HR Wallingford
Working with water

Grove Lodge, Admiral's Walk

Review of First Steps BIA Response

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Executive Summary

Introduction

This document has been prepared in response to a report by Dr Michael de Freitas of First Steps Ltd, regarding a planning application for works at Grove Lodge, Admiral's Walk. The works include the construction of a single storey basement. The First Steps report primarily concerns hydrogeological issues that have been discussed in the Basement Impact Assessment (BIA) and in other planning documents.

The First Steps report is long and very emotive. It contains a few concerns that are repeatedly raised. Some are quite general, whilst others are more specific.

A response prepared by Mr Michael Eldred has also been reviewed. He considers potential local impacts, with particular reference to Terrace Lodge and Admiral's House. He repeats some of the concerns raised by Dr de Freitas.

General points

- Some information in the BIA has been misunderstood by Dr de Freitas or has been taken out of context;
- Some of his comments are of general hydrogeological interest but are not particularly relevant to Grove Lodge. They leave the impression of problems and issues which do not in reality exist at the site;
- Some points are repeated many times and are linked to many of the concerns;
- Dr de Freitas repeatedly states concerns about the use of assumptions and assertions (in the context of his report taken to mean unsubstantiated comments not based on fact). However, this is not correct - we have used all available facts in assessing the basement impacts;
- Conversely, many of Dr de Freitas' comments are conjecture – being incorrect / inappropriate to the site.

Specific issues

- Many of the concerns relate to the accuracy and suitability of recorded groundwater levels at the boreholes, with repeated suggestions of layers of perched water at higher levels than recorded. This view is conjecture. There is no suggestion of this matter in the soil investigation reports.
- Water levels at a nearby well and swimming pool are quoted, but with no supporting information. Full substantiation is required for them to be used. These quoted levels are not directly relevant at the basement as there is a significant hydraulic gradient. Its impact is not fully acknowledged
- The maximum water level of 124.5m at the well – as quoted by Dr de Freitas - is not inconsistent with a measured water level of 123.7m at BH1 (25m away). This represents a hydraulic gradient of about 1 in 30 - significantly shallower than the overall ground surface gradient in the area (1 in 10 to 1 in 15).
- Concerns are raised about an inability to fully understand groundwater flows due to data limitations. However, any such limitations have not compromised the overall assessment of the proposals.

Conclusion

Our conclusions on the BIA and the First Steps assessment are as follows:

- In the BIA we have presented an understanding of the local soil characteristics and the groundwater regime that is more than adequate to support the proposed works;
- There is sufficient soil and groundwater data presented to make the necessary decisions;

- Within the assessment we identified appropriate parameters for the design and construction of the works. They can be implemented safely, taking full account of the stability of excavations and properties – see the detailed Ground Movement Assessment;
- In doing so we have considered all available data, investigating where there are anomalies. We have based decisions, assumptions and conclusions on the maximum available data;
- We have considered both short-term (construction) and long-term issues;
- All the key conclusions from the BIA remain robust and are suitable to support the planning application.

We reiterate our overall conclusion from the BIA that the proposed basement meets the relevant requirements of DP27 and CS14 and should be approved with respect to CPG4.

Contents

1. Introduction

A planning response has been prepared by Dr Michael de Freitas of First Steps Ltd, on behalf of Mr and Mrs Gardiner of Admiral's House and Mr and Mrs Seaton of Terrace Lodge, both of Admiral's Walk. It consists of 18 pages of text, plus appendices. It is a technical document which discusses various concerns with respect to the proposed basement, predominantly from a hydrogeological perspective.

Whilst it is a lengthy response it should be noted that in practice a number of the issues that have been raised are covered repeatedly.

Thus, in responding it is not appropriate to provide a detailed section by section response. Rather, what are considered to be the key issues in the First Steps Ltd document are discussed in the main text, with additional information, relating to specific points, included as an appendix.

This report, which has been prepared by the authors of the Planning Application Basement Impact Assessment, seeks to address the key issues by referring back to information in the BIA, by providing some additional explanation and by drawing on contributions provided by others.

Key issues raised by Dr de Freitas include:

- The use of facts and assumption;
- The layout of the site investigation boreholes – influencing the understanding of groundwater flows;
- Local topography and groundwater levels and flows;
- Rainfall and its influence on groundwater levels;
- The accuracy of monitored groundwater levels;
- Admiral's House – the well and swimming pool;
- Reported holes in the road at Admiral's Walk;
- Comments made in response to the previous planning application.

These issues are discussed in subsequent sections. The subjects are often inter-related, so there are links between sections. Additional information is included in the appendices.

In addition, a response prepared by Eldred Geotechnics Ltd. has also been reviewed. Mr Michael Eldred considers potential local impacts, with particular reference to Terrace Lodge and Admiral's House. He repeats some of the concerns raised by Dr de Freitas. The issues in the Eldred report including groundwater, soil characteristics, structural stability and construction issues. Responses to points that he has raised are given in Appendix C.

2. Facts, assumptions and judgements

2.1. Introduction

In several places in his document Dr de Freitas says that information that is presented as fact in the BIA is actually "*opinions and assertions*". Dictionaries define an assertion as being a strongly expressed statement of fact or belief. However, it would seem from the context of his statements that by "*assertion*" Dr de Freitas means a view that is not backed up by evidence.

However, these concerns and comments are unfounded. We have presented many facts, have used multiple data sources were possible and have made careful and sound judgements based on all the information available to us. Our basic approach to this and to other projects is outlined below.

2.2. Summary of approach

When developing proposals for a project such as this an engineering team uses a combination of fact, interpretation and assumption. In this case many of the facts were based on the detailed ground investigation works that were carried out (the ground investigation reports are included as part of the BIA, to provide appropriate evidence).

However, the need for assumptions and judgements is usually inevitable and is part of the engineering discipline. These should be made by trained and experienced professionals and should be based on the use of all the available information, being developed with an understanding of the performance of soils, construction materials, construction processes, etc. This is the approach used in this case. Wherever factual information has been available it has been used, backed up by sound engineering judgement where necessary.

