0.50	3.10			
						Complete at 3.10m		

Plan

Remarks

Sides stable during excavation
Pit dry
Backfilled with arisings

Scale (approx)	Logged By	Figure No.
1:25		2681.TP 5

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APPENDIX B

STANDPIPE RECORDS

STANDPIPE RECORDS

GAS EMISSIONS AND WATER LEVELS

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No: 2681
Sheet No: 1/1

Date	Atmos Press. mb	Measurement	Units	Location							
				BH1		BH3		BH4			
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady
30/11/05	1010	Flow rate	l/hr	0.4	0.0	-0.3	0.0	-0.2	0.0		
		Methane	%	0.0	0.0	0.0	0.0	0.0	0.0		
		Carbon dioxide	%	0.7	0.2	0.1	0.1	0.3	0.3		
		Oxygen	%	19.5	19.1	19.6	19.6	19.4	19.3		
		Water level	m bgl	4.55		7.98		2.43			

Date	Atmos Press. mb	Measurement	Units	Location							
				BH1		BH3		BH4			
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady
16/12/05	1010	Flow rate	l/hr	0.5	0.0	0.5	0.0	0.4	0.0		
		Methane	%	0.0	0.0	0.0	0.0	0.0	0.0		
		Carbon dioxide	%	0.8	0.8	0.0	0.0	0.1	0.1		
		Oxygen	%	17.6	17.2	20.8	20.8	20.6	20.5		
		Water level	m bgl	4.53		7.89		2.45			

Date	Atmos Press. mb	Measurement	Units	Location							
				BH1		BH3		BH4			
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady
16/01/06	1008	Flow rate	l/hr	0.3	0.0	2.4	0.0	0.2	0.0		
		Methane	%	0.0	0.0	0.0	0.0	0.0	0.0		
		Carbon dioxide	%	0.8	0.8	0.0	0.0	0.1	0.2		
		Oxygen	%	17.4	17.3	20.7	20.7	20.4	20.2		
		Water level	m bgl	4.58		7.90		2.47			

Date	Atmos Press. mb	Measurement	Units	Location							
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady
		Flow rate	l/hr								
		Methane	%								
		Carbon dioxide	%								
		Oxygen	%								
		Water level	m bgl								

Date	Atmos Press. mb	Measurement	Units	Location							
				Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady
		Flow rate	l/hr								
		Methane	%								
		Carbon dioxide	%								
		Oxygen	%								
		Water level	m bgl								

Readings taken with GA 2000 manufactured by Geotechnical Instruments Ltd.

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APPENDIX C

LABORATORY TEST RESULTS

SUMMARY OF GEOTECHNICAL TESTS

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No: 2681
Sheet No: 1/1

Loc'n	Sample No	Depth m	Description	CLASSIFICATION								TRIAXIAL COMPRESSION - TOTAL STRESS							CHEMICAL		
				Natural Moisture Content %	Liquid Limit %	Plastic Limit %	Plast. Index %	Passing 425µm %	Class	Saturation Moisture Content %	Dry Density Mg/m³	Type	Moisture Content %	Bulk Density Mg/m³	Radial Stress kPa	Deviator Stress kPa	Cohesion cu, kPa assuming Øu = 0	Cohesion cu, kPa Øu, deg	Sulphate (SO4) Water g/l	Sulphate (SO4) Soil (Sol) g/l	pH
BH1	D6	3.00	Brown gravelly CLAY																		
	D8	4.00	Firm orange brown sandy gravelly CLAY																	0.17	7.4
BH2	D5	4.00	FILL: Brown gravelly cobbly silty clay with rare brick fragments																	0.24	7.3
																				0.13	7.4
BH3	D6	5.50	Orange brown slightly gravelly CLAY																		
BH4	D2	2.00	Orange brown slightly gravelly clayey fine SAND																	0.28	7.5
																				0.17	7.5
TP3	B1	1.50	FILL: Chalk							27	1.57										
										27	1.55										
										27	1.56										
	B2	3.50	Orange brown SILT																		
TP4	B1	1.70	FILL: Chalk																	0.21	7.4
										26	1.57										
										26	1.59										
										26	1.57										
TP5	B1	1.00	Yellow sandy SILT																		
																				0.15	7.3

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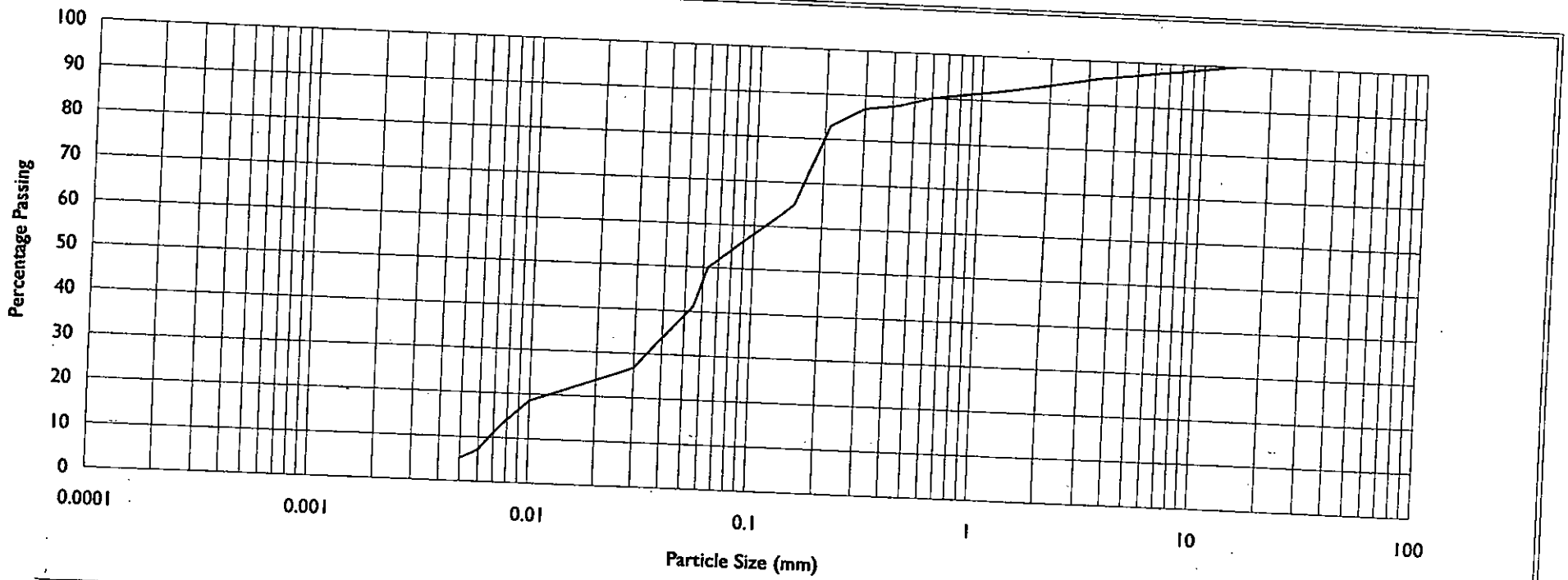
PARTICLE SIZE DISTRIBUTION

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No: 2681
Sheet No: 1/1



Clay	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	Cobbles
	Silt			Sand			Gravel			
Hydrometer				Sieve						

Location: TP5
Sample: B1
Depth, m: 1.00

Description:-
Yellow with dark brown spots very sandy SILT

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CALIFORNIA BEARING RATIO

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

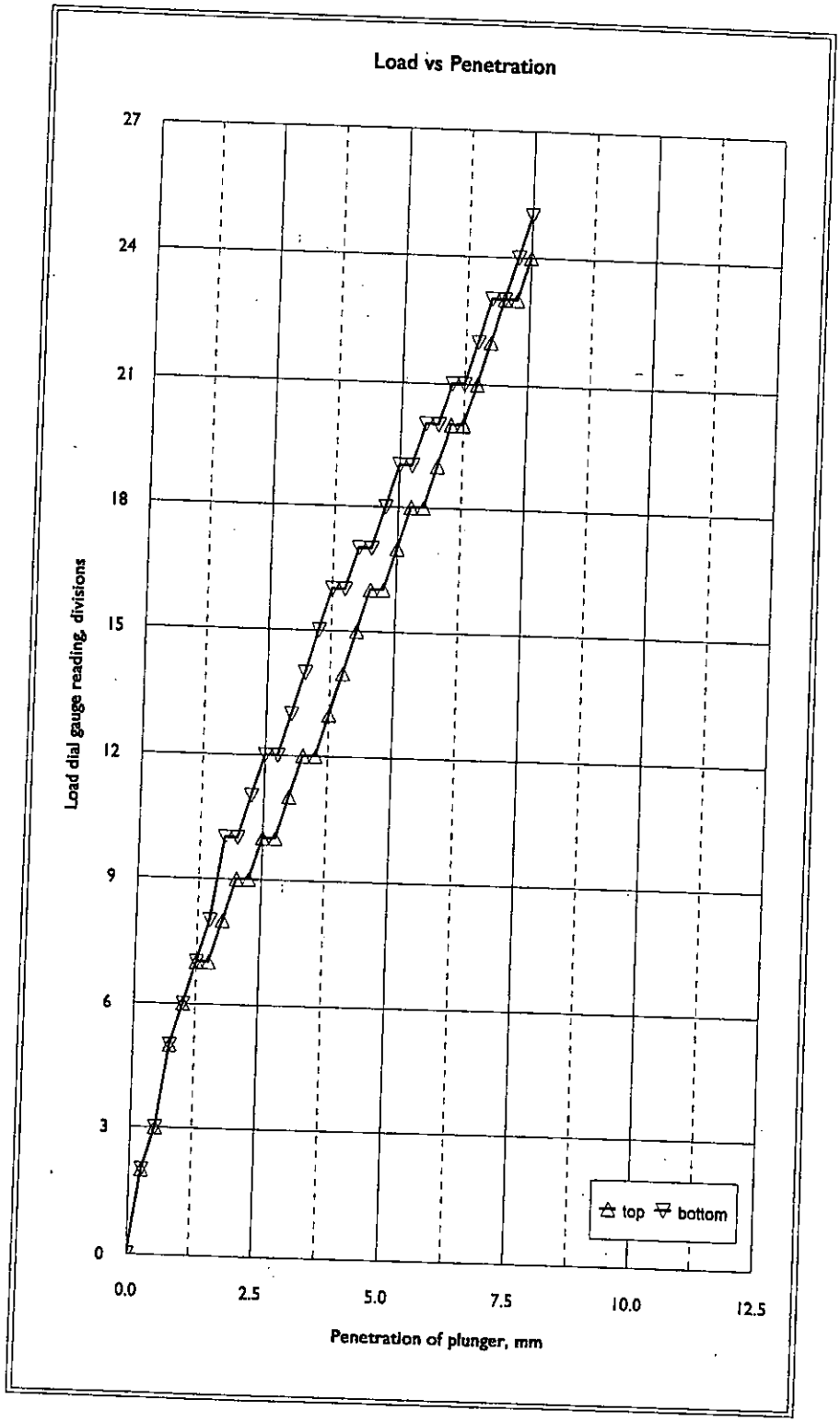
Project No: 2681
Sheet No: 1/2

Loc'n	Sample	Depth (m)
TP3	B2	3.5

Description
Firm orange brown SILT

Sample Preparation	
In situ	
Undisturbed	
Remoulded	
Recompacted	**2.5kg**
	4.5kg

Penetration mm	Load Dial Gauge, div top	Load Dial Gauge, div bottom
0.00	0	0
0.25	2	2
0.50	3	3
0.75	5	5
1.00	6	6
1.25	7	7
1.50	7	8
1.75	8	10
2.00	9	10
2.25	9	11
2.50	10	12
2.75	10	12
3.00	11	13
3.25	12	14
3.50	12	15
3.75	13	16
4.00	14	16
4.25	15	17
4.50	16	17
4.75	16	18
5.00	17	19
5.25	18	19
5.50	18	20
5.75	19	20
6.00	20	21
6.25	20	21
6.50	21	22
6.75	22	23
7.00	23	23
7.25	23	24
7.50	24	25
Surcharge, kg		4.0
Seating Load, N		
Proving Ring Factor, N/div		25.61



CBR at 2.5mm = (Dial reading x ring factor)/132.4
CBR at 5.0mm = (Dial reading x ring factor)/199.6

Moisture Cont. %	Density, Mg/m³ Bulk	Density, Mg/m³ Dry	% retained at 20mm
15	2.07	1.80	0

C B R %	Penet'n	Top	Bottom
	2.5mm	1.9	2.3
	5.0mm	2.2	2.4

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CALIFORNIA BEARING RATIO

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Pavillion Developments
Agent: DWA Architects

