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Assessment of Effect of 40 Queens Grove Basement on Adjacent Highway

1 Introduction

This note summarises the results of analyses undertaken to demonstrate that the excavation and construction of the proposed basement at 40 Queens Grove will not lead to excessive deformation of the public highway running along the southern boundary of the site.

2 Proposed Development

The proposed development comprises the demolition of the existing property at 40 Queens Grove, installation of a basement perimeter wall, excavation of the basement and construction of a new property on the site. A location plan of the site is shown in on drawing EPA QGR 00 081. The proposed development is shown on drawing EPA QGR 00 101. An extract showing the boundary with the public highway is shown below.

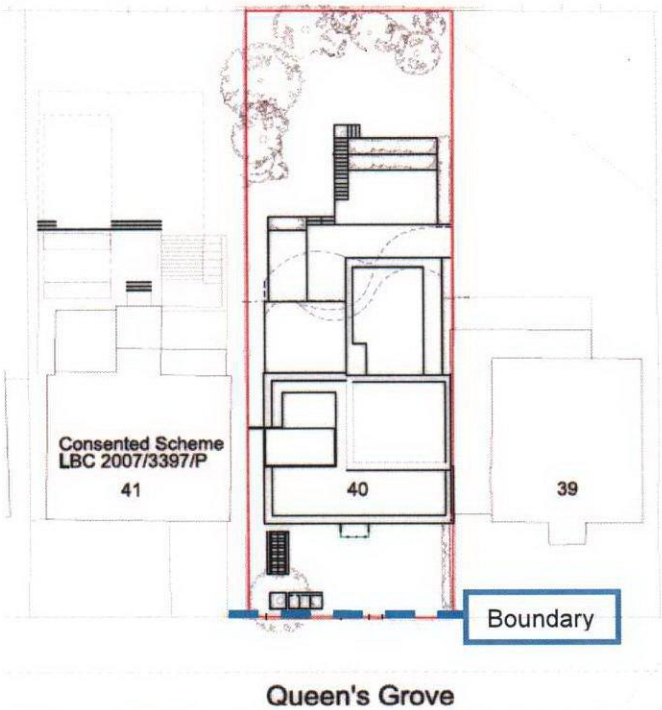


Figure 1 Boundary between 40 Queens Grove and Public Highway

Typically the basement is a single storey at around 4m in depth, though local to the boundary with the Highway there is a local deepening to 7m depth to facilitate installation of a car lift. The

proposed basement plan is shown on sketch EPA QGR SK 005, and an extra identifying the deeper area is included below.

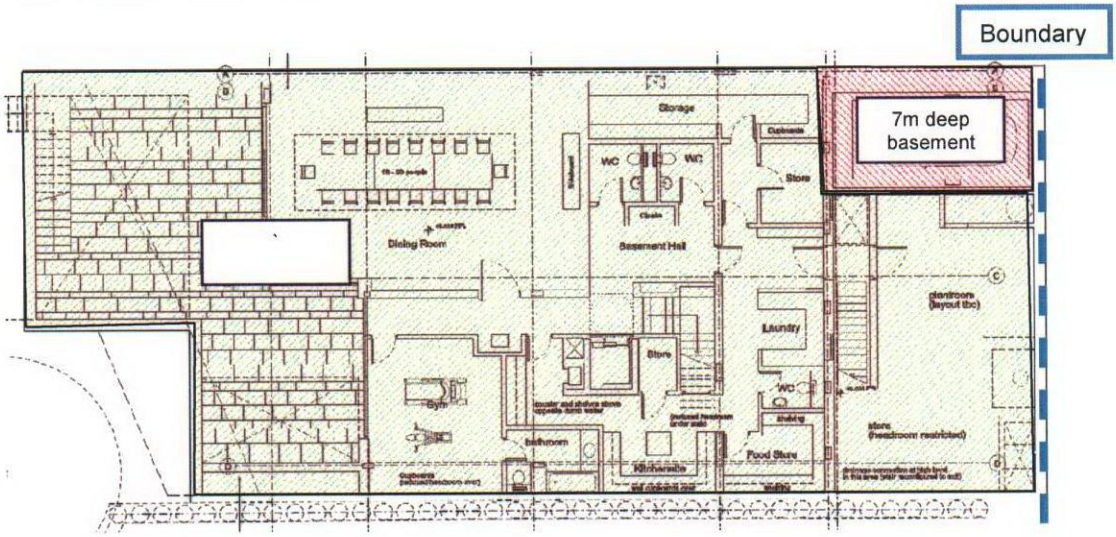


Figure 2 Plan of proposed basement depths

The following figure shows a section through the proposed development.