Indeed, during the period of the initial planning application some additional information was provided through some of the planning responses. This additional information has been reviewed and was used as appropriate.

However, it should also be noted that there can often be uncertainty regarding some information – particularly where there are multiple sources of data. This may be because some of the information provided is based on opinion rather than being fact, is based on memory from a long time ago, is incomplete, is out of date, is not particularly relevant to the site, contradicts other details, etc. Thus, it is often appropriate to treat information with caution. However, we have not rejected "*material that might prove inconsistent with the conclusions desired*". That is a serious but wholly untrue suggestion.

In collating and using the details made available to us we have sought to understand the information and any possible causes of uncertainty. We have indicated this in the BIA report – for example, information on the water levels and the operation of the well at Admiral's House has been received from different sources and it is not all clear / does not appear to be totally consistent. Thus, some degree of interpretation is inevitable.

2.3. Conclusion

The approach of using fact and where necessary interpretation and judgements is normal for such a project. To imply that we have made strong / positive statements without any factual basis is incorrect. We have based our assessments on facts and on sound judgements.

3. Layout of the site investigation boreholes

3.1. Introduction

Concerns are expressed by Dr de Freitas several times that the ground investigation work carried out to assist in the development of proposals for Grove Lodge was "*defective*". A specific issue raised concerned the layout of the boreholes.

Dr de Freitas concluded that as a result of this particular point the reports associated with the ground engineering were "*defective*".

3.2. Purpose, layout and scale of ground investigation

The key purpose for the ground investigation work was to assess the foundation bearing conditions and other soil parameters, to be used in the development of proposals for the works. However, groundwater levels were also to be determined. With these points in mind two investigations were commissioned.

Initially one borehole (BH1 on Figure 4.1 of the BIA) was drilled near the front of the garage, very close to the site of the proposed basement. During the second investigation BH2 was drilled in the rear garden, within the footprint of the proposed basement, at the opposite corner to BH1. They were approximately 20m apart.

A third borehole was drilled, at the site of a proposed Orangery, which at that stage was intended to include a basement. It was about 20m beyond the basement. Whilst the three boreholes were in a line it is important to note that the locations were all carefully considered, with the key purpose noted above very much in mind.

Whilst one can always present an argument for the inclusion of additional boreholes or for different locations, in practice three boreholes at the key locations at such a small site is very reasonable – indeed, more boreholes than commonly used for a project of this small scale.

In addition to the boreholes a window sample hole was drilled to the south-west of BH1. This showed similar ground conditions to BH1. The limited groundwater data indicated a lower groundwater level that that observed at BH1.

3.3. Importance in understanding groundwater flows

Dr de Freitas notes that the boreholes are more or less in a straight line. We do understand that as a consequence of this the groundwater data is less useful with respect to assessing the local groundwater flow direction than if the boreholes were in a triangle. However, it does not mean that there is little value in the available groundwater data, as implied by Dr de Freitas. The need to have details of soil conditions at the basement sites themselves was a key aspect of the site selection and that has not changed.

The issue of groundwater flow direction is raised repeatedly. One use of it is to help to understand any local changes in the groundwater conditions as a result of a possible future obstruction to the flow. In such a situation there might be an increase in the groundwater level upgradient of the proposed structure and a reduction downgradient of it. The groundwater flow direction and differences in groundwater levels would therefore be of interest in determining the hydraulic gradient and in making an assessment of the scale of any changes.

This issue is addressed in Section B.5.2 of Appendix B of the BIA, which discusses information from the Camden Geological, Hydrogeological and Hydrological Study, prepared by Arup in 2010. However, it is important to note that the Arup document – which is important in the assessment of basement impacts throughout Camden - indicates that even where there are several adjacent basements their net impact on groundwater levels upgradient and downgradient of the structure is actually small.

In this case we recognise that accurate calculations are not possible because there is insufficient information readily available. However, the following key points should be noted:

- The base of the basement excavation will be at approximately the peak observed groundwater level at BH1 (monitored for 11 months with little variation over that period) and it is well above the groundwater level at BH2;
- The base of the basement is within a sand and gravel layer (permeable material) and as such is well above the top of the low permeability clay layer;
- The basement sectional area is small compared to the overall area available for groundwater flows around the structure, even if the groundwater level was to be above the basement.

Any local changes in the groundwater levels will only occur if the basement was to significantly obstruct the groundwater flow. The scale of the effect would be related to how much of the basement reduced the cross-sectional area of groundwater flow, the soil permeability under and around the basement and the available area for flow to be diverted through. Each of these factors indicates a small local impact.

Thus, it was reasonably concluded that any changes in groundwater levels associated with the basement will be small and that a detailed assessment was unnecessary.

3.4. Conclusion

The concern raised about the ground investigation is a key issue to Dr de Freitas and as such is repeated many times. Many of his other concerns relate closely to this.

We understand the technical issues behind what he says. Whilst the information that he is concerned about would be beneficial it is not vital. So, it was not necessary to obtain all the information he discusses in order to confirm the suitability and adequacy of the proposed works.

4. Topography and groundwater flows

It is recognised that in the absence of sufficient detailed geotechnical information for the wider area (e.g. groundwater flow direction, velocity, etc.), some assumptions may be required when developing an understanding of the groundwater regime.

As part of this the local topography is useful in providing an initial assessment of the possible direction of groundwater flow. This approach was used. Whilst the main direction of ground slope at and near the site is to the south there is also a component in the surrounding area in a westerly direction. This can be seen when reviewing local ground contours. The local ground surface gradient is typically about 1 in 10 to 1 in 15.

Dr de Freitas stops at this "*first attempt*". However, we did not. Hence our further identifying the likely western component of flow.

Reviews of the BGS geological map and a map from the "Lost Rivers of London" – included in the BIA – suggest that there is also likely to be a westerly component of groundwater flow in the general area.

Finally, reviewing the measured groundwater levels for the immediate site indicates a reduction in groundwater level from east to west. Indeed, the Ground Engineering site investigation report concluded that there was some groundwater flow in a westerly direction However, this does also allow a southerly component of flow.