Project No: 2681
Sheet No: 2/2

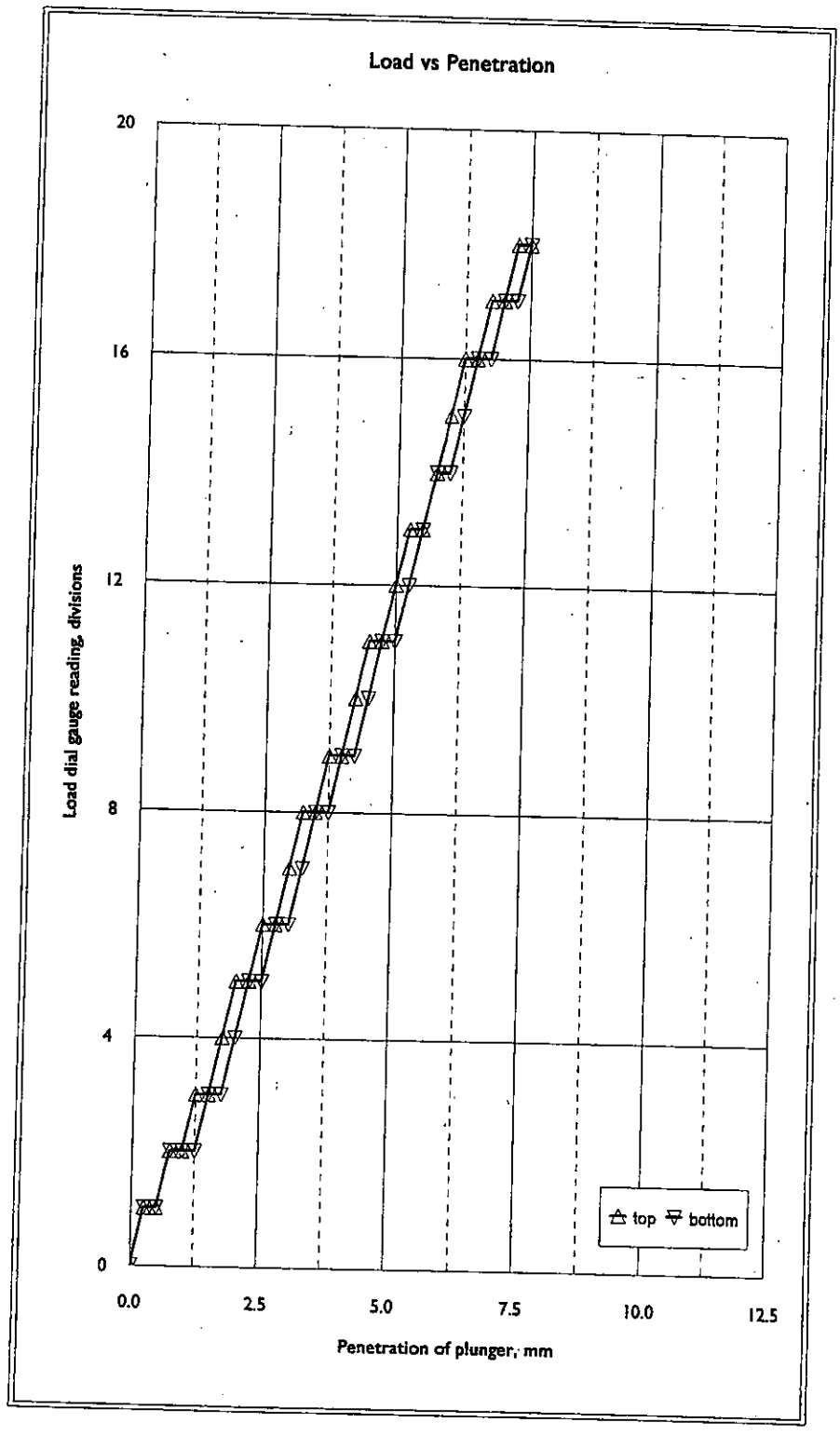
Loc'n	Sample	Depth (m)
TP5	B1	1.0

Description
Yellow very sandy SILT

Sample Preparation	
In situ	
Undisturbed	
Remoulded	
Recompacted	**2.5kg**
	4.5kg

Penetration mm	Load Dial Gauge, div top	bottom
0.00	0	0
0.25	1	1
0.50	1	1
0.75	2	2
1.00	2	2
1.25	3	2
1.50	3	3
1.75	4	3
2.00	5	4
2.25	5	5
2.50	6	5
2.75	6	6
3.00	7	6
3.25	8	7
3.50	8	8
3.75	9	8
4.00	9	9
4.25	10	9
4.50	11	10
4.75	11	11
5.00	12	11
5.25	13	12
5.50	13	13
5.75	14	14
6.00	15	14
6.25	16	15
6.50	16	16
6.75	17	16
7.00	17	17
7.25	18	17
7.50	18	18

Surcharge, kg	4.0
Seating Load, N	
Proving Ring Factor, N/div	25.61



CBR at 2.5mm = (Dial reading x ring factor)/132.4
CBR at 5.0mm = (Dial reading x ring factor)/199.6

Moisture Cont. %	Density, Mg/m³ Bulk	Dry	% retained at 20mm
15	2.05	1.79	0

CBR %	Penet'n	Top	Bottom
	2.5mm	1.2	1.0
	5.0mm	1.5	1.4

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CONTAMINANTS IN SOIL

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No: 2681
Sheet No: 1/1

Location	Sample	Depth m	Arsenic	Cadmium	Chromium	Lead	Mercury	Selenium	Copper	Nickel	Zinc	Barium	Beryllium	Vanadium	TPH by GCMS unspeciated	Cyanide free	pH	Sulphate (SO4) total	Sulphate (SO4) sol. g/l	PAH by GCMS unspeciated	
BH2		2.50	<10	<0.5	<2	<5	<0.3	<0.5	<2	<5	13	<10	<0.5	<5	<10	<5	8.9	650		<0.05	
BH4		0.50	<10	<0.5	27	19	<0.3	<0.5	14	16	55	44	0.71	42	<10	<5	8.5	250			
TP1		0.50	<10	<0.5	5	19	<0.3	<0.5	10	7	21	21	<0.5	6	<10	<5					
		2.50	13	<0.5	20	460	1.2	<0.5	42	16	80	90	1	38	45	<5	8.2	600		3.3	
TP2		1.60	<10	<0.5	3	7	<0.3	<0.5	4	<5	13	12	<0.5	<5	<10	<5					
		2.40	<10	<0.5	24	22	<0.3	<0.5	11	11	39	49	0.73	40	<10	<5	8.4	<200		1.5	
TP3		0.50	<10	<0.5	4	16	<0.3	<0.5	35	6	24	20	<0.5	<5	94	<5				10	
TP5		0.30	12	<0.5	26	47	<0.3	<0.5	14	17	59	63	0.97	42	24	<5	8.2	<200		0.91	
		1.00	<10	<0.5	19	22	<0.3	<0.5	8	10	48	34	0.62	32	<10	<5	7.9	<200		<0.05	
CLEA trigger			20	1 - 8*	130	450	8	35		50											

CLEA trigger applicable to residential land use with plant uptake

* cadmium trigger is pH dependent (1, 2 or 8 mg/kg at pH = 6, 7 or 8 respectively)

All units are mg/kg dry weight of soil unless otherwise stated, except for pH which is dimensionless

Exceptions denoted thus: XX

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CONTAMINANTS IN SOIL

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No: 2681
Sheet No: 1/1

Speciated Polyaromatic Hydrocarbons					
Location	BH4	TP1	TP2	TP3	TP4
Sample					
Depth, m	0.50	2.50	2.40	0.30	1.00
Determinand	Concentration, mg/kg				
PAH					
napthalene	<0.05	0.1	<0.05	<0.05	<0.05
acenapthylene	<0.05	<0.05	<0.05	<0.05	<0.05
acenapthene	<0.05	0.35	<0.05	<0.05	<0.05
fluorene	<0.05	0.38	<0.05	<0.05	<0.05
phenanthrene	<0.05	5.1	<0.05	0.09	<0.05
anthracene	<0.05	0.75	<0.05	<0.05	<0.05
fluoranthene	<0.05	6.1	0.06	0.14	<0.05
pyrene	<0.05	4.5	<0.05	0.14	<0.05
benzo(a)anthracene	<0.05	2.3	<0.05	0.10	<0.05
chrysene	<0.05	2.0	<0.05	0.05	<0.05
benzo(b)fluoranthene	<0.05	2.0	<0.05	0.10	<0.05
benzo(k)fluoranthene	<0.05	0.67	<0.05	<0.05	<0.05
benzo(a)pyrene	<0.05	1.3	<0.05	0.09	<0.05
indeno(123-cd)pyrene	<0.05	0.82	<0.05	<0.05	<0.05
dibenzo(ah)anthracene	<0.05	0.32	<0.05	<0.05	<0.05
benzo(ghi)perylene	<0.05	1.1	<0.05	0.07	<0.05
Total PAH	<0.05	28	0.06	0.78	<0.05

Notes
1. Total PAH = Sum of 16 identified components
2. The results are expressed as mg/kg dry weight soil after correction for moisture content

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CONTAMINANTS IN SOIL

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No : 2681
Sheet No : 1/1

Location	Sample	Depth m	Asbestos identification		
			Description of matrix	Overall percentage of asbestos identified (approx.)	Type of asbestos identified
BH2		2.50	Soil	<0.001	
TP1		0.50	Soil	<0.001	
TP3		0.50	Soil	<0.001	
TP5		0.30	Soil	<0.001	

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CONTAMINANTS IN WATER

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No: 2681
Sheet No: 1/1
Sampled on: 29/11/05

Location	Sample	Depth m	Arsenic	Cadmium	Chromium	Lead	Mercury	Copper	Nickel	Zinc	Barium	Beryllium	Vanadium	Cyanide free	Cyanide complex	Nitrate	pH	Sulphate (SO4)	TPH total	Sulphur elemental	Acetone
BH4	s/pipe		<10	<5	<10	<5	<0.1	<10	<10	<10	21	<5	65	<30			7.4	110000	<10		

All units are µg/l unless otherwise stated, except for pH which is dimensionless.

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CONTAMINANTS IN WATER

Project: OLD SHOREHAM ROAD, SHOREHAM BY SEA, SUSSEX
Client: Abbeycare Investments Ltd
Agent: DWA Architects

Project No: 2681
Sheet No: 1/1
Sampled on: 29/11/05

Speciated Polyaromatic Hydrocarbons by GC/MS

Location	BH4
Sample	s/pipe
Depth, m	
Determinand	Concentration µg/l
PAH	
Napthalene	<0.05
Acenapthylene	<0.05
Acenapthene	<0.05
Fluorene	<0.05
Phenanthrene	<0.05
Anthracene	<0.05
Fluoranthene	<0.05
Pyrene	<0.05
Benzo(a)anthracene	<0.05
Chrysene	<0.05
Benzo(b)fluoranthene	<0.05
Benzo(k)fluoranthene	<0.05
Benzo(a)pyrene	<0.05
Indeno(123-cd)pyrene	<0.05
Dibenzo(ah)anthracene	<0.05
Benzo(ghi)perylene	<0.05
Total PAH	<0.05

Notes
1. Total PAH = Sum of 16 identified components

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APPENDIX D

FIGURES

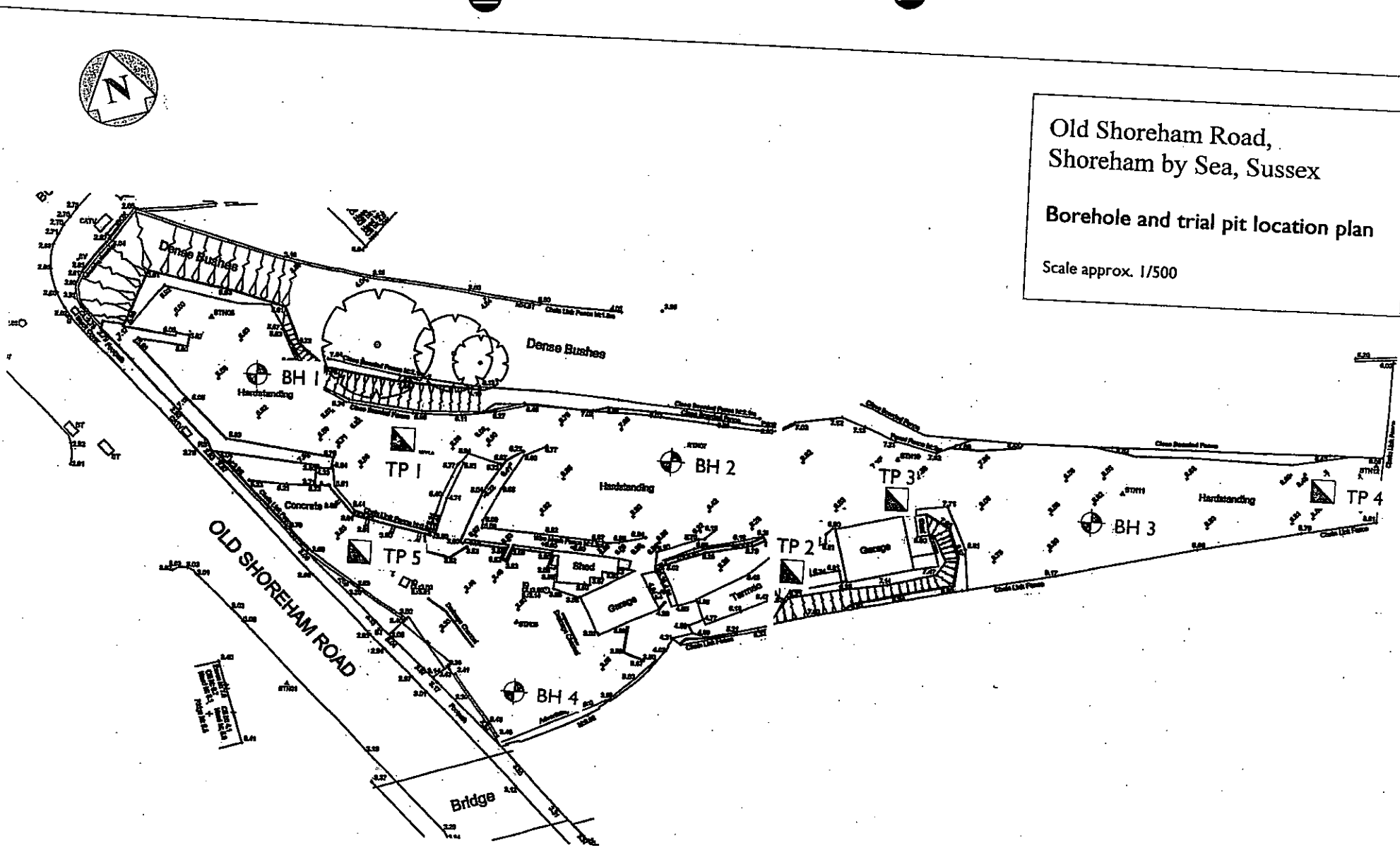
N
Old Shoreham Road,
Shoreham by Sea, Sussex
Borehole and trial pit location plan
Scale approx. 1/500
Dense Bushes
Dense Bushes
BH 1
Hardstanding
TP 1
BH 2
Hardstanding
TP 3
TP 4
BH 3
Hardstanding
TP 2
TP 5
Concrete
Shed
Garage
Garage
Tennis
OLD SHOREHAM ROAD
BH 4
Bridge