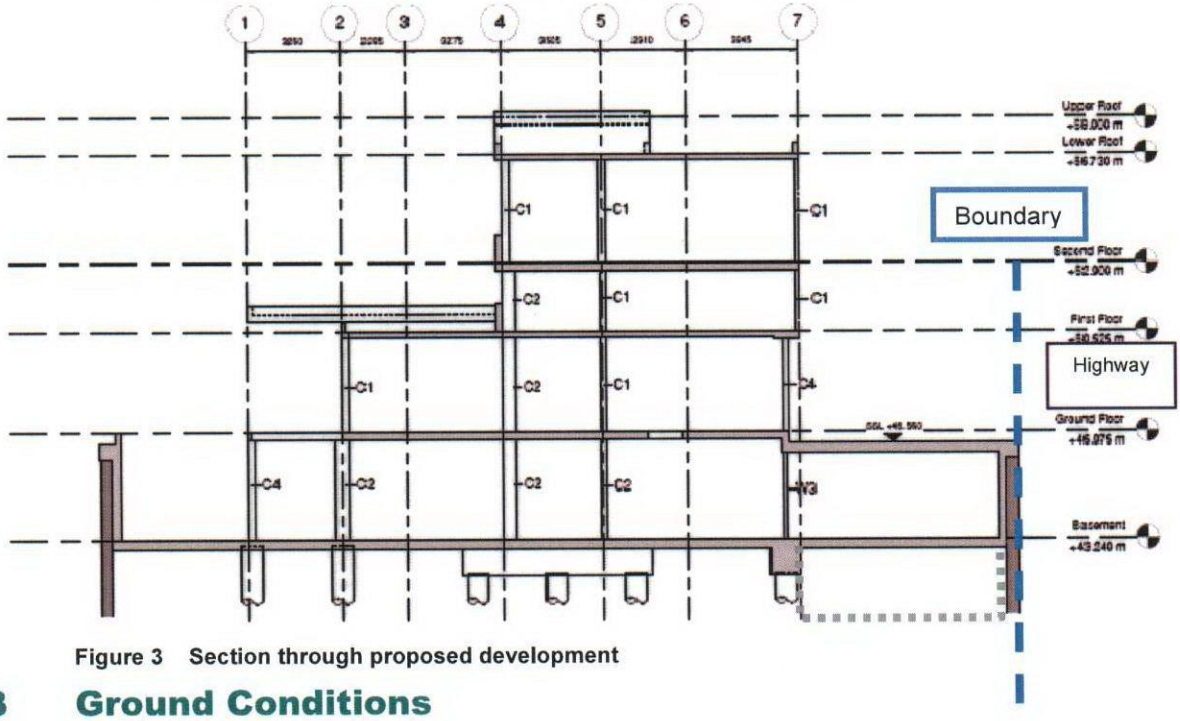


Figure 3 Section through proposed development

3 Ground Conditions

The ground conditions at the site comprise Made Ground over London Clay. For the purposes of this analysis, the Made Ground is assumed to be 1m thick. The London Clay has been proved to be over 30m thick.

During a recent ground investigation some minor seepages were identified in the upper few metres of the ground, but significant ground water was not identified.

For both retaining wall and heave calculations the design parameters have been derived from ground investigation data from the site and other nearby projects. These design parameters are given in Table 1 below.

Stratum	γ (kN/m³)	c_u (kN/m²)	ϕ' (°)	Heave		Retaining wall	
				E' (MN/m²)	E_u (MN/m²)	E' (MN/m²)	E_u (MN/m²)
Made Ground	20	-	28	7	7	7	-7
London Clay	20	50 + 5z	24	$400c_u$	$500c_u$	$800c_u$	$1000c_u$

z is depth in metres below top of stratum.