All of this information was considered and it was concluded that there are probably both westerly and southerly components of the groundwater flow. We have not sought to suggest the amounts of both of these and the actual flow direction because there is insufficient evidence to accurately identify this for the site area. In view of the relative depths of the basement and the groundwater we do not consider that it is necessary to know this accurately.

Whilst Dr de Freitas spends much of his report referring to such issues, in practice the other evidence shows that the suitability of the proposals does not actually depend on the exact direction of groundwater flow.

5. Rainfall and changes in groundwater levels

Dr de Freitas has concerns with respect to understanding how quickly the groundwater levels respond to rainfall, in order to help understand the overall groundwater flow regime. This is mentioned by him several times and is of interest as it relates to the permeability of the soil and to the groundwater response rate.

However, Dr de Freitas is wrong in saying that there is no evidence to show how water levels respond to rainfall. Analysis of rainfall and the borehole water level information (see BIA Figure B.3 and Figure B.4) clearly shows that the local groundwater levels respond very quickly to significant rainfall events. The groundwater rises rapidly in response to immediately preceding significant storms. Note: the secondary Y axis (for the rainfall) is incorrectly labelled on these graphs. It should be “Daily Rainfall (mm)”.

The comment made by HR Wallingford about the groundwater dropping “*gradually*” was meant to be in contrast to the rapid rise. It is not meant to suggest a slow recession with an associated large reservoir, as indicated by Dr de Freitas. It simply reflects the natural processes that one would anticipate – a slower recession than rise for such an area.

The relationship between rainfall and groundwater levels is discussed in Section B.3 of Appendix B of the BIA. Important points to note include:

- Groundwater levels are observed to vary, broadly in response to rainfall;
- Depths vary quickly – typically within about a day for significant rainfall events;
- At BH1 the maximum range of depth variation was only about 0.2m over the 11 month logging period;
- The quick response suggests a small contributing area and a relatively high soil permeability. Both are true for this site;
- The recorded rainfall is for a site on the far side of the Heath. It should be reasonably representative of the site and its upgradient area.

The reason for Dr de Freitas’s suggestion of a long-term response is unclear. However, the data shows quick responses.

6. Monitored groundwater levels

6.1. Introduction

Concerns are frequently expressed by Dr de Freitas regarding the presence of perched water and the monitoring of groundwater levels at the boreholes. He suggests that the instrumentation in the boreholes pierced "*the clay horizons supporting the perched water levels so ensuring the water levels they support cannot be measured*". However, this comment is conjecture and is misleading. The issue of perched water is considered below and in Appendix B.

6.2. Perched water

All three boreholes pass through the permeable upper layers of sand and gravel and then into the lower clayey sand and sandy, silty clay area (the Bagshot formation). The top part of this lower area is not permeable, so supports the perched groundwater immediately above. However, when the instrumentation was installed it was sealed within the clay area. It was not as Dr de Freitas asserts – acting as "*a local drain that hydraulically short-circuits the natural groundwater condition thus corrupting the data collected on the lowest water level".* Normal site investigation practices were followed. In addition, the borehole logs show no evidence of distinct layers of clay or of perched water in the upper areas, above this.

Whilst the issue of perched water is discussed in the BIA and in associated documents this is in part a general discussion of the structure of the Bagshot formation in the area, and in part a reference to the observed and monitored perched water conditions seen at the boreholes.

The instrumentation correctly monitored the levels of the perched water above the clay. There is no reason to suggest that there was anything wrong in what was done - whether in the measurements made, the data being "*corrupted*", or with issues concerning data interpretation. The site investigation provides no evidence to suggest that there is water "*perched on the clayey horizons at higher elevations",* as Dr de Freitas describes it.

It would appear from some of his comments that Dr de Freitas considered the possibility of additional areas of perched water in these upper areas. The issues of the boreholes, perched water and the groundwater level readings have been reviewed in detail and a summary of this is given in Appendix B.

6.3. Groundwater flow

Various misleading comments have been made by Dr de Freitas when describing the groundwater flow. For example:

- Flow into the well is described as "*vigorous*" and "*cascading*". These terms are quite dramatic. We have been advised that whilst flow down the inside of the well is clearly visible a word like "flow" or "trickle" could be more accurate. Note: we understand that the rate will vary with time and that descriptions will vary from person to person.
- The perched water level is described by Dr de Freitas as going up and down. However, whilst there is clearly a variation in levels it should be noted that the variations observed at the boreholes were small. In the case of BH1 – the highest recorded perched water level – the depth varied by only 0.2m over an 11 month period.

- The abandonment of the Admiral's House swimming pool excavation due to the ingress of water is quoted. However, there are insufficient records provided to properly understand this issue. There is some uncertainty regarding the levels of the pool – the inside of the pool itself and also the base level of the excavation. This will be considerably lower and may be different at the shallow and deep ends. A full explanation of this is required to support the reports from nearly 30 years ago.
- It is important to note that the swimming pool site is upgradient of the well and of the proposed new basement. Thus, at any given time the groundwater level at the pool will be higher than at the proposed basement.

Further comments on levels at the swimming pool and the well are made in Section 7.

Dr de Freitas compares the effects of the well and the piezometers on groundwater levels.

We are agreed that there is evidence of perched water at the well, with water entering at a certain level and dropping to a far lower level. However, Dr de Freitas says that during the monitoring period the piezometers were doing the same. There is not one piece of information that indicates that this has occurred. Rather, it is based on speculation that all the piezometer installations allowed perched water from an upper level to pass through a clay layer to the lower level, thus making their level reading erroneous. Dr de Freitas says "*that is what is happening in the piezometers and is real evidence that proves the Application is fundamentally wrong on this point"*. This statement is speculation - there is no such evidence at all. However, this flawed argument forms the basis for much of Dr de Freitas' objection.