Figure 1

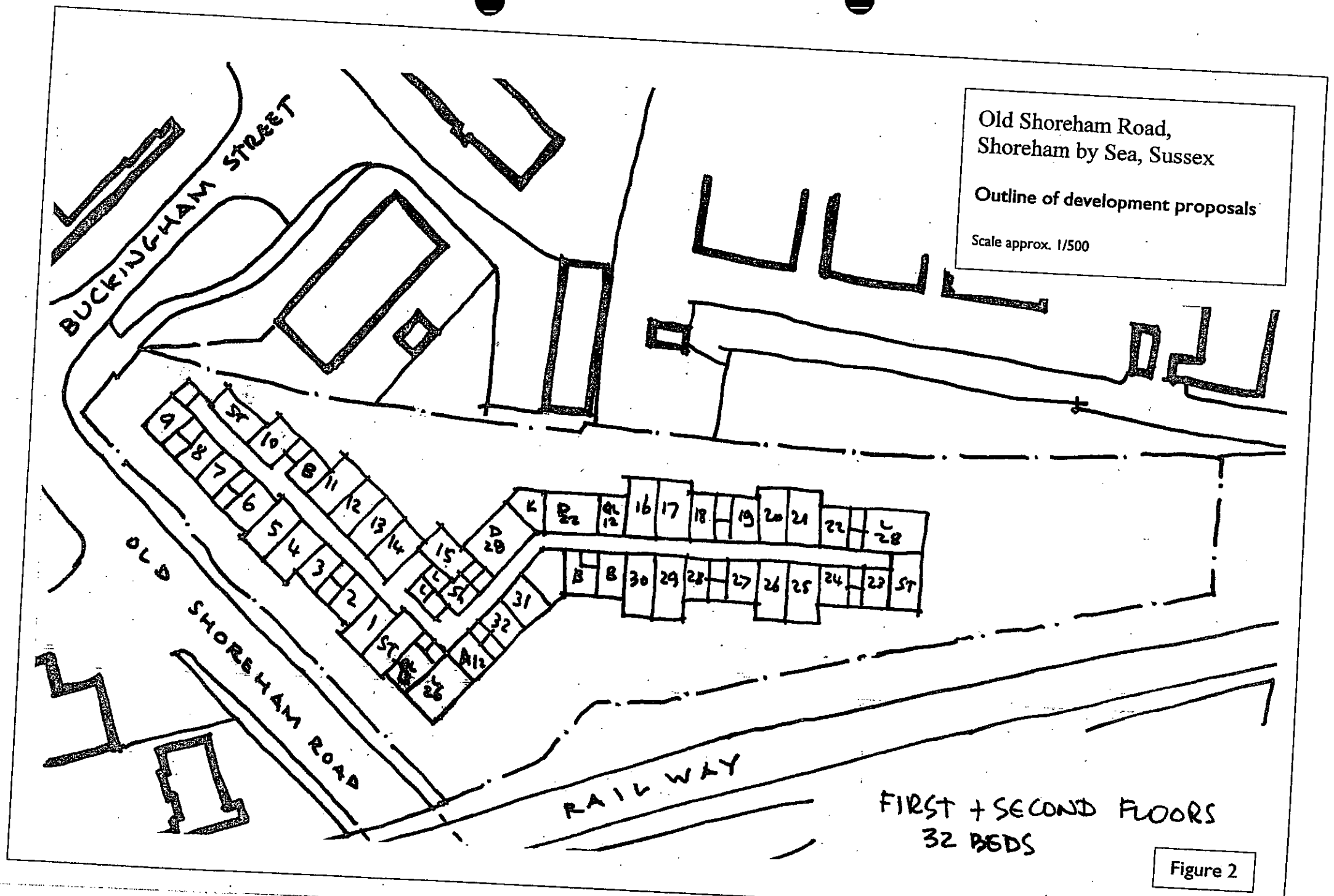
Old Shoreham Road,
Shoreham by Sea, Sussex
Outline of development proposals
Scale approx. 1/500
BUCKINGHAM STREET
OLD SHOREHAM ROAD
RAILWAY
FIRST + SECOND FLOORS
32 BEDS

Figure 2

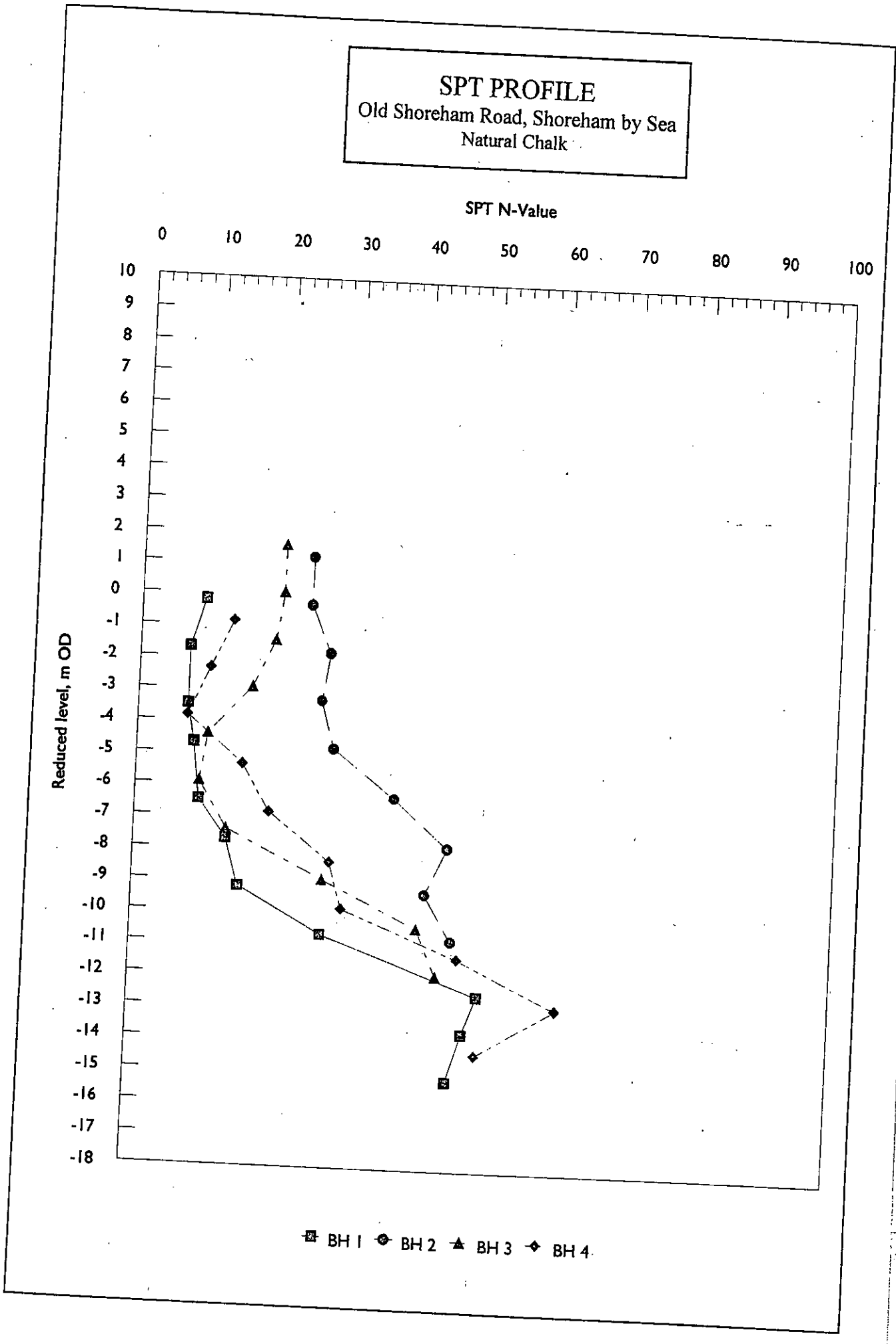

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Figure 3

Appendix 6 Flood Risk Assessment

Flood Risk Assessment

12 - 18 Old Shoreham Road, Shoreham

DRAFT FOR COMMENT

Prepared by:	Checked by:
Dr Paul Garrad	Jennifer Stringer
Consultant Hydrologist	Principal Consultant
31st October 2005	1st November 2005
.....	.....
Signature	Signature

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Summary

- The requirements for a flood risk assessment are provided in Planning Policy Guidance Note 25: Development and Flood Risk (PPG25) together with the Environment Agency's Guidance Notes.
- The proposed development will involve the construction of a four-storey residential Care Home with associated car parking facilities.
- The site lies within 200m of the tidally affected River Adur which forms the main potential source of fluvial flooding of the site and inundation from extreme sea levels overtopping the Adur defences is also considered the most likely route of flood water.
- The Environment Agency suggests a 200 year tide level at Shoreham of 4.40m OD which, allowing for a climatic change increase of 6mm/yr suggests a 200 year level of 4.700m OD by 2060.
- Flood defence crest levels for the Adur estuary are 4.99m at the Lawson Quay, 5.50m to the north at the disused railway embankment and these are well above the predicted 200 year tide level. The Riverside Business Park defence is at 3.866m OD and these defences are insufficient for the 2000 and 2060 predicted 200 year flood. Overtopping may therefore be expected to occur under extreme tidal conditions.
- A dynamic model has been used to calculate the rate of overtopping of these defence under extreme tidal condition based on the width and height of the defence at different levels and the height verse storage relationship of the Riverside Business park and Old Shoreham Road flood cell. This suggests the 2000 and 2060 flood would be continuous across the estuary and flood cell due to the low level and large width of the flood defences at this location.
- Calculations suggest a scheme to improve the defences along the Riverside Business Park river frontage to a level of 4.7m OD would prevent flooding of the site.
- Any flooding suggests water levels at the development site will rise fairly rapidly and reach the same level as the in the tidal estuary. There is safe access onto dry higher ground within the site.
- The development includes buildings or structures below the 200 year flood level and these are at risk from flooding. It is recommended that all floor levels are 300mm higher than the predicted 200 year 2060 flood levels of 4.7m OD, i.e. at 5.0m OD. There will be no displaced water, no change in the flooding potential for sites upstream and downstream and hence no requirement for compensatory storage.
- The site will generate the same volume of runoff as the existing situation as the land use of the site will not be changed. The use of Sustainable Urban Drainage Systems (SUDS) as part of the development plans could reduce the volume of runoff but the beneficial effects would be small due to the small footprint of the development compared to the existing situation.

- In terms of PPG25 the predicted flood levels are based on a tidal inundation model of the area and suggest that the site can be considered to be inside the Agency's defined Flood Zone 3. Zone 3 areas are considered as developed areas, undeveloped areas or functional flood plains and the site is clearly an existing developed area. Paragraph 30 of PPG25 indicates that Zone 3 developed areas may be suitable for residential, commercial or industrial development provided the appropriate minimum standard of flood defences (including suitable warning and evacuation procedures) can be maintained for the lifetime of the development. If a raised flood wall is constructed then the sequential test suggests that development at this site should be permitted. Alternatively ensuring all floor levels are above the predicted flood level with freeboard, and with safe escape and access, would also suggest this development could be considered.

Introduction

Requirements for a Flood Risk Assessment

- The requirements for a flood risk assessment are provided in "Planning Policy Guidance Note 25: Development and Flood Risk" (PPG25). This document requires that flood risk should be considered in the planning and development process in order to reduce any future flood damage to property and loss of life. PPG25 emphasises the importance of managing and reducing flood risk in the land use development and planning process by taking account of flood risk and the impacts of climate change.