Table 1 Summary of geotechnical parameters for design

4 Basement wall details

It is proposed that a contiguous piled wall be installed around the perimeter of the basement to provide both temporary support during excavation and in the permanent condition. In the permanent case a secondary liner wall will also be constructed to resist water pressures.

It is proposed that the wall will comprise 10m long 450mm diameter contiguous piles at 600mm centres. The geometry is as follows;

- Retained ground level +47mOD
- Excavation level: +40mOD

The general constriction sequence comprises:

- Install Wall
- Excavate to +42.8mOD
- Install temporary prop at +43mOD
- Excavate to +40mOD
- Install permanent slabs (+47mOD, +43mOD and +40mOD)

5 Causes of Ground Movement

5.1 Introduction

Construction of the proposed development will lead to ground movements around the site that can have a potential effect on adjacent structures and utilities

Two key factors will contribute to movement of the ground around the basement wall at the boundary with Queens Grove. This are discussed individually below and the following section presents the results of calculations undertaken to quantify the magnitude of the anticipated movement.

5.2 Heave

Unloading of the ground due to excavation of the basement leads to heave of the underlying soil. Figure 4 shows typical ground movement patterns induced by excavation in front of a retaining wall to form a basement.

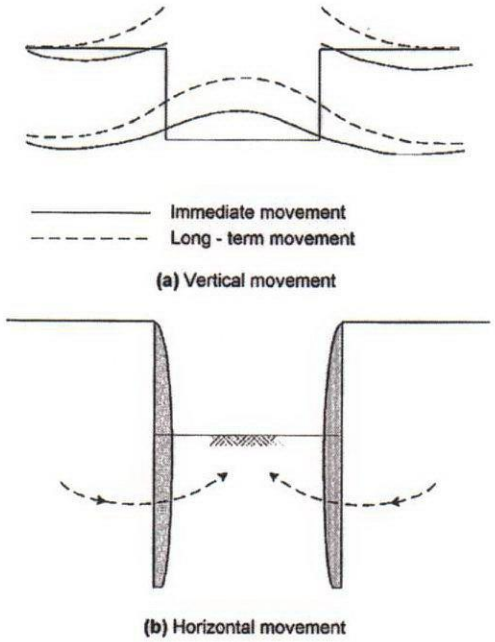


Figure 4 Typical ground movement pattern associated with excavation stress relief

Vertical and horizontal movements occur due to the removal of vertical load at the base of the excavation and due to the removal of lateral support to the sides of the wall.

5.3 Wall Deflection

As excavation of the basement occurs, there is a removal of support to the contiguous piled wall, which will then deform in order to mobilise resistance from any propping that is in place and the soil beneath the excavation. The lateral movement of the wall leads to an associated settlement of the ground behind the wall. This effect is discussed in CIRIA Report C580 "Embedded Retaining Wall: Guidance for more Economic Design", and a method of estimating settlement based on the results of retaining wall analysis is presented which has been reproduced in Figure 5.