7. Levels at Admiral's House well and swimming pool

7.1. Introduction

Various levels and depths associated with water ingress at the well, the top of the well collar, the base of the swimming pool floor, etc. have been quoted by First Steps Ltd and by Mr Gardiner at various times, which are not fully consistent. The information is not presented clearly and there is no explanation of the survey work. Greater clarity is necessary if such levels are to be used.

7.2. Levels used in the BIA and by Mr Gardiner and Dr de Freitas

The project team asked to discuss the observed conditions at the well with Mr Gardiner's experts. However, that request was denied. We were therefore unable to gain access to details of groundwater conditions and recorded levels at the well or at the swimming pool.

Thus, it was necessary to use copies of historical plans and cross-sections provided by Mr Gardiner and / or available on the planning portal. Information from these was used, and wherever possible multiple sources were used. Whilst it has been recognised and stated by HR Wallingford that there is some tolerance in some levels it is anticipated that they are reasonably accurate figures.

HR Wallingford's estimated level for the basement floor at the well was about 126.0m and the collar of the well about 126.1m. These are within about 300mm of levels quoted by Dr de Freitas – presumably from the survey work carried out by himself and Mr Eldred.

In an email from Mr Gardiner on 18th June 2015 it was stated that the top level of the well was more or less at the ground level at the base of the steps at the front of Admiral's House – thus it should be at approximately 127.9m. This is nearly 2m different from the figure advised by Dr de Freitas. Whilst this may

be a simple error / poor estimate it is unclear whether or not this has been used when calculating any of the historical water levels for the well.

HR Wallingford's estimated base of excavation level for the swimming pool (deep end) was about 123.6m. This was based on plans of the proposed pool – no "As Built" plans being available. However, it has been reported that the excavation at the shallow end was abandoned at 124.51m due to water ingress – just over a metre higher.

If Dr de Freitas' quoted water levels at the well and at the swimming pool are to be compared with the recent borehole data it is requested that their derivation is clearly presented, with details of any relevant survey work provided and with any assumptions and estimates identified.

The opportunity to liaise with Mr Gardiner's advisors, which may have included access to the well, was denied. Thus, Dr de Freitas' inference of us not visiting the site is misleading. We would have taken the opportunity if it had been available.

7.3. Swimming pool and well

Dr de Freitas quotes that a groundwater level of at least 124.51m caused problems with the excavations for the Admiral's House swimming pool. This was constructed 27 years ago and it was previously understood that no records were available. No details of how this level was recently determined are given.

It is important to note that the swimming pool site is upgradient of Grove Lodge and of the well. Water enters through the side walls of the well and flows down the sides to the bottom. Thus, the well tends to draw the local groundwater level down – acting as a drain. Thus, because of the relative positions of the swimming pool, the well and the proposed basement, and the draining effect of the well, the ground water level at the swimming pool will be significantly higher than at the proposed basement. Thus, a reported level there higher than the basement is not necessarily a problem.

In paragraph 13 Dr de Freitas quotes a maximum observed water level of 124.47m at the well. However, the date of this and how this level was determined are not stated. Its accuracy is uncertain. In addition, the wording of the comment makes it unclear whether this actually means a water level at the swimming pool or at the well.

7.4. Discussion

It is noted by Dr de Freitas that using the various figures "*water levels range over 6.09m*".

Firstly, we consider that there is some uncertainty regarding some of the quoted levels. We consider that the reported water levels at the well and swimming pool should only be used when further clarity of their derivation is provided.

In addition, even if one ignores any uncertainties, the statement is misleading. The well provides clear evidence that there are separate groundwater levels at that location and that these are several metres apart (vertically). Water at a higher (perched) level – enters through the sides of the well and drains down the inside. The well acts as a drain, linking the upper water level to the deeper one. To take the difference between the two separate water levels and to imply that water could be anywhere within the range is misleading.

It must also be noted that there is an incomplete acknowledgement of the effect of the hydraulic gradient that occurs in the area. The available data for the swimming pool and well, for BH1 and a borehole at Fleet

House on the edge of Admiral's Walk (water level at approximately 122.4m) indicates a significant hydraulic gradient in that area. The perched groundwater levels at the basement site will be significantly less than the perched water levels at the well and at the swimming pool. For Dr de Freitas to quote levels at those locations and simply to compare them to the basement level is quite inappropriate. This is illustrated on Figure 7.1 – a long-section from the well, through the site of BH1, to a borehole drilled at the edge of Admiral's Walk at Fleet House (2012). Whilst it is accepted that the groundwater level data illustrated is for different days, we have included the highest levels available for each site.

Our approach of recognising changes in groundwater level across the area and to use actual groundwater levels from the basement site is considered to be the most robust approach.