- Paragraph 60 of PPG25 requires that a Flood Risk Assessment (FRA) should be submitted with a planning application to determine the risks of flooding at a development site. As such a FRA is an essential element in the overall assessment of the economic viability of the development as well as its acceptability in planning terms.

- Guidance on the content of flood-risk assessments is contained in Appendix F of PPG25, which is reproduced in this report as Appendix A. In addition the Environment Agency have produced four Guidance Notes on "Development and Flood Risk Assessments" which aim to simplify the requirements for flood risk assessments according to the nature of the development and the site location in relation to the Zone 3 flood plain. These Guidance Notes are;

- FN1 - Minor Development within the Zone 3 Flood Plain
- FN2 - Non-Minor Development within the Zone 3 Flood Plain
- FN3 - Minor Development outside the Zone 3 Flood Plain
- FN4 - Non-Minor Development outside the Zone 3 Flood Plain

- The Environment Agency has indicated that as the site is within the designated flood plain a Flood Risk Assessment is required. The Agency Guidance Notes and Appendix F of PPG25 have therefore been used as guidelines for the content of this Flood Risk Assessment.

Consultation

- In preparing this FRA the Environment Agency have been consulted in terms of their requirements for a Flood Risk Assessment report and the extent of available information on flood risk affecting the proposed development site and the height of

the existing flood defences. Their views were also sought on the likely mechanisms of flooding, the run-off implications of the proposed development and any control measures they consider would be acceptable.

- The Agency's letter of 22 July 2005 indicates the proposed development site may be at risk from flooding and hence they requested that the applicant provide a Flood Risk Assessment with the planning application in accordance with PPG25 to enable the flood risk to be determined. This report fulfils this requirement.

Site Details

Location Plan

- The proposed development site is located on the west side of Shoreham (Figure 1) immediately north of the Brighton to Worthing railway line on Old Shoreham Road. The site is currently occupied by a garage and car showroom parking area (Photo 1) and is bounded by commercial and residential properties on Old Shoreham Road to the west, Victoria Road to the east and Swiss Gardens the north (Figure 2). An aerial photograph of the site and surrounding areas (Figure 3) shows the adjacent land uses and confirms this is a developed area, rather than undeveloped or functional flood plain. The site is part of the disused branch railway line to Steyning (Photo 2).
- A topographical survey of the site and surrounding area (Figure 4) provides the elevation of the site. This varies from a low point at 3.0m OD on the western boundary adjacent to Old Shoreham Road rising to 5.65m OD in the middle of the site on the old railway line and to a high point of 8.61m OD at the eastern edge of the site boundary. Old Shoreham Road is around 2.65m OD to 3.15m OD in front of the site. The variation in topography is evident in Photos 3 and 4.

The Proposed Development

- The proposed development involves the construction of a residential Care Home over four floors with 70 bedrooms and associated car parking, catering and storage facilities.
- The ground floor will be 300mm above existing ground levels at 3.3m OD (Figure 5) and will include staff rooms, kitchen and laundry facilities, plant and storage areas with covered car parking areas to the rear. There will be no residential accommodation on the ground floor. The first floor (Figure 6) at 7.3m OD will have 27 bedrooms with lounge, dining rooms and bathrooms. The second floor (Figure 7) will have a similar layout with 27 bedrooms and the third floor 15 bedrooms (Figure 8). To the rear and to the east of the building there will be two garden areas on the raised ground of the disused railway cutting, with access from the upper floors of the Care Home.
- Parts of the disused railway embankment will be removed from the higher points indicated on the topographical survey i.e. the building footprint including the undercroft car parking will all be reduced to a level of around 3.1m OD. There will

be a combination of ground level reduction and retaining walls although the details have not been fully considered as yet.

Hydrology and Flooding

Local Hydraulics and Flood Risk

- A site visit has allowed identification of the main potential sources of flooding, and any structures that could influence local hydrology and hydraulics in times of flood, as required by PPG25. The main potential source of flooding of the site is from the River Adur estuary 200m to the west of the site (Figure 1). Extreme tides in the Adur estuary could potentially overtop the local flood defences and inundate the site from west. There are no other watercourses or water bodies nearby that are likely to affect the development site.

- The Environment Agency's Flood Plain Map for Shoreham (Figure 9) suggests the east and west banks of the Adur, including the margins of the development site, could be affected by extreme flooding. However these maps assume no flood defences are present and for this location this may be unrealistic. With tidal defences this predicted extent of flooding may be unlikely to occur although this needs to be confirmed.

- A precise definition extreme flood levels is therefore required. These can be compared to the height of the existing and any planned defences to confirm whether the proposed development is acceptable in terms of flood risk. It will then be possible to determine whether the site is above or below the likely flood level and whether alleviation options or restrictions on development should be considered. This FRA therefore considers the likely maximum flood levels from the tidal River Adur and is described in Section 4.

Existing Flood Alleviation Measures

- As detailed above the main potential source of flood water is extreme tidal events on the River Adur which is 200m to the west of the proposed development site. In terms of overtopping there are three stretches of coastline or flood defences that need to be considered.

- The area to the north of Riverbank Business Centre is protected by the embankment of the disused railway line.

- Between the disused railway embankment and the existing Worthing to Brighton railway bridge is the Riverbank Business Centre flood defence. This is a wide grassed 266m long embankment (Photos 5, 6 and 7) which appears to have been subject to ad hoc repairs (Photos 8 and 9). Any flood water which overtops this defence would enter the

Riverside Business Centre and could flow eastwards towards Old Shoreham Road and the proposed development site.

- The new development at Lawsons Quay by Berkeley Homes has a new flood defence wall which is higher than the Riverside defence (Photo 10).
    - In terms of the height of these tidal flood defences a survey undertaken by the Environment Agency in 1996 suggests the top of the disused railway embankment is 5.19 to 6.03m OD, the Riverside flood defence is 3.84 to 4.09m OD and Lawsons Quay 4.23m OD (Figure 10). The low points are below the railway bridge at 2.52 to 3.03m but these probably do not form part of the flood defence.
    - As the Lawson Quay is a new development (post 1996) with a new flood defence wall the Agency's survey data was supplemented by a dedicated topographical survey undertaken in October 2005 for this flood risk assessment. This reveals the Lawsons Quay flood defence has a minimum height of 4.97 to 4.99m OD, the Riverside defences are between 3.87 and 4.27m OD and the railway embankment 5.29 to 6.0m OD. The Riverside Business Park embankment therefore forms the low point in the flood defences along this stretch of the Adur.
    - The calculation tide levels and the effectiveness of these defences is described in Section 4.

Historical Flooding

- Details of historical flooding have been sought from relevant Authorities and sources. As detailed above the Flood Plain Maps provided by the Environment Agency (Figure 9) are often based on the maximum historic flood and do not account for new or modified flood defences. These maps cannot be used as an accurate guide of historic flooding at the site and are intended to be an indicative measure of flood risk only.
- In terms of measured water levels, both the Environment Agency and Shoreham Port Authority measure fluvial flows and tide levels on the Adur and these are considered below.

Fluvial Flows and Levels

- In terms of measured water levels and fluvial flows the Environment Agency operate a number water level and flow measurement stations in the Sussex area including main rivers such as the River Arun and Adur. The nearest gauging station to the site is on the Chess Stream at Chess Bridge (Table 3.1). Although this gauge is in an upstream catchment it does form a useful indication of the date and magnitude of major fluvial flood events in the area.

Table 3.1 Environment Agency Gauging Stations Near Shoreham

CEH Ref No	Watercourse	Location	NGR	Start Date	End Date	No Years
41012	Adur	Sakeham	TQ219190	04-Nov-67	13-Nov-02	36
41014	Arun	Pallingham	TQ047229	11-Feb-74	02-Jan-03	30
41028	Chess Stream	Chess Bridge	TQ217173	20-Jan-65	02-Jan-03	39

- The largest five floods in the period of record at these three stations are provided in Table 3.2. This suggests the largest flood in the period of record was in November 1974, and other major floods include October/November 2000, December 1999 and December 1979. The October/November 2000 flood caused some disruption to the Sussex area, including closure of the A27 and the access road to Shoreham airport although there are no records of flooding at the development site at this time.

Table 3.2 Largest Floods at Environment Agency Gauging Stations

	41012 Adur at Sakeham		41014 Arun at Pallingham		41028 Chess Stream at Chess Bridge	
Rank	Date	Flow (m^3/s)	Date	Flow (m^3/s)	Date	Flow (m^3/s)
1	12-Oct-00	57.923	28 Dec 79	149.052	21-Nov-74	14.258
2	22 Nov 74	48.450	02 Oct 93	114.861	06-Nov-00	13.538
3	25 Dec 99	48.242	08 Apr 79	105.726	14-Apr-81	12.381
4	28 Dec 79	47.760	06 Nov 00	97.463	24-Dec-99	11.557
5	11 Feb 74	44.709	09 Dec 82	94.920	10-Jan-93	10.956

Tide Gauge Levels

- The Shoreham Port Authority and the Environment Agency both operate tide gauges in Shoreham Harbour (TQ235047). Records at the Port Authority began in 1950 and data are available until December 1998 although there are only 18 years of record are available in this 48 year period. The Environment Agency RECS/RTS gauge started on 5 March 1997 and records are available until September 2002. Comparison of the Agency's RTS data with the nearby Newhaven RTS gauge suggests drift occurred throughout most of 1997 and 1998 and these data are of dubious accuracy. The annual maximum data series from both gauges is provided in Appendix B and the largest 5 annual maximum tides in the period of record are provided in Table 3.3.

Table 3.3 Largest 5 Annual Maximum Tides at Shoreham Tide Gauge

Year	Date	Annual Maximum
1985	08 April 1985	3.98
1990	27 Feb 1990	3.98
1983	02 Feb 1983	3.93
2000	12 Dec 2000	3.92
1991	03 Jan 1991	3.87

- This suggests the largest tidal events in recent years were on 8 April 1985 and 27 February 1990 when levels reached 3.98m OD. Although this is higher than the ground level of the site there are no records of flooding of the site at this time.

Other Sources of Information

- Another useful source of historical flood information is the British Hydrological Society's "Chronology of British Hydrological Events" which has also been checked to provide further anecdotal evidence of flood events in the Worthing, Lancing and Shoreham area. Only one entry for Worthing exists and none for Lancing or Shoreham and this is summarised in Table 3.4.

Table 3.4 Summary of Historical Floods in Worthing and Shoreham from BHS Database

Year	Month	Day	Quotation
1867	June	3	Worthing, West Sussex: "... Rain began to fall about 10 p.m. on the night of the 2nd, and continued without cessation for five and a half hours ... The greatest downpour, however, took place between 12 midnight and 1.15 a.m. ... with very little hail ... On measuring the contents of my rain gauge next morning, I found the large amount of 2.08 inches ..."

- There is therefore no measured information, direct, historical, photographic or other evidence on the extent or depth of flood events or flood water levels on the development site.

Flood Risk at the Proposed Development site

Objectives

- The development plan (Figures 5 to 8) are for the construction of a residential care home of four storeys with associated car parking facilities. Excavation of some earth materials is anticipated from the disused railway embankment but there will be no major change to flood plain topography.
- As detailed in Sections 3.2 and 3.3, although the site lies on the edge of the Agency's Flood Plain Map (Figure 9) it is considered that a more precise definition of extreme flood levels is required. These can then be compared to the level of the flood defences, to confirm whether the proposed development site is susceptible to flooding and whether alleviation options or restrictions on development should be considered.
- The site is 200m from the Adur and in tidal estuaries it is usual that tidal extreme events give higher water levels than fluvial extremes and are considered. If the site lies above the 200 year tidal flood level the site is above the required flooding threshold, there will be no impact on flood plain hydraulics and flood storage and no major changes to the hydraulic behaviour of the site during flood events. However, if the site lies below the 200 year tidal flood level the site may be affected by flooding, could influence flood plain hydraulics, reduce flood storage and may require compensatory storage or flood prevention measures. An objective of this FRA is therefore to define the 200 year tidal flood level on the Adur, compare this to the height of the flood defences, and determine which parts of the site and the development will be affected by extreme tidal events. An assessment of extreme tidal levels and associated probabilities is therefore required.

Tide Level Probability

Extreme Tide Levels

- As detailed above the main potential source of flood water for the site and this area of Shoreham is from extreme tidal events on the River Adur estuary 200m to the west. The Environment Agency has provided a 200 year estimate of 4.40m OD for the year 2000 year tide and 4.7m OD for 2060 (Environment Agency letter of 22 July 2005) which is based on historical flood defence levels such as used in Shoreline Management Plans.
- The Proudman Oceanographic Labs (POL) Spatial Revised Joint Probability method (SRJPM) has also been used (Table 4.1) to calculate extreme sea levels

and this suggests a 200 year sea level of 3.97m OD. A more recent Agency report by JBA also calculated extreme tide levels for various return periods at Shoreham (Ref 1) and suggested a 200 year extreme sea level of 4.76m OD (Table 4.1).