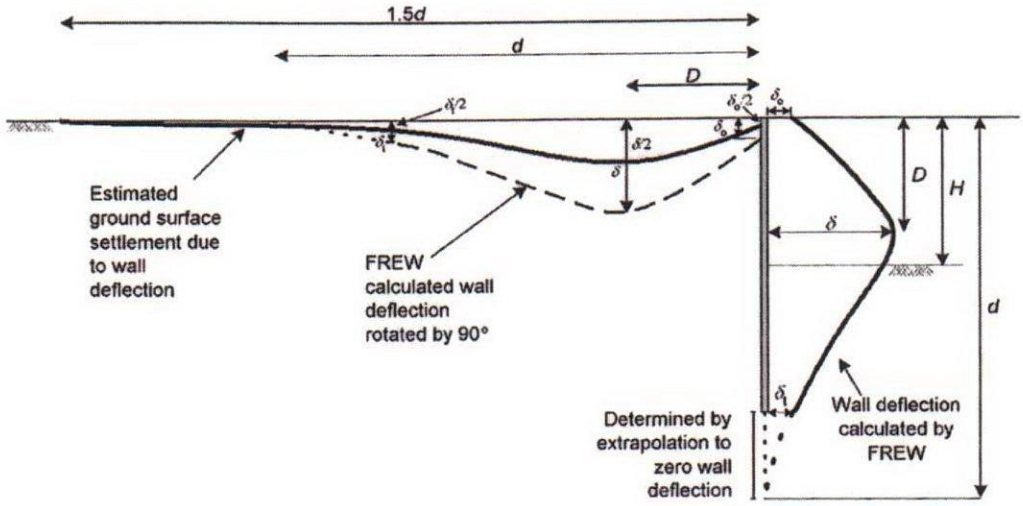


Figure 5 Estimation of settlement due to wall deformation (extract from CIRIA C580)

This method of calculation has been adopted and the results are presented in the following section.

6 Movement Predictions

6.1 Heave

Based on the soil parameters presented in Section 3, a calculation of the potential heave that may result from the unloading of the soil during excavation has been made. The analyses have been carried out using Oasys VDISP. VDISP calculates the settlements (and stresses if required) within a linear or non-linear elastic soil mass due to changes in vertical stress.

Two areas of unloading were modelled, a general unloading of 80ka (equivalent to 4m of excavation) and a localised additional excavation of 60kPa to model the additional 3m of dig in the corner of the basement adjacent to Queens Grove.

Figure 6 below shows the contours of heave calculated by VDISP. Figure 7 shows a cross section of the predicted heave based on line from the boundary of the site extending into Queens Grove. The plot shows that movement is expected to extend a distance of approximately 20m from the excavation.