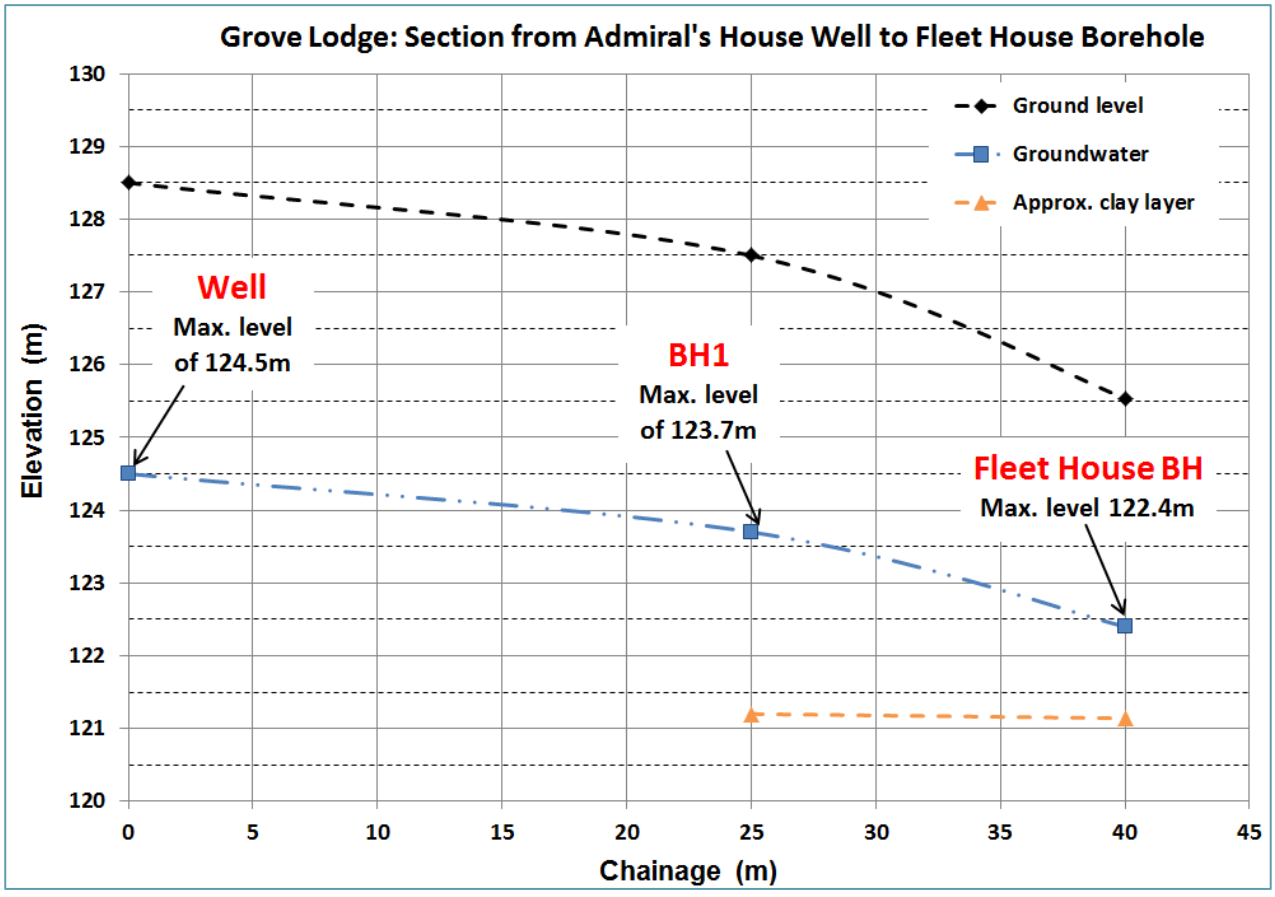

Figure 7.1: Cross-section illustrating groundwater levels.

8. Holes in Admiral's Walk

The issue of the holes in Admiral's Walk was raised at the time of the first planning application. Whilst not discussed in detail in the new BIA it is discussed in the Consultation Statement and was considered during the preparation of the details for the new planning application and the new BIA.

- Many assumptions have been made by Dr de Freitas on this issue;

- A problem of a hole appearing in Redington Road has been quoted. However, it is wrong to simply assume that this is directly relevant to this site and to the Admiral's Walk holes;
- Redington Road is over 500m west of Grove Lodge and is at / close to the boundary of the permeable Bagshot Beds and the lower permeability clay layer – a likely location of springs. Thus, the ground conditions near the surface will be different at Redington Road than at Grove Lodge.
- Bullet 10 of paragraph 5 says that the collapses "*can be explained by the erosion of the ground by groundwater".* This is vague and quite different to Dr de Freitas' comment in March, when he stated that it was related to leaky drains, which will be near the surface and not in the groundwater flow area – several metres below ground. There is much conjecture here. This is not suitable evidence. Indeed, it is misleading and inappropriate.

9. Previous planning application and BIA

In March 2015 Dr de Freitas prepared a detailed response to the earlier planning application. The issues raised in this were reviewed and a response prepared. All significant issues were addressed in our response. This is included in the Consultation Statement that forms part of the planning application.

In addition, the BIA for the new application discussed what were considered to be the most significant issues in more detail than in the previous BIA, drawing on appropriate details presented by Dr de Freitas and Mr Gardiner in their previous planning responses.

It was considered that some of the issues that are included in the Consultation Statement did not also merit detailed discussion in the BIA. It had already been established that they were not actually relevant – e.g. the reported holes in the road in Admiral's Walk.

Nothing has been left out of the new BIA in an attempt to mislead the reader or to misrepresent the situation, as suggested by use of the phrase "*selectively omitted*". This is simply an assumption on the part of Dr de Freitas and is not true.

10.Conclusion

10.1.Introduction

We have reviewed the report prepared by Dr Michael de Freitas of First Steps Ltd, regarding the Grove Lodge planning applications. The First Steps report primarily concerns hydrogeological issues that are discussed in the BIA and in its associated documents.

The First Steps report is long and emotive. It contains a few concerns that are repeatedly raised. Some are quite general whilst others are more specific.

We appreciate the concerns raised and consider it to be very important that issues are considered in the light of the best available information for the site. That is what we did in the BIA. However, some of the Dr de Freitas' comments are based on generalisations of the hydrogeology of the Hampstead area, rather than on site-specific details. This has led to some incorrect interpretations by Dr de Freitas.

Key issues are discussed in the main text of this report, with additional information provided in the Appendices. We have included reference to the Ground Movement Assessment report, which is not referred to in Dr de Freitas' document.

We have also addressed the responses prepared by Mr Michael Eldred. Many are the same or very similar to those raised by Dr de Freitas.

10.2. General points

- Some information presented in the BIA has been misunderstood by Dr de Freitas and / or it has been taken out of context;
- Some of his comments are of general hydrogeological interest. Whilst perhaps relevant to some parts of the Hampstead area they are not all pertinent to Grove Lodge. However, such comments give the impression of problems and issues which in reality do not exist at the site;
- Some of the points are repeated many times and linked to many of the concerns;
- Dr de Freitas repeatedly expresses concerns about the use of assumptions and assertions. Taken in the context of his report we understand his meaning of “assertion” to be unsubstantiated comments that are not based on fact. However, this concern is wrong. Rather, we have used all available facts to assess the potential impacts;
- Conversely, many of Dr de Freitas’ comments are conjecture.