Table 4.1 Extreme Sea Levels (m AOD) for Year 2000 at Shoreham

Method	Return Period (years)					
	1	10	25	50	100	200
EA Estimates						4.40
SRJPM	3.00	3.32	3.50	3.62	3.82	3.97
JBA Report	3.83	4.15	4.33	4.45	4.65	4.76

- There is therefore a range of extreme tide estimates. The main difference between SRJPM and the JBA estimates are due to the 1 year level - slope of the curves as the same. The POL method provides a 1 year level of 3.00m OD compared to JBA's 3.83m. A check on the 1 year level using peaks over threshold data from the Environment Agency's RECS/RTS gauge for the 4 year period 1st September 1998 to 30th August 2002 (Appendix C) confirms the JBA 1 year of 3.83m and is reasonable.

- In addition the Annual maximum data in Appendix B were used to derive extreme sea levels using the Generalised Logistic (GL) and General Extreme Value (GEV) distributions. The calculated sea levels (Table 4.2) suggest a 200 year sea level of 6.33m OD, although these curves are based on only 18 years of data and extension to the 200 year event is fraught with uncertainties.

Table 4.2 Extreme Sea Levels (m AOD) for 2000 at Shoreham based on RTS data

Method	Return Period (years)					
	1	10	25	50	100	200
GL	3.589	4.234	4.604	5.016	5.586	6.377
GEV	3.565	4.238	4.629	5.040	5.592	6.334

- Further examination of the annual maximum tide levels data at Shoreham and Newhaven from the Agency's RTS/RECS data suggests much of the Shoreham data between January 1997 and March 1998 is erroneous (Figure 11) due to drift and spikes. The JBA estimates may be based on this erroneous data. As per the Agency's letter of 22 July 2005 the 200 year estimate of 4.40m OD in Table 4.1 is used in preference to the POL-SRJPM, JBA and RTS data derived values in Tables 4.1 and 4.2.

- If the 1 year level is taken as 3.83m OD and the 200 year estimate is 4.40m, the other return period levels can be calculated from interpolation of growth factors between the 1 year and 200 year levels. The adopted estimated extreme levels are given in Table 4.3,

Table 4.3 Adopted Extreme Sea Levels (m AOD) for Year 2000 at Shoreham

Method	Return Period (years)					
	1	10	25	50	100	200
EA Estimates	3.83	4.02	4.12	4.19	4.32	4.40

- For the present day extreme tides Table 4.3 suggests:

- The area to the north of Riverbank Business Centre is protected by the embankment of the disused railway line at 5.33 to 5.66m OD, which is above the 200year tide level.

- The Riverbank Business Centre flood defences at 3.87 and 4.27m OD forms the low point along this stretch of coastline. The 200 year tide is above the minimum height of these defences and this defence is susceptible to overtopping for the 5 year flood and above. Any flood water could then enter the Riverside Business Centre, flow eastwards towards Old Shoreham Road and to the proposed development site. The minimum height of the existing flood defences is between the 5 and 10 year level.

- The new Berkeley Homes development at Lawsons Quay has a new flood defence wall with a minimum height of 4.97 to 4.99m OD, which is above the present day 200 year extreme sea level.

Climate Change Impacts

- The definition of defence standards for tidal areas should include an allowance for climate change for the lifetime of the development as required by PPG25, which is usually taken as 50 years or to 2060. In July 1989 MAFF announced a strategy to respond to global warming, embracing the use of current predictions of sea level rise in reviewing existing standards for coastal defences. The Inter Governmental Panel on Climate Change (Ref 2) offered predictions of global sea level rise for various scenarios of which the 'IPCC best estimate trend' is accepted as the most appropriate at this time. More recent estimates by MAFF (Ref 3), and the Climate Change Impacts Review Group (Ref 4) indicate a global sea level rise of 19cm by the 2020s (i.e. 7.6 mm/yr) and 37cm by the 2050s (i.e. 6.7mm/yr).

- The climate change sea-level rise estimates from MAFF's project appraisal guidance for climate change defence levels have been adopted. These predictions have been accepted as providing the best basis for the appraisal of coastal

defences and the accepted rates, also allowing for isostatic rebound and crustal movements, for the various Environment Agency regions are given in Table 4.4.

Table 4.4 Regional Rates of Relative Sea Level Rise

Environment Agency Region	Allowance (mm/year)
Anglian, Thames and Southern	6.0
North West and North East	4.0
Other Environment Agency Regions	5.0

- The EA extreme tide levels in Table 4.3 are therefore adjusted to account for sea level rise to a design year of 2060 by including the predicted sea level rise in Southern Region provided by MAFF (Table 4.4) of 6 mm/year and the results given in Table 4.5. This suggests a 200 year level of 4.70m OD at Shoreham by 2060.

Table 4.5 Assumed Extreme Sea Levels (m AOD) for Year 2060 at Shoreham

Method	Return Period (years)					
	1	10	25	50	100	200
EA Estimates	4.13	4.32	4.42	4.49	4.62	4.70

- In terms of overtopping of the three defences, by 2060;

- The area to the north of Riverbank Business Centre is protected by the embankment of the disused railway line which provides protection to 5.33 to 5.66m OD which is above the 2060 200year tide level.

- The Riverbank Business Centre flood defence between 3.87 and 4.27m OD is susceptible to the 1 year extreme tidal event and above by 2060. This embankment forms the low point along this stretch of coastline.

- The Berkeley Homes development at Lawsons Quay by has a new flood defence wall of 4.97 to 4.99m OD which is at above the 200 year extreme sea level.

  - Due to the relatively low elevation of the Riverside Business Centre embankment , extreme tidal events in the Adur estuary are likely to overtop this defence, inundate the Riverside Business Park and water could then flow across Old Shoreham Road towards the development site. Whether this occurs is dependent on flooding mechanisms as described below.

Flooding Mechanisms

- Due to the relatively low elevation of the flood defence adjacent to the Riverside Business Centre the most likely flood route for an extreme tidal event in Adur estuary is by overtopping this flood defences, inundation of the Riverside Business Park and water would then flow across Old Shoreham Road towards the development site. The degree of overtopping, volume of inundation and maximum flood levels in this area is dependent on two relationships;

- the height verses flow relationship of the defence, and the relative level of the defence and extreme tide level, and
- the height -storage relationship of the area behind the sea wall which dictates how the overflow volume fills up the storage area behind the defence and hence to what level the overtopped volume would rise.

- Both of these are based on limited survey data but on the basis of the assumptions given below these relationships can be approximated and used to determine the likely water levels behind this flood defence when it is overtopped.

Height verses flow relationship of the flood defence

- The grass embankment alongside the Riverside Business Centre is variable in height between 3.866 and 4.268m OD and a relationship between level and flow has been derived based on the topographical survey. This is approximated as:

Flow (m^3/s) =50.086*(Head) $^{1.7629}$

- The relationship is provided in Table 4.6 and suggests the 200 year 2000 extreme tide of 4.4m OD would result in a flow over the flood defence of 16.57 m^3/s or 994m^3/min. The 2060 200 year tide of 4.70m would allow 36.37 m^3/s or 2182m^3/min, principally as this tide is 0.834m above the minimum elevation of the flood defence, and the defence is 260m wide at this level.

Table 4.6 Height verse Flow Relationship for Riverside Flood Defence

Level (m OD)	Head (m)	Flow (m^3/s)	Flow (m^3/min)
3.866	0.0	0.00	0.0
3.9	0.034	0.13	7.7
4.0	0.134	1.45	86.9
4.1	0.234	3.87	232.2
4.2	0.334	7.25	434.8
4.3	0.434	11.50	689.9
4.4	0.534	16.57	994.4
4.5	0.634	22.43	1345.8
4.6	0.734	29.04	1742.2
4.7	0.834	36.37	2182.2

Height -storage relationship of the Flood Cell

- The height -storage relationship of the area behind the sea wall is based on limited topographical survey data, but the Riverside Business Centre is assumed to be a triangular area of 160m by 175m with a minimum ground level at 1.80m OD. Once water levels exceeds the entrance on Old Shoreham Road, which is at 3.0m OD, any flood water would flow northwards along this road and north east towards Buckingham Street. This area is assumed to 30m by 400m. The volume of each of these two areas, and the combined volume, is given in Table 4.7.

- A comparison of Tables 4.6 and 4.7 suggests the 200 year 2000 tide of 4.4m would allow 16.57 m^3/s, 994m^3/min or 29,820m^3 in a 30 minute period which, if it occurred would cause water levels to rise to 3.5m OD. The 2060 200 year tide of 4.7m would allow 36.37 m^3/s, 2,182m^3/min or 65,460m^3 in a 30 minute period which, if it occurred would cause water levels in the flood cell to rise to 4.7m OD.

- These are obvious simplifications as tidal water levels rise and fall slowly and hence the volume of overtopping would also change as tidal height varies. The use of a dynamic approach to model these changing water levels, overtopping rates and resultant flood levels is detailed below.

Table 4.7 Height verse Storage Relationship behind Riverside Flood Defence

	Riverside			Old Shoreham Road			Total
H	W	L	Vol (m3)	W	L	Vol (m3)	Vol (m3)
1.8	80	120	1000				1000
2.0	100	140	2400				2400
2.2	120	160	4320				4320
2.4	140	175	6770				6770
2.6	160	175	9570				9570
2.7	160	175	10970				10970
2.8	160	175	12370				12370
2.9	160	175	13770			0	13770
3.0	160	175	15170	20	400	2400	17570
3.1	160	175	16570	20	400	2800	19370
3.2	160	175	17970	30	400	3400	21370
3.3	160	175	19370	30	400	4000	23370
3.4	160	175	20770	30	400	4600	25370
3.5	160	175	22170	30	400	5200	27370
4.0	160	175	29170	30	400	8200	37370
4.2	160	175	31970	30	400	9400	41370
4.4	160	175	34770	30	400	10600	45370
4.6	160	175	37570	30	400	11800	49370

Dynamic Modelling

- The rise and fall of an extreme tidal event has been considered by dynamic modelling of the Adur water levels, overtopping of the Riverside flood defences and how water levels in Riverside Business Centre and Old Shoreham Road would vary. The calculations are based on the generation of three consecutive tidal cycles using harmonic constants provided in the Admiralty Tide Tables. The head of water above the flood defence is used to calculate flow over the Riverside flood wall using the rating equation described above. The model then calculates water levels behind the sea wall based on the height verses storage relationship detailed above. It is assumed the only flow from the flooded area back to the estuary occurs over the sea wall rather than through any low level drainage pipes or flapped valves and these calculations therefore represent a worst case.

- Figure 12 shows that the 200 year tide of 4.40m results in a large influx of water over the flood defence during the first tide so that water levels in the flood cell are the same as in the estuary. This suggests water levels would be continuous across the estuary, the Riverside Business Park and Old Shoreham Road, reaching the same water level of 4.4m OD. As stated above this is occurs because the existing

flood defence is low (3.866m OD) and wide (260m) allowing a full interchange of water to the Shoreham area. The calculations are given in Appendix D.

- Figure 13 shows that the 200 year 2060 tide of 4.70m which also show that flood water becomes continuous across the estuary, Riverside Business Park flood cell and Old Shoreham Road, reaching the same water level of 4.7m OD. The calculations are given in Appendix E.

- In conclusion due to the low level of the existing flood defence (3.866m OD) and width (260m) a full interchange of water will occur during extreme tidal events with the Riverside Business Park, the proposed development site and much of this part of Shoreham flooded to he same level as the estuary.

Recent Events

- As detailed in Table 3.3, the largest events in recent years occurred on 6 April 1985 and 27 February 1990 when tide levels in Shoreham Harbour reached 3.96m OD. This would have resulted in overtopping of the Riverside flood defences (at 3.866m OD) but there were no reports of flooding of the proposed development site at these times. Figure 14 shows the assumed tidal curve for this event and confirms that water levels in the flood cell would have reached 1.87, 2.04 and 2.22m OD if the same water level occurred on three consecutive tides. Any flood water would therefore have been contained within the Riverside Business Park and would not have reached Old Shoreham Road at 3.0m OD.

- The limited extent of flooding that would have occurred during these events is due to the small head of water over the flood defence (less than 10 cm) and for a limited time (1 hour or less) and hence flow volumes would have been small. The model suggests the volume of water that would have flowed over the wall on each tide would have been between 2000 and 4000 m^3, which as Table 4.7 indicates would have caused only a small rise in water levels.

Flood Defence Options

- The Agency have a preliminary scheme to improve the flood defences along the western frontage of the River Adur to a level of 4.7m OD, probably by 2007/2008. Some degree of flood protection to the proposed development site, the Riverside Business Park and this area of Shoreham could also be provided if the eastern Adur flood defences at the Riverside Business Park were also raised.

- The predicted water levels in the Riverside Business Park flood cell have been calculated using the dynamic model detailed above and the results are summarised in Table 4.8. Raising the flood defence to 4.4m or below would have little impact if three tides occurred consecutively and would not protect the site from flooding by

overtopping. Raising this defence to 4.5 or 4.6m would offer some protection and reduced water levels and a new defence at 4.7m would fully protect the site.

Table 4.8 Flood Cell Water Levels (m AOD) for 2060 200 year tide at Shoreham

	Flood Defence Level							
Tide	**3.866**	**4.0**	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**
Tide 1	4.70	4.70	4.50	3.98	3.14	2.48	1.90	1.80
Tide 2	4.70	4.70	4.70	4.70	4.04	2.95	2.09	1.80
Tide 3	4.70	4.70	4.70	4.70	4.62	3.32	2.27	1.80

- These are indicative calculations, based on an uncalibrated model, but serve to show the inadequacy of the existing flood defence. The calculations do not include a breach of any of the Shoreham flood defences and hence it may be prudent to ensure all floor levels for the proposed development are above the 20060 200 year tide level of 4.7m OD with an additional 300mm freeboard, or at 5.0m OD.

Site Cross Sections

- PPG25 requires that cross-sections of the site are provided showing finished floor, road and any other relevant levels relative to the source of flooding and to anticipated water levels and associated probabilities. The flood levels in relation to the existing site cross sections are shown on Figures 15 and 16 for east west section across the middle and southern part of the site. The degree of land lowering is not known at this stage. This confirms the 200 year flood will inundate the western part of the development site on the lower ground adjacent to Old Shoreham Road. The higher parts of the site will not flood. However the proposed ground floor level at 3.1m OD will be susceptible to flooding by 2060 by the 1 year event.

Flood Characteristics

Speed and Duration of Flooding

- PPG25 requires an assessment of the likely rate or speed with which flooding might occur, the order in which various parts of the location or site might flood and the likely duration of flood events. Appendix E suggest the 2060 flood will overtop at 11:30 and reach the level of Old Shoreham Road by 12:15, i.e. within 45 minutes, which is fairly rapid. This is a worst case estimate base on one dimensional modelling and the actual rate will depend on obstacles in the flood cell, flood plain roughness etc. However, it is likely that the lower parts of the site will flood within 1 to 2 hours. The higher parts of the site on which the development will be built are not expected to flood during the 200 year event. There will be safe access onto dry higher ground from the site.

Volume of Displacement

- The volume of water which would be displaced from the site for various flood levels, before and after development, is usually compared to determine the need for compensatory storage. However, as the area proposed for development is a replacement of existing buildings and built ground there is no requirement for compensatory storage.

- PPG25 requires an assessment of the likely impact of any displaced water on neighbouring or other locations that might be affected subsequent to development. This should include the potential for a change of the flooding regime both upstream and downstream of the site due to ground raising or flood embankments. As detailed above, it is likely that there will be no additional displaced water and hence no changes in flooding potential for upstream and downstream sites.

Runoff Generation

- The run-off likely to be generated from the development can be calculated using FEH rainfall data. However, as the development will occur on similar impermeable hard standing, the runoff will be similar to the existing situation. The 100 year storm will generate the same volume of runoff as the land use of the site will not be changed. The use of Sustainable Urban Drainage Systems (SUDS) as part of the development plans could further reduce the volume of runoff but as the volumes

are small, due to the small foot print of the development, this is not considered further.

Fluvial Morphology

- There is considered to be no potential impact of the development on fluvial morphology nor on the likely longer-term stability and sustainability of any watercourses.

Residual Risks

- The residual risks are assessed after the construction of any necessary defences. As new or modified flood defence arrangements are not provided, the consideration of their behaviour under extreme events is not required.

PPG25 - The Sequential Test

- PPG25 provides a sequential test which developers and the Planning Authority should consult in considering sites for development. This is provided in paragraph 30 of PPG25.
- The predicted flood levels are based on a tidal inundation model of the area and suggest the site can be considered to inside the Agency's defined Flood Zone 3. Zone 3 areas are considered as one of either developed areas, undeveloped areas or functional flood plains and the site is clearly an existing developed area. Paragraph 30 of PPG25 indicates that Zone 3 developed areas may be suitable for residential, commercial or industrial development provided the appropriate minimum standard of flood defences ((including suitable warning and evacuation procedures) can be maintained for the lifetime of the development. If a raised flood wall is constructed then the sequential test suggests that development at this site should be permitted. Alternatively ensuring all floor levels are above the predicted flood level with freeboard, and with safe escape and access, would also suggest this development could be considered.

Conclusions

- The requirements for a flood risk assessment are provided in Planning Policy Guidance Note 25: Development and Flood Risk (PPG25) together with the Environment Agency's Guidance Notes.
- The proposed development will involve the construction of a four-storey residential Care Home with associated car parking facilities.
- The site lies within 200m of the tidally affected River Adur which forms the main potential source of fluvial flooding of the site and inundation from extreme sea levels overtopping the Adur defences is also considered the most likely route of flood water.
- The Environment Agency suggests a 200 year tide level at Shoreham of 4.40m OD which, allowing for a climatic change increase of 6mm/yr suggests a 200 year level of 4.700m OD by 2060.
- Flood defence crest levels for the Adur estuary are 4.99m at the Lawson Quay, 5.50m to the north at the disused railway embankment and these are well above the predicted 200 year tide level. The Riverside Business Park defence is at 3.866m OD and these defences are insufficient for the 2000 and 2060 predicted 200 year flood. Overtopping may therefore be expected to occur under extreme tidal conditions.
- A dynamic model has been used to calculate the rate of overtopping of these defence under extreme tidal condition based on the width and height of the defence at different levels and the height verse storage relationship of the Riverside Business park and Old Shoreham Road flood cell. This suggests the 2000 and 2060 flood would be continuous across the estuary and flood cell due to the low level and large width of the flood defences at this location.
- Calculations suggest a scheme to improve the defences along the Riverside Business Park river frontage to a level of 4.7m OD would prevent flooding of the site.
- Any flooding suggests water levels at the development site will rise fairly rapidly and reach the same level as the in the tidal estuary. There is safe access onto dry higher ground within the site.
- The development includes buildings or structures below the 200 year flood level and these are at risk from flooding. It is recommended that all floor levels are 300mm higher than the predicted 200 year 2060 flood levels of 4.7m OD, i.e. at 5.0m OD. There will be

no displaced water, no change in the flooding potential for sites upstream and downstream and hence no requirement for compensatory storage.

- The site will generate the same volume of runoff as the existing situation as the land use of the site will not be changed. The use of Sustainable Urban Drainage Systems (SUDS) as part of the development plans could reduce the volume of runoff but the beneficial effects would be small due to the small footprint of the development compared to the existing situation.

- In terms of PPG25 the predicted flood levels are based on a tidal inundation model of the area and suggest that the site can be considered to be inside the Agency's defined Flood Zone 3. Zone 3 areas are considered as developed areas, undeveloped areas or functional flood plains and the site is clearly an existing developed area. Paragraph 30 of PPG25 indicates that Zone 3 developed areas may be suitable for residential, commercial or industrial development provided the appropriate minimum standard of flood defences (including suitable warning and evacuation procedures) can be maintained for the lifetime of the development. If a raised flood wall is constructed then the sequential test suggests that development at this site should be permitted. Alternatively ensuring all floor levels are above the predicted flood level with freeboard, and with safe escape and access, would also suggest this development could be considered.

References

1. Report on Regional Extreme Tide Levels, EA Southern Region, JBA, February 2003.

2. The Inter Governmental Panel on Climate Change (1990). Houghton, J. T., Jenkins, G. J., & Ephralms, J. J. (1990). Climate Change: the IPCC Scientific Assessment. Cambridge University Press: Cambridge.

3. MAFF (1993)

4. Climate Change Impacts Review Group, (1996). Review of the Potential Effects of Climate Change in the United Kingdom. Second Report, prepared for the Department of the Environment. HMSO. London: 247 pp.

Figures

Appendices

Appendix A

Guidance on Requirements for Undertaking a Flood Risk Assessment. (PPG25 (App F).

Appendix A Guidance on Requirements for Undertaking a Flood Risk Assessment. PPG25 (Appendix F).

F1 This guidance relates only to the commissioning and undertaking of flood risk assessment studies at particular sites or over particular areas

Flood Risk Assessments

F2. Flood risk assessments may be of a relatively minor nature, evaluating a small development on a low risk site with minimal secondary effects, or may comprise major basin-wide studies for significant infrastructure developments. On occasions, preliminary or scoping studies may be undertaken prior to a fuller assessment. Developers should consult the Environment Agency and other relevant operating authorities to determine what information is already available on flood risk potentially affecting or affected by their site and its proposed development. They should also take full account of the local knowledge of flooding in the community.

F3. The detail and technical complexity of a flood risk report will reflect the scale and potential significance of the study but, in all cases, whenever a flood risk assessment is undertaken for any location, the resulting report should address, as a minimum, the following requirements:

1. A location plan at an appropriate scale that includes geographical features, street names and identifies all watercourses or other bodies of water in the vicinity. This should include drainage outfalls and, if necessary, cross-refer to their operational arrangements in the body of the report.
2. A plan of the site showing levels related to Ordnance Datum, both current and following development.
3. A more detailed indication, if appropriate, of flood alleviation measures already in place, of their state of maintenance and their performance.
4. An assessment of the source of potential flooding - rivers, tidal, coastal, groundwater, surface flow or any combination of these.
5. A plan of the site showing any existing information on extent and depth of flood events or on flood predictions. Information may be anecdotal, photographic, survey results or model estimates. The events should be identified with date/time, source of the data and supporting information provided on rainfall and/or return period, or probability of occurrence of the flood or storm surge event, or combination. Recorded data are particularly valuable and, if available, should be highlighted along with evidence of any observed trends in flood occurrence. Any changes that have taken place since the last event should be identified.
6. A plan and description of any structures which may influence local hydraulics. This will include bridges, pipes/ducts crossing the watercourse, culverts, screens, embankments or walls, overgrown or collapsing channels and their likelihood to choke with debris.
7. An assessment of the probabilities and any observed trends and the extent and depth of floods for the location and in the catchment context and, if appropriate, routes and speed of water flow. At this stage best estimates, based on the most up-to-date findings, should also be made of climate change impacts on probabilities. The assessment should ensure that the development meets an acceptable standard of flood defence for the design life of the development.
8. A cross-section of the site showing finished floor levels or road levels, or other relevant levels relative to the source of flooding, and to anticipated water levels and associated probabilities.
9. An assessment of the likely rate or speed with which flooding might occur, the order in which various parts of the location or site might flood, the likely duration of flood events and the economic, social and environmental consequences/impacts of flooding.
10. An assessment of the hydraulics of any drains or sewers, existing or proposed, on the site during flood events. The methodology for assessment must be clearly stated.

11. An estimate of the volume of water which would be displaced from the site for various flood levels following development of the site and of the run-off likely to be generated from the development proposed.
12. An assessment of the likely impact of any displaced water on neighbouring or other locations which might be affected subsequent to development. This should address the potential for change of the flooding regime both upstream and downstream of the site due to ground raising or flood embankments.
13. An assessment of the potential impact of any development on fluvial or coastal morphology and the likely longer-term stability and sustainability.
14. Because of the uncertainties in flood estimation and expected climate change impacts, hydrological analysis of flood flows and definition of defence standards should include the allowances for increased flows and sea-level rise in MAFF's project appraisal guidance for flood defence cited in Appendix A.
15. An assessment of the residual risks after the construction of any necessary defences. Where new or modified flood defence arrangements are provided, consideration should always be given to their behaviour in extreme events greater than those for which they are designed and information should be provided on the consideration given to minimising risks to life in such circumstances.

Appendix B

Shoreham Tide Gauge Annual Maximum (AMAX) data

Shoreham Tide Gauge Annual Maximum (AMAX) data

	Shoreham PA		Environment Agency Data	
	Date	AMAX	Date	AMAX
1967	05/10/67 12:06	3.84		
1968				
1969				
1970				
1971				
1972				
1973				
1974				
1975				
1976				
1977				
1978	11/01/78 00:12	3.61		
1979				
1980				
1981				
1982				
1983	02/02/83 02:22	3.93		
1984				
1985	08/04/85 00:37	3.98		
1986				
1987	07/10/87 10:48	3.77		
1988	16/09/89 23:59	3.65		
1989	13/12/89 11:32	3.74		
1990	27/02/90 00:28	3.98		
1991	03/01/91 00:36	3.87		
1992				
1993	11/01/93 13:02	3.8		
1994	26/02/94 23:55	3.68		
1995	23/12/95 11:42	3.84		
1996				
1997	14/01/97 23:48	3.55	*25/07/97 14:45*	*5.508*
1998			*14/01/98 00:15*	*4.029*
1999	24/10/99 10:32	3.83	*06/11/99 22:30*	*3.940*
2000			12/12/00 23:30	3.92
2001			12/03/01 00:30	3.857
2002			01/03/02 00:15	3.669

RTS data discounted for period 1997 to 1999 due to drift and spikes in data set.