10.3. Specific issues

- Many of the concerns relate to the accuracy and suitability of recorded groundwater levels. There are repeated suggestions of layers of perched water at higher levels than recorded. This is conjecture - there is no suggestion of this in the soil investigation reports;
- Water levels at the nearby well and swimming pool are quoted, but with no supporting information. Full substantiation is required for them to be used;
- Quoted levels at the well and swimming pool are not directly relevant at the basement as there is a significant hydraulic gradient. However, the impact of this is not fully acknowledged by Dr de Freitas;
- Concerns are raised about insufficient data resulting in an inability to fully understand groundwater flows. However, this has not compromised the overall assessment of the proposals.

10.4. Key conclusions

Our conclusions on the BIA and the First Steps response are as follows:

- In the BIA we have presented an understanding of the local soil characteristics and the groundwater regime that is more than adequate to support the proposed works;
- There is sufficient soil and groundwater data presented to make the necessary decisions;
- Within the assessment we identified appropriate parameters for the design and construction of the works. They can be implemented safely, taking full account of the stability of excavations and properties – see the detailed Ground Movement Assessment;
- In doing so we have considered all available data, investigating where there are anomalies. We have based decisions, assumptions and conclusions on the use of all available data;
- We have considered both short-term (construction) and long-term issues;
- All the key conclusions from the BIA remain robust and are suitable to support the planning application.

We reiterate our overall conclusion from the BIA that the proposed basement meets the relevant requirements of DP27 and CS14 and should be approved with respect to CPG4.

Appendices

A. Specific comments

A.1. Introduction

This appendix considers some of the specific issues detailed in Dr de Freitas' report, referring to pages and section numbers. This is not a line by line response - in part because many issues are raised several times and it is not necessary for us to repeat our responses. It is also in part because many issues are covered in the main section of this document.

A.2. Page 6, Section 19

Dr de Freitas expresses concern regarding "*corrupted*" data at BH1 for a 6 week period. However, this is already explained in Section B.3 of Appendix B of the BIA. It relates to the logger at BH1 being reset at slightly the wrong level for the period of the second ground investigation. The data just needs a minor vertical adjustment.

For bullet point 11, the reference to Section 4.5.2 in the HR Wallingford report is incorrect. It should be Section 4.3.2.

A.3. Page 7, Section 20

The collection of data occurring prior to HR Wallingford's involvement is fine. This was organised by skilled and experienced professionals. The overall requirements of CPG4 were fulfilled, albeit in a slightly different sequence. The usability of the hydrogeological data and in particular the direction of flow is discussed in Sections 3 and 5 of this document.

A.4. Page 7, Section 21, 1a

The borehole evidence for the site indicates that the base of the basement is at the top of the observed perched water level at BH1, and is well above the Bagshot Beds Upper Aquifer that is referred to in CPG4. It is termed the "*principal*" aquifer in the BIA. In this context "*principal"* means the main aquifer in the immediate area, rather than the EA's definition - an aquifer that provides a high level of water storage and which may support water supply and / or river base flow on a strategic scale.

A.5. Page 7, Section 21, 1b

The use of "*possibly*" in 1b in the BIA relates to the perched water. The question is designed as a way of identifying if an issue should be considered in detail. Sometimes the answer is not initially clear, so "*possibly*" is a fair answer, resulting in further consideration. However, that does not automatically mean that there will be an impact on the aquifer (Question 1a).

The review and the details presented in the BIA support the conclusion that there will be no impact on the perched water table or on the aquifer below the clay.

HR Wallingford's concerns about the accuracy and the use of reported level data from the well and the swimming pool are noted in Section 7. Dr de Freitas frequently uses this data. However, clarity regarding its derivation is required if it is to be used.

The information presented in Section 4.5.2 and in Appendix B of the BIA relates to facts from the ground investigations and from other sources. It is wrong to describe this as "*assertions*" and using "*corrupt*" data.

A.6. Pages 7 and 8, Section 21.1

The issue of the direction of groundwater flow is discussed in Sections 3 and 4 of this document. Various sources of available evidence indicate southerly and westerly components of groundwater flow in the area. However, it was and is recognised that the exact direction at the site itself is not known. Hence the use of the note "*Approximate direction of groundwater flow*" on Figure 4.1.

A.7. Pages 8 to 9, Section 21.3

The base of the basement (approximately 123.65m) will be well above the "*principal*" ground water level (dampness observed at BH2 at about 114m and at previous boreholes at the adjacent Fleet House site. It will be at or above the perched groundwater observed at BH1 and BH2.

Comments by Dr de Freitas on the best choice of well location and overflowing wells are irrelevant. What is relevant is reliable observed data. That is what has been used in this assessment.

We have acknowledged that a detailed analysis of the groundwater flows has not been carried out. However, this does not mean that the conclusion in our bullet point 15 in the Groundwater Summary within Section 4.3.2 is invalid. The evidence shows that there is a permeable material at and above the base of the basement and that the highest recorded groundwater level was at about the base level, with it reducing across the basement. The proposed basement does not provide a significant obstruction to groundwater flows. We have used all of the evidence available to us to come to this conclusion.

Perched water is referred to many times in Section 4.3.2 and in Appendix B, with details of the observed levels and discussion of the impacts.

A.8. Pages 9 to 10, Section 21.4

Dr de Freitas' comparison of the plan areas of the well and the proposed basement is not relevant. The basement is located at / above the perched water table, so has very little, if any, effect. However, the well acts as a drain, such that the perched water drains to the next level of water, many metres down. Thus, it draws down groundwater locally and has a considerably greater effect in the local area. To suggest that the basement must have a larger impact than a well, on the basis of their different plan areas, is incorrect and very misleading. It reflects insufficient thought as to what the different effects might be and how they might operate.

A.9. Page 11, Section B.4.3

Dr de Freitas talks about "*quite variable water levels*" at the site, contrasting them with the more consistent conditions reported at the boreholes. He ignores the fact that the data he quotes for the well and swimming

pool is hydraulically upgradient of the basement site – so the levels he quotes are inevitably significantly higher but are not directly relevant to the site. He clouds the situation by making inappropriate comparisons.