Appendix C

Calculation of the 1 Year Tide Level from Shoreham RTS records

Calculation of the 1 Year Tide Level from Shoreham RTS records

Date	Level		Parameter	Value
06/11/99 22:30	3.94		No Yrs	4
12/12/00 23:30	3.92		Average	3.681
09/09/98 12:45	3.894		No Values	20
06/11/98 12:15	3.87		Minimum	3.506
12/03/01 00:30	3.857		Lamda	5
25/12/99 01:00	3.775		Beta	0.175
19/09/01 12:45	3.703			
04/01/99 00:15	3.693		Return Period (yrs)	Level
08/10/98 12:30	3.691		1	3.788
19/10/01 12:45	3.684			
01/03/02 00:15	3.669			
29/09/00 12:30	3.597			
17/02/99 11:30	3.579			
10/02/01 12:30	3.568			
29/01/02 11:45	3.564			
21/08/01 13:00	3.535			
29/04/02 00:45	3.535			
18/04/99 00:00	3.527			
05/12/98 11:45	3.522			
01/09/00 13:30	3.506			

Appendix D

Tide Calculations and flow into Riverside Flood cell for 2000 200 year flood of 4.4m OD

Tide Calculations and flow into Riverside Flood cell for 2000 200 year flood of 4.4m OD

t (hrs)	Tide Level		Head (m)	Q (m3/s)	Vol (m3)	Culm Vol	Flood Cell Level
18/11/00 07:00:00	-2.819		0	0.000	0	0	1.80
18/11/00 07:15:00	-2.724		0	0.000	0	0	1.80
18/11/00 07:30:00	-2.573		0	0.000	0	0	1.80
18/11/00 07:45:00	-2.370		0	0.000	0	0	1.80
18/11/00 08:00:00	-2.116		0	0.000	0	0	1.80
18/11/00 08:15:00	-1.816		0	0.000	0	0	1.80
18/11/00 08:30:00	-1.474		0	0.000	0	0	1.80
18/11/00 08:45:00	-1.097		0	0.000	0	0	1.80
18/11/00 09:00:00	-0.689		0	0.000	0	0	1.80
18/11/00 09:15:00	-0.258		0	0.000	0	0	1.80
18/11/00 09:30:00	0.190		0	0.000	0	0	1.80
18/11/00 09:45:00	0.647		0	0.000	0	0	1.80
18/11/00 10:00:00	1.106		0	0.000	0	0	1.80
18/11/00 10:15:00	1.560		0	0.000	0	0	1.80
18/11/00 10:30:00	2.002		0	0.000	0	0	1.80
18/11/00 10:45:00	2.424		0	0.000	0	0	1.80
18/11/00 11:00:00	2.819		0	0.000	0	0	1.80
18/11/00 11:15:00	3.182		0	0.000	0	0	1.80
18/11/00 11:30:00	3.506		0	0.000	0	0	1.80
18/11/00 11:45:00	3.786		0	0.000	0	0	1.80
18/11/00 12:00:00	4.018		0.1524	1.818	1636	1636	1.89
18/11/00 12:15:00	4.198		0.3322	7.179	6462	8098	2.49
18/11/00 12:30:00	4.323		0.457	12.594	11334	19432	2.91
18/11/00 12:45:00	4.391		0.5246	16.063	14457	33889	3.58
18/11/00 13:00:00	4.400		0.534	16.575	14917	48806	4.28
18/11/00 13:15:00	4.351		0.0713	0.477	429	49235	4.30
18/11/00 13:30:00	4.244		-0.055	-0.305	-274	48961	4.29
18/11/00 13:45:00	4.082		-0.205	-3.069	-2762	46199	4.16
18/11/00 14:00:00	3.866		-0.292	-5.715	-5143	41056	4.13
18/11/00 14:15:00	3.600		-0.265	-4.819	-4337	36719	3.93
18/11/00 14:30:00	3.288		-0.062	-0.377	-339	36380	3.91
18/11/00 14:45:00	2.936		-0.047	-0.225	-202	36177	3.90
18/11/00 15:00:00	2.549		-0.037	-0.151	-136	36042	3.90
18/11/00 15:15:00	2.133		-0.031	-0.108	-98	35944	3.89
18/11/00 15:30:00	1.694		-0.026	-0.082	-74	35871	3.89
18/11/00 15:45:00	1.241		-0.023	-0.064	-57	35813	3.89
18/11/00 16:00:00	0.780		-0.02	-0.051	-46	35767	3.88
18/11/00 16:15:00	0.318		-0.018	-0.042	-38	35729	3.88
18/11/00 16:30:00	-0.136		-0.016	-0.035	-31	35698	3.88
18/11/00 16:45:00	-0.576		-0.015	-0.030	-27	35671	3.88
18/11/00 17:00:00	-0.995		-0.013	-0.025	-23	35649	3.88
18/11/00 17:15:00	-1.385		-0.012	-0.022	-20	35629	3.88
18/11/00 17:30:00	-1.741		-0.012	-0.019	-17	35612	3.88
18/11/00 17:45:00	-1.949		-0.011	-0.017	-15	35596	3.88
18/11/00 18:00:00	-2.219		-0.01	-0.015	-13	35583	3.88
18/11/00 18:15:00	-2.440		-0.009	-0.013	-12	35571	3.87
18/11/00 18:30:00	-2.608		-0.009	-0.012	-11	35560	3.87
18/11/00 18:45:00	-2.720		-0.008	-0.011	-10	35551	3.87
18/11/00 19:00:00	-2.774		-0.008	-0.010	-9	35542	3.87
18/11/00 19:15:00	-2.769		-0.007	-0.009	-8	35534	3.87
18/11/00 19:30:00	-2.707		-0.007	-0.008	-7	35527	3.87
18/11/00 19:45:00	-2.587		-0.007	-0.007	-7	35520	3.87
18/11/00 20:00:00	-2.411		-0.006	-0.007	-6	35514	3.87
18/11/00 20:15:00	-2.183		-0.006	-0.006	-6	35508	3.87
18/11/00 20:30:00	-1.906		-0.006	-0.006	-5	35503	3.87
18/11/00 20:45:00	-1.585		-0.006	-0.005	-5	35498	3.87
18/11/00 21:00:00	-1.225		-0.005	-0.005	-5	35493	3.87

18/11/00 21:15:00	-0.832		-0.005	-0.005	-4	35489	3.87
18/11/00 21:30:00	-0.412		-0.005	-0.004	-4	35485	3.87
18/11/00 21:45:00	0.028		-0.005	-0.004	-4	35482	3.87
18/11/00 22:00:00	0.481		-0.005	-0.004	-3	35478	3.87
18/11/00 22:15:00	0.939		-0.004	-0.004	-3	35475	3.87
18/11/00 22:30:00	1.395		-0.004	-0.003	-3	35472	3.87
18/11/00 22:45:00	1.841		-0.004	-0.003	-3	35469	3.87
18/11/00 23:00:00	2.271		-0.004	-0.003	-3	35466	3.87
18/11/00 23:15:00	2.677		-0.004	-0.003	-3	35464	3.87
18/11/00 23:30:00	3.053		-0.004	-0.003	-2	35461	3.87
18/11/00 23:45:00	3.392		-0.004	-0.003	-2	35459	3.87
19/11/00 00:00:00	3.689		-0.004	-0.002	-2	35457	3.87
19/11/00 00:15:00	3.939		0.0691	0.451	405	35862	3.89
19/11/00 00:30:00	4.137		0.2491	4.320	3888	39750	4.07
19/11/00 00:45:00	4.282		0.2121	3.253	2928	42678	4.21
19/11/00 01:00:00	4.370		0.1632	2.050	1845	44523	4.29
19/11/00 01:15:00	4.400		0.1067	0.970	873	45396	4.33
19/11/00 01:30:00	4.371		0.037	0.150	135	45530	4.34
19/11/00 01:45:00	4.283		-0.057	-0.317	-285	45245	4.33
19/11/00 02:00:00	4.139		-0.187	-2.617	-2355	42890	4.22
19/11/00 02:15:00	3.941		-0.276	-5.182	-4664	38227	4.00
19/11/00 02:30:00	3.690		-0.133	-1.426	-1284	36943	3.94
19/11/00 02:45:00	3.393		-0.073	-0.495	-445	36497	3.92
19/11/00 03:00:00	3.053		-0.052	-0.274	-246	36251	3.91
19/11/00 03:15:00	2.676		-0.041	-0.176	-159	36092	3.90
19/11/00 03:30:00	2.268		-0.033	-0.124	-111	35981	3.89
19/11/00 03:45:00	1.835		-0.028	-0.091	-82	35899	3.89
19/11/00 04:00:00	1.386		-0.024	-0.070	-63	35835	3.89
19/11/00 04:15:00	0.926		-0.021	-0.056	-50	35785	3.88
19/11/00 04:30:00	0.464		-0.019	-0.045	-41	35744	3.88
19/11/00 04:45:00	0.007		-0.017	-0.038	-34	35710	3.88
19/11/00 05:00:00	-0.438		-0.015	-0.032	-28	35682	3.88
19/11/00 05:15:00	-0.863		-0.014	-0.027	-24	35658	3.88
19/11/00 05:30:00	-1.451		-0.013	-0.023	-21	35637	3.88
19/11/00 05:45:00	-1.816		-0.012	-0.020	-18	35619	3.88
19/11/00 06:00:00	-2.143		-0.011	-0.018	-16	35603	3.88
19/11/00 06:15:00	-2.425		-0.01	-0.016	-14	35588	3.88
19/11/00 06:30:00	-2.657		-0.01	-0.014	-13	35576	3.88
19/11/00 06:45:00	-2.837		-0.009	-0.012	-11	35565	3.87
19/11/00 07:00:00	-2.961		-0.009	-0.011	-10	35555	3.87
19/11/00 07:15:00	-3.027		-0.008	-0.010	-9	35545	3.87
19/11/00 07:30:00	-3.034		-0.008	-0.009	-8	35537	3.87
19/11/00 07:45:00	-2.981		-0.007	-0.008	-8	35530	3.87
19/11/00 08:00:00	-2.870		-0.007	-0.008	-7	35523	3.87
19/11/00 08:15:00	-2.702		-0.007	-0.007	-6	35516	3.87
19/11/00 08:30:00	-2.479		-0.006	-0.007	-6	35510	3.87
19/11/00 08:45:00	-2.206		-0.006	-0.006	-5	35505	3.87
19/11/00 09:00:00	-1.887		-0.006	-0.006	-5	35500	3.87
19/11/00 09:15:00	-1.526		-0.005	-0.005	-5	35495	3.87
19/11/00 09:30:00	-1.130		-0.005	-0.005	-4	35491	3.87
19/11/00 09:45:00	-0.704		-0.005	-0.005	-4	35487	3.87
19/11/00 10:00:00	-0.257		-0.005	-0.004	-4	35483	3.87
19/11/00 10:15:00	0.206		-0.005	-0.004	-4	35480	3.87
19/11/00 10:30:00	0.677		-0.005	-0.004	-3	35476	3.87
19/11/00 10:45:00	1.148		-0.004	-0.003	-3	35473	3.87
19/11/00 11:00:00	1.612		-0.004	-0.003	-3	35470	3.87
19/11/00 11:15:00	2.060		-0.004	-0.003	-3	35467	3.87
19/11/00 11:30:00	2.487		-0.004	-0.003	-3	35465	3.87
19/11/00 11:45:00	2.884		-0.004	-0.003	-2	35462	3.87
19/11/00 12:00:00	3.246		-0.004	-0.003	-2	35460	3.87
19/11/00 12:15:00	3.567		-0.004	-0.002	-2	35458	3.87
19/11/00 12:30:00	3.842		-0.004	-0.002	-2	35456	3.87

19/11/00 12:45:00	4.066		0.1964	2.841	2557	38012	3.99
19/11/00 13:00:00	4.235		0.2463	4.235	3811	41823	4.17
19/11/00 13:15:00	4.347		0.1804	2.446	2202	44025	4.27
19/11/00 13:30:00	4.400		0.1307	1.386	1248	45273	4.33
19/11/00 13:45:00	4.394		0.0657	0.413	371	45644	4.35
19/11/00 14:00:00	4.327		-0.018	-0.042	-38	45606	4.34
19/11/00 14:15:00	4.202		-0.141	-1.593	-1434	44172	4.28
19/11/00 14:30:00	4.020		-0.256	-4.544	-4089	40083	4.09
19/11/00 14:45:00	3.785		-0.22	-3.459	-3113	36970	3.94
19/11/00 15:00:00	3.499		-0.074	-0.510	-459	36511	3.92
19/11/00 15:15:00	3.168		-0.053	-0.280	-252	36259	3.91
19/11/00 15:30:00	2.797		-0.041	-0.179	-161	36098	3.90
19/11/00 15:45:00	2.392		-0.033	-0.125	-113	35985	3.89
19/11/00 16:00:00	1.959		-0.028	-0.093	-83	35902	3.89
19/11/00 16:15:00	1.506		-0.024	-0.071	-64	35838	3.89
19/11/00 16:30:00	1.040		-0.021	-0.056	-51	35787	3.88
19/11/00 16:45:00	0.568		-0.019	-0.046	-41	35746	3.88
19/11/00 17:00:00	0.097		-0.017	-0.038	-34	35712	3.88
19/11/00 17:15:00	-0.364		-0.015	-0.032	-29	35683	3.88
19/11/00 17:30:00	-0.808		-0.014	-0.027	-24	35659	3.88
19/11/00 17:45:00	-1.228		-0.013	-0.023	-21	35638	3.88
19/11/00 18:00:00	-1.618		-0.012	-0.020	-18	35619	3.88
19/11/00 18:15:00	-1.971		-0.011	-0.018	-16	35603	3.88
19/11/00 18:30:00	-2.281		-0.01	-0.016	-14	35589	3.88
19/11/00 18:45:00	-2.543		-0.01	-0.014	-13	35576	3.88
19/11/00 19:00:00	-2.753		-0.009	-0.013	-11	35565	3.87
19/11/00 19:15:00	-2.909		-0.009	-0.011	-10	35555	3.87
19/11/00 19:30:00	-3.007		-0.008	-0.010	-9	35546	3.87
19/11/00 19:45:00	-3.046		-0.008	-0.009	-8	35537	3.87
19/11/00 20:00:00	-3.025		-0.007	-0.008	-8	35530	3.87
19/11/00 20:15:00	-2.944		-0.007	-0.008	-7	35523	3.87
19/11/00 20:30:00	-2.806		-0.007	-0.007	-6	35517	3.87