A.10. Page 12, Section B.5.2

The suggestion of the 6.09m range in groundwater levels is incorrect and very misleading. It is discussed in Section 7.4.

Bullet points 8 and 9 in the Groundwater Summary section do not contradict bullet point 7. BP 7 considers changes in water level with time – the limited variation observed at all sites. The difference between the levels quoted in BPs 8 and 9 relate to the different locations. There is no contradiction.

The influence of the well on local groundwater levels is described in Section 7.3, as well as indicated in Appendix B of the BIA. In effect the well acts as a drain to the perched water level in that area, draining it to the lower aquifer. The observations in the well – irrespective of the actual levels – show this effect. The suggestion that an influence one way means an influence the other way may sound plausible if the details of what this means are not stated. However, it is not appropriate. If water drains through the well from the higher to the lower level - several meters lower - it does not mean that it will flow the other way.

On page 9 Dr de Freitas uses the appearance of surface water in wet weather at other locations in Hampstead to support his objections to this project. However, as he himself states earlier on the same page, in Hampstead there is a "*seepage surface around the hill*". This is part of the natural hydrogeology of the area – irrespective of buildings of any form. Seepage, springs, etc., at other locations in Hampstead, and situated at different elevations relative to the boundaries between different soils, is no argument against this site. The assessment has to be based on the site-specific conditions and not on generalisations that are not applicable at this site.

A.11. Page 10, Section 21.5 / B3

The issue of rainfall is discussed in Section 5. There is a clear and quick response observed and noted in the BIA.

A.12. Page 13, Section 23.3

Dr de Freitas discusses Section 3 of the applicant's response to comments from Dr de Freitas related to the original BIA. That response is clear. It is not confusing. It repeats information from the BIA, provides a more detailed explanation of the situation and strongly rebuts some of Dr de Freitas' previous concerns.

A.13. Page 13, Section 23.3a

Dr de Freitas has prepared a geological section as part of his response, using information from the boreholes. He has included on it the details at the well that we have discussed previously – details which we consider require greater explanation if they are to be used - see Section 7. Dr de Freitas rather perversely states that the water level data "*is useless for groundwater purposes*", despite this being the best data available, with continuous records available at the site for a period of 11 months.

It is also important to note that the well location is set back about 22m from the line of the boreholes. A significant hydraulic gradient will occur in this area – such that the groundwater level at BH1 (about 25m downgradient the well) will be significantly lower than it is at the well.

The quoted maximum water level of about 124.5m at the well is not at all inconsistent with a water level of 123.7m at BH1 about 25m away. This represents a hydraulic gradient of approximately 1 in 30, which is significantly shallower than the overall ground surface gradient in the area – typically 1 in 10 to 1 in 15.

A water level of 124.5m at the well does not mean that this is the water level at BH1. The BH1 level will be substantially lower – hence the 123.7m observed.

Dr de Freitas criticises comments in the 7th paragraph of Section 3.1 of the relevant part of the Consultation Statement and also in the 4th paragraph of Section 3.2. However, it would seem that he does not understand what was being said. We state that we recognise the evidence for perched water occurring both at the site and in nearby areas. There is clearly evidence for this. However, what we also say is that there is no evidence from the site borehole data for multiple levels of perched water at the site. We stated this to try to correct the previous assumption by Dr de Freitas that there were multiple layers of perched water at the boreholes, despite the lack of evidence. We are not contradicting ourselves in the two quoted paragraphs.

Many of the issues that Dr de Freitas raises here are his key concerns, which have already been covered in the first sections of this document. Fundamental flaws have been identified.

A.14. Page 15, Section 23.5

The issue of the holes in Admiral's walk was reviewed, seeking all the evidence available. This is discussed in the Consultation Statement and Section 8 of this report. Evidence for a site about 500m away is not relevant and there is nothing presented by Dr de Freitas to support the suggestion that local soil erosion has occurred due to groundwater flows.

A.15. Pages 16 and 17, Section 24.2

In this section Dr de Freitas is unfortunately coming to some wrong conclusions. The BIA presents the situation for the planning application, and is accompanied by various other documents. As part of this a ground movement assessment (GMA) has been prepared and included with the planning application. This document, which includes consideration of the following issues, has not been referred to by Dr de Freitas.

- The underlying geology and groundwater;
- Ground movement due to the proposed development and damage to neighbouring properties.

In addition, more engineering detail will be considered during the detailed design and construction stages. The design team will have full access to the BIA and supporting records – such as the site investigation details, GMA, etc.. The design will be prepared with this information in mind, taking a conservative approach on groundwater details, stability, etc., as is common practice.

A.16. Page 17, Section 25

Dr de Freitas' comments that the views of objectors were not considered at the time of the pre-application audit are irrelevant. The main audit by Campbell Reith – to be a complete review of the relevant information from the planning application – includes consideration of relevant concerns from objectors.

B. Boreholes, perched water and level readings

This appendix is based on advice provided by a chartered Civil Engineer and Fellow of the Geological Society, with particular experience in geotechnical design, including basements.

The positions and depths of the standpipe response zones within the boreholes are summarised below:

Borehole	Response Zone levels (mOD)	Recorded Water Level (mOD)
WS1	127.2 to 122.2	Not monitored
BH2	127.3 to 118.5	122.3
BH3	128 to 119.1	123.25
BH1	126.4 to 120.5	123.7

These results show that the BH response zones were within a range from very near to the ground surface through to the base of the sands and below the basement formation. Dr de Freitas states in point 11 that "…. *(the standpipes) average out along their lengths the various heads that may be present".* Whilst theoretically possible, this relies on there being discrete bands of clay within the Bagshot Formation with water bearing sand bands between them. The boreholes show no evidence of this.