Appendix E

Tide Calculations and flow into Riverside Flood cell for 2060 200 year flood of 4.7m OD

Tide Calculations and flow into Riverside Flood cell for 2060 200 year flood of 4.7m OD

t (hrs)	Tide Level		Head (m)	Q (m3/s)	Vol (m3)	Culm Vol	Flood Cell Level
18/11/00 07:00:00	-2.519		0	0.000	0	0	1.80
18/11/00 07:15:00	-2.424		0	0.000	0	0	1.80
18/11/00 07:30:00	-2.273		0	0.000	0	0	1.80
18/11/00 07:45:00	-2.070		0	0.000	0	0	1.80
18/11/00 08:00:00	-1.816		0	0.000	0	0	1.80
18/11/00 08:15:00	-1.516		0	0.000	0	0	1.80
18/11/00 08:30:00	-1.174		0	0.000	0	0	1.80
18/11/00 08:45:00	-0.797		0	0.000	0	0	1.80
18/11/00 09:00:00	-0.389		0	0.000	0	0	1.80
18/11/00 09:15:00	0.042		0	0.000	0	0	1.80
18/11/00 09:30:00	0.490		0	0.000	0	0	1.80
18/11/00 09:45:00	0.947		0	0.000	0	0	1.80
18/11/00 10:00:00	1.406		0	0.000	0	0	1.80
18/11/00 10:15:00	1.860		0	0.000	0	0	1.80
18/11/00 10:30:00	2.302		0	0.000	0	0	1.80
18/11/00 10:45:00	2.724		0	0.000	0	0	1.80
18/11/00 11:00:00	3.119		0	0.000	0	0	1.80
18/11/00 11:15:00	3.482		0	0.000	0	0	1.80
18/11/00 11:30:00	3.806		0	0.000	0	0	1.80
18/11/00 11:45:00	4.086		0.2205	3.485	3136	3136	2.07
18/11/00 12:00:00	4.318		0.4524	12.374	11136	14273	2.67
18/11/00 12:15:00	4.498		0.6322	22.320	20088	34361	3.60
18/11/00 12:30:00	4.623		0.757	30.659	27593	61954	4.89
18/11/00 12:45:00	4.691		-0.203	-3.017	-2715	59238	4.77
18/11/00 13:00:00	4.700		-0.067	-0.426	-383	58855	4.75
18/11/00 13:15:00	4.651		-0.098	-0.835	-751	58104	4.71
18/11/00 13:30:00	4.544		-0.17	-2.194	-1974	56129	4.62
18/11/00 13:45:00	4.382		-0.24	-4.046	-3641	52488	4.45
18/11/00 14:00:00	4.166		-0.286	-5.509	-4958	47530	4.43
18/11/00 14:15:00	3.900		-0.534	-16.549	-14894	32636	3.74
18/11/00 14:30:00	3.588		0	0.000	0	32636	3.74
18/11/00 14:45:00	3.236		0	0.000	0	32636	3.74
18/11/00 15:00:00	2.849		0	0.000	0	32636	3.74
18/11/00 15:15:00	2.433		0	0.000	0	32636	3.74
18/11/00 15:30:00	1.994		0	0.000	0	32636	3.74
18/11/00 15:45:00	1.541		0	0.000	0	32636	3.74
18/11/00 16:00:00	1.080		0	0.000	0	32636	3.74
18/11/00 16:15:00	0.618		0	0.000	0	32636	3.74
18/11/00 16:30:00	0.164		0	0.000	0	32636	3.74
18/11/00 16:45:00	-0.276		0	0.000	0	32636	3.74
18/11/00 17:00:00	-0.695		0	0.000	0	32636	3.74
18/11/00 17:15:00	-1.085		0	0.000	0	32636	3.74
18/11/00 17:30:00	-1.441		0	0.000	0	32636	3.74
18/11/00 17:45:00	-1.649		0	0.000	0	32636	3.74
18/11/00 18:00:00	-1.919		0	0.000	0	32636	3.74
18/11/00 18:15:00	-2.140		0	0.000	0	32636	3.74
18/11/00 18:30:00	-2.308		0	0.000	0	32636	3.74
18/11/00 18:45:00	-2.420		0	0.000	0	32636	3.74
18/11/00 19:00:00	-2.474		0	0.000	0	32636	3.74
18/11/00 19:15:00	-2.469		0	0.000	0	32636	3.74
18/11/00 19:30:00	-2.407		0	0.000	0	32636	3.74
18/11/00 19:45:00	-2.287		0	0.000	0	32636	3.74
18/11/00 20:00:00	-2.111		0	0.000	0	32636	3.74
18/11/00 20:15:00	-1.883		0	0.000	0	32636	3.74
18/11/00 20:30:00	-1.606		0	0.000	0	32636	3.74

18/11/00 20:45:00	-1.285		0	0.000	0	32636	3.74
18/11/00 21:00:00	-0.925		0	0.000	0	32636	3.74
18/11/00 21:15:00	-0.532		0	0.000	0	32636	3.74
18/11/00 21:30:00	-0.112		0	0.000	0	32636	3.74
18/11/00 21:45:00	0.328		0	0.000	0	32636	3.74
18/11/00 22:00:00	0.781		0	0.000	0	32636	3.74
18/11/00 22:15:00	1.239		0	0.000	0	32636	3.74
18/11/00 22:30:00	1.695		0	0.000	0	32636	3.74
18/11/00 22:45:00	2.141		0	0.000	0	32636	3.74
18/11/00 23:00:00	2.571		0	0.000	0	32636	3.74
18/11/00 23:15:00	2.977		0	0.000	0	32636	3.74
18/11/00 23:30:00	3.353		0	0.000	0	32636	3.74
18/11/00 23:45:00	3.692		0	0.000	0	32636	3.74
19/11/00 00:00:00	3.989		0.1226	1.238	1114	33751	3.79
19/11/00 00:15:00	4.239		0.3726	8.786	7907	41658	4.16
19/11/00 00:30:00	4.437		0.2784	5.256	4730	46388	4.38
19/11/00 00:45:00	4.582		0.202	2.987	2688	49076	4.51
19/11/00 01:00:00	4.670		0.1644	2.076	1868	50944	4.59
19/11/00 01:15:00	4.700		0.1068	0.971	874	51818	4.63
19/11/00 01:30:00	4.671		0.037	0.150	135	51953	4.64
19/11/00 01:45:00	4.583		-0.057	-0.317	-285	51668	4.63
19/11/00 02:00:00	4.439		-0.187	-2.616	-2355	49313	4.52
19/11/00 02:15:00	4.241		-0.276	-5.182	-4664	44649	4.30
19/11/00 02:30:00	3.990		-0.308	-6.297	-5667	38982	4.03
19/11/00 02:45:00	3.693		-0.168	-2.161	-1945	37037	3.94
19/11/00 03:00:00	3.353		-0.077	-0.549	-494	36543	3.92
19/11/00 03:15:00	2.976		-0.054	-0.294	-264	36279	3.91
19/11/00 03:30:00	2.568		-0.042	-0.186	-168	36111	3.90
19/11/00 03:45:00	2.135		-0.034	-0.129	-116	35995	3.89
19/11/00 04:00:00	1.686		-0.029	-0.095	-86	35909	3.89
19/11/00 04:15:00	1.226		-0.025	-0.073	-66	35843	3.89
19/11/00 04:30:00	0.764		-0.022	-0.058	-52	35792	3.89
19/11/00 04:45:00	0.307		-0.019	-0.047	-42	35749	3.88
19/11/00 05:00:00	-0.138		-0.017	-0.039	-35	35715	3.88
19/11/00 05:15:00	-0.563		-0.016	-0.032	-29	35686	3.88
19/11/00 05:30:00	-1.151		-0.014	-0.028	-25	35661	3.88
19/11/00 05:45:00	-1.516		-0.013	-0.024	-21	35639	3.88
19/11/00 06:00:00	-1.843		-0.012	-0.021	-19	35621	3.88
19/11/00 06:15:00	-2.125		-0.011	-0.018	-16	35605	3.88
19/11/00 06:30:00	-2.357		-0.01	-0.016	-14	35590	3.88
19/11/00 06:45:00	-2.537		-0.01	-0.014	-13	35578	3.88
19/11/00 07:00:00	-2.661		-0.009	-0.013	-11	35566	3.87
19/11/00 07:15:00	-2.727		-0.009	-0.011	-10	35556	3.87
19/11/00 07:30:00	-2.734		-0.008	-0.010	-9	35547	3.87
19/11/00 07:45:00	-2.681		-0.008	-0.009	-8	35538	3.87
19/11/00 08:00:00	-2.570		-0.007	-0.009	-8	35531	3.87
19/11/00 08:15:00	-2.402		-0.007	-0.008	-7	35524	3.87
19/11/00 08:30:00	-2.179		-0.007	-0.007	-6	35517	3.87
19/11/00 08:45:00	-1.906		-0.006	-0.007	-6	35511	3.87
19/11/00 09:00:00	-1.587		-0.006	-0.006	-5	35506	3.87
19/11/00 09:15:00	-1.226		-0.006	-0.006	-5	35501	3.87
19/11/00 09:30:00	-0.830		-0.006	-0.005	-5	35496	3.87
19/11/00 09:45:00	-0.404		-0.005	-0.005	-4	35492	3.87
19/11/00 10:00:00	0.043		-0.005	-0.005	-4	35487	3.87
19/11/00 10:15:00	0.506		-0.005	-0.004	-4	35484	3.87
19/11/00 10:30:00	0.977		-0.005	-0.004	-4	35480	3.87
19/11/00 10:45:00	1.448		-0.005	-0.004	-3	35477	3.87
19/11/00 11:00:00	1.912		-0.004	-0.004	-3	35474	3.87
19/11/00 11:15:00	2.360		-0.004	-0.003	-3	35471	3.87
19/11/00 11:30:00	2.787		-0.004	-0.003	-3	35468	3.87
19/11/00 11:45:00	3.184		-0.004	-0.003	-3	35465	3.87
19/11/00 12:00:00	3.546		-0.004	-0.003	-3	35463	3.87

19/11/00 12:15:00	3.867		-0.002	-0.001	-1	35462	3.87
19/11/00 12:30:00	4.142		0.2723	5.056	4550	40012	4.08
19/11/00 12:45:00	4.366		0.2835	5.429	4886	44898	4.31
19/11/00 13:00:00	4.535		0.2246	3.601	3241	48139	4.46
19/11/00 13:15:00	4.647		0.1854	2.567	2311	50450	4.57
19/11/00 13:30:00	4.700		0.1306	1.385	1246	51696	4.63
19/11/00 13:45:00	4.694		0.0657	0.413	371	52067	4.65
19/11/00 14:00:00	4.627		-0.018	-0.042	-38	52029	4.64
19/11/00 14:15:00	4.502		-0.141	-1.593	-1434	50595	4.58
19/11/00 14:30:00	4.320		-0.256	-4.544	-4089	46506	4.39
19/11/00 14:45:00	4.085		-0.301	-6.029	-5426	41080	4.13
19/11/00 15:00:00	3.799		-0.266	-4.855	-4370	36710	3.93
19/11/00 15:15:00	3.468		-0.062	-0.372	-335	36375	3.91
19/11/00 15:30:00	3.097		-0.046	-0.223	-201	36174	3.90
19/11/00 15:45:00	2.692		-0.037	-0.150	-135	36040	3.90
19/11/00 16:00:00	2.259		-0.031	-0.108	-97	35943	3.89
19/11/00 16:15:00	1.806		-0.026	-0.081	-73	35869	3.89
19/11/00 16:30:00	1.340		-0.023	-0.064	-57	35812	3.89
19/11/00 16:45:00	0.868		-0.02	-0.051	-46	35766	3.88
19/11/00 17:00:00	0.397		-0.018	-0.042	-38	35729	3.88
19/11/00 17:15:00	-0.064		-0.016	-0.035	-31	35697	3.88
19/11/00 17:30:00	-0.508		-0.015	-0.029	-27	35671	3.88
19/11/00 17:45:00	-0.928		-0.013	-0.025	-23	35648	3.88
19/11/00 18:00:00	-1.318		-0.012	-0.022	-20	35628	3.88
19/11/00 18:15:00	-1.671		-0.011	-0.019	-17	35611	3.88
19/11/00 18:30:00	-1.981		-0.011	-0.017	-15	35596	3.88
19/11/00 18:45:00	-2.243		-0.01	-0.015	-13	35583	3.88
19/11/00 19:00:00	-2.453		-0.009	-0.013	-12	35571	3.87
19/11/00 19:15:00	-2.609		-0.009	-0.012	-11	35560	3.87
19/11/00 19:30:00	-2.707		-0.008	-0.011	-10	35550	3.87
19/11/00 19:45:00	-2.746		-0.008	-0.010	-9	35542	3.87
19/11/00 20:00:00	-2.725		-0.007	-0.009	-8	35534	3.87
19/11/00 20:15:00	-2.644		-0.007	-0.008	-7	35526	3.87
19/11/00 20:30:00	-2.506		-0.007	-0.007	-7	35520	3.87