There is a single band of "*medium dense grey-green … locally clayey…silty gravelly SAND*" recorded in boreholes BH02 and BH03. This is between 124.5m and 123.5m in BH2 and between 125.1m and 124m in borehole BH2 (approximately 4m below ground level in both locations). No water strikes are recorded in the boreholes above this level – although it is noted that water was added whilst boring to assist drilling through the gravels. No other reference is made to clay in the soils above the recorded water levels.

It is notable that above the '*locally clayey*' band that the soils are described as SAND and GRAVEL and sandy GRAVEL, to rare silty fine to medium SAND – and are therefore significantly coarser than the silty fine sand which underlies the '*locally clayey*' band. This would suggest that if there were to be a perched aquifer above this '*locally clayey'* band, then its permeability would be significantly higher than that of the aquifer beneath this band. This would allow the standpipe to fill up to the higher level, recording such water if it were present. This conclusion is supported by the results of Particle Size Distribution testing which indicate that D10 samples (10% passing) are markedly coarser above the '*locally clayey'* band, than they are below it.

BH1 is logged in less detail – however it too notes the Bagshot Formation to become more sandy toward the base of the layer.

On the basis of the above it is considered that the standpipes are recording the regional water level. Local perched water in the Made Ground may be present – however this would be expected to be of limited volume and lateral persistence.

C. Response to comments by Mr M Eldred

C.1. Introduction

This appendix is prepared in response to the report prepared by Eldred Geotechnics Ltd., on the Grove Lodge planning application (Eldred report: G1505-RP-01-E1, 3rd September 2015). The Eldred report covers various issues, including groundwater, soil characteristics, structural stability and construction issues. These are inter-related issues.

The report refers to the work carried out by Dr de Freitas and repeats many of the concerns raised by Dr de Freitas, particularly related to groundwater levels. Thus, it is not necessary to repeat our responses to those issues. This is relevant for many of the paragraphs.

The remainder of Eldred's concerns are typical of those that would be raised and addressed during the Statutory Party Wall process at the detail design construction stage of a project.

This appendix brings together comments from various members of the project team, who have reviewed and commented on Mr Eldred's response.

C.2. Long-term effects of piling

Mr Eldred expresses concern about the possibility of erosion caused by groundwater flowing between the contiguous piles.

If this were to happens at depth, below the basement, then there should not be a significant risk. Groundwater movement is likely to be slow in the silty sands beneath the basement, and even if the piles were to accelerate flows, there is nowhere for the silt to go.

The groundwater data that we have indicates that water is below the basement, and whilst stratification could affect the monitored levels – the borehole information suggests that this is not occurring.

Mr Eldred comments that there may be groundwater erosion between the piles below basement level which has not been considered in the design. However Mr Eldred should be aware that the principal (male) piles in the basement retaining walls will be founded in the clay soil at depth and so not be subject to erosion (paragraph 12).

Mr Eldred quotes other cases of subsidence / holes appearing in other parts of London, including a large hole at Blackheath Hill. However, it is quite inappropriate and scaremongering to make such references, when in practice geological conditions are different and each case unique. For example, a factor in the Blackheath Hill incident was reported to be local historical chalk workings. Indeed, Mr Eldred does state "*The geology of Hampstead is different*", which indicates that he himself is aware that you should not make such simple links and references.

In paragraph 44 Mr Eldred also refers to the Reddington Road situation that is raised by Dr de Freitas. However, the lack of knowledge of that situation is exposed by his comment that "*it might have been one where such information was lacking*". This illustrates that comparisons with other sites where details are unknown and / or situations are different are wholly inappropriate.

Whilst he also notes the reported near-surface holes in Admiral's Walk, referred to by Dr de Freitas, there is not specific information that explains the cause of the reported incidents.

C.3. Admiral's House

Mr Eldred has observed existing distortion in the Party Wall with Admiral's House. This wall is some 3m from the nearest planned excavation and so is not considered to be of concern. Any pre-existing distortion in the Party Wall will be noted in the Party Wall Awards at the appropriate time.

C.4. Terrace Lodge

The foundations of Terrace Lodge would be temporarily exposed during construction and protected with concrete blinding. The foundations would not be undermined or "*perched at the edge of a shallow excavation*" as Mr Eldred speculates (paragraph 6).

Piling near existing foundations is routinely carried out on properties throughout London and without significant detriment – see paragraph 7.

Mr Eldred speculates that the finished construction "*leaves the Terrace Lodge footings exposed and resting on or very near ground surface*" – see paragraph 8. This is not the case; the footings of Terrace Lodge will be covered by landscaping at the end of construction, as they are now.

In paragraph 9 Mr Eldred speculates about underpinning of Terrace Lodge. However underpinning is not proposed.

Mr Eldred notes that the groundwater level would need to be determined in order to design underpinning to Terrace Lodge. We note Mr Eldred's observation, but note that underpinning of Terrace Lodge is not proposed.

Mr Eldred notes that the planning application contains a ground movement assessment, but asserts that it is meaningless. Unfortunately Mr Eldred offers no technical support to his emotive words. Such unsubstantiated statements are not relevant and cannot be assessed (paragraph 11).

C.5. Surface water drainage

The surface water drainage from the lightwell will be pumped to a higher level and discharged to a new soakaway. At the detailed design stage the exact location of the soakaway will be determined. It will be located in the rear garden, at a distance from all dwellings – in line with normal good practice. There is sufficient room available in the garden for this.

C.6. Construction

In paragraph 43 Mr Eldred comments that "*the success of continuous flight auger (CFA) piling constructed through granular material can sometimes be marred by "overflighting*"." This is a known construction risk appreciated by all competent piling contractors and the risk will be designed out at detail design stage. For example, the piling contractors may choose to sleeve the piles through the granular material in order to mitigate the construction risk.

Mike Eldred notes a reduction in the density and the strength of the granular material above the clay.

This is probably due to a variation in the material which becomes much siltier at this depth. In addition, the SPT's undertaken in these areas are below the water table. Whilst the drillers should have maintained a head of water within the borehole to prevent excess bore pressure, the fact that the soils are relatively fine could cause elevated pore pressures as the SPT is undertaken, leading to a reduced 'N' value.

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