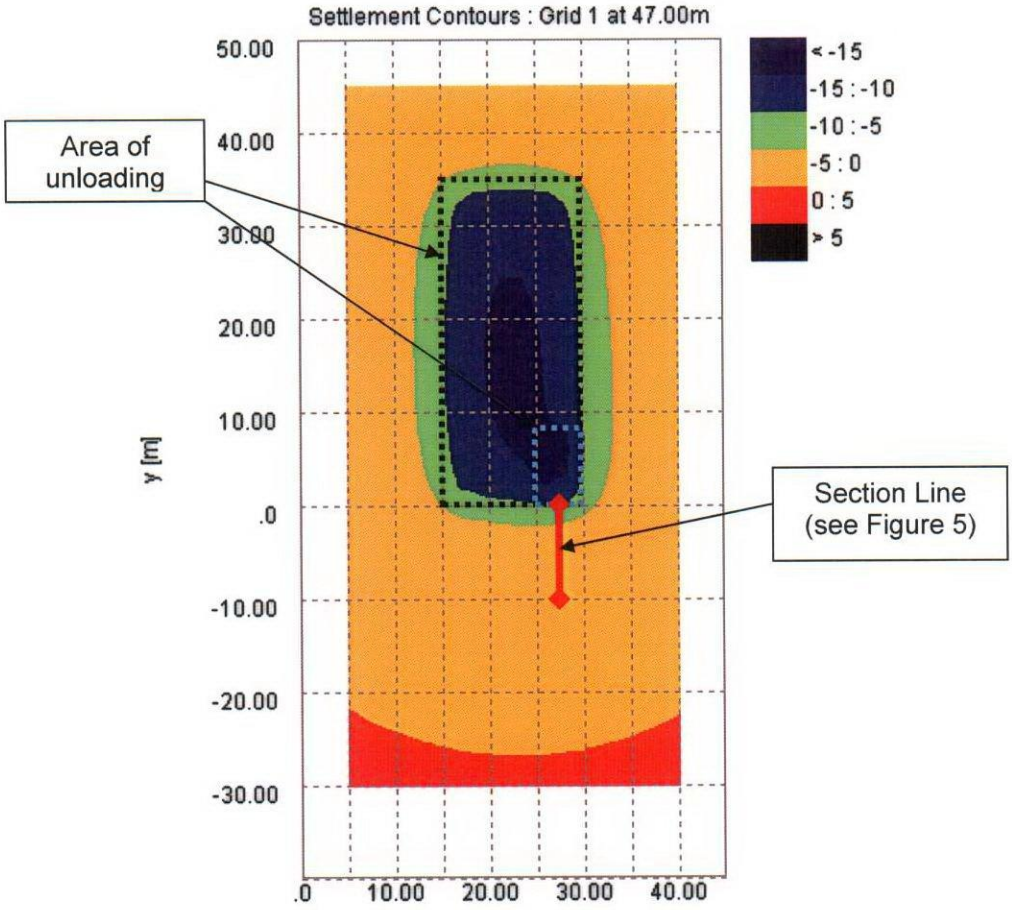


Figure 6 Contours of Heave from VDISP Output

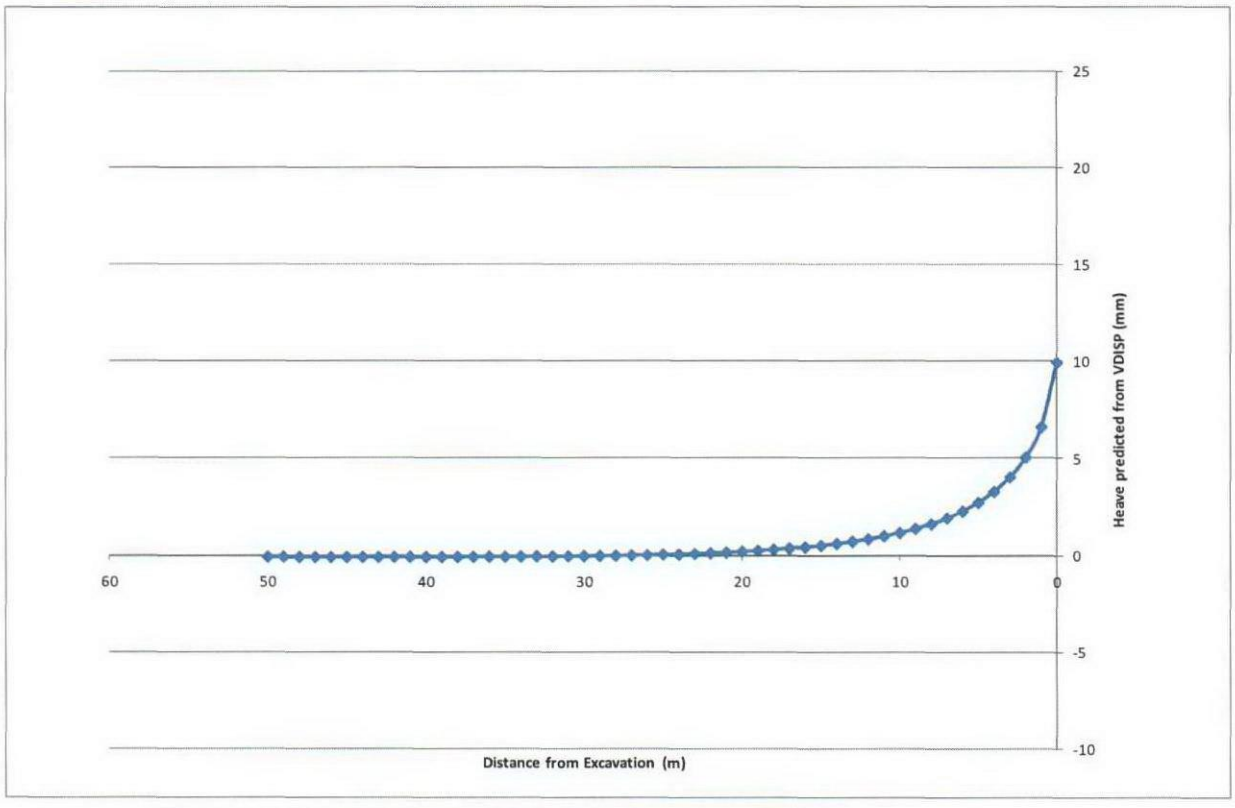


Figure 7 Variation of heave with distance from excavation

6.2 Wall Deflections

Based on the results of FREW retaining wall analyses, estimates of settlement behind the basement wall due to lateral deformation of the wall have been made. These are presented in Figure 8.

The results show that up to 15mm of settlement may be expected behind the wall as a result of lateral deformations.

The following section combines this result with the heave displacement predictions to show the overall movement that can be expected in the highway as a result of the proposed works at 40 Queens Grove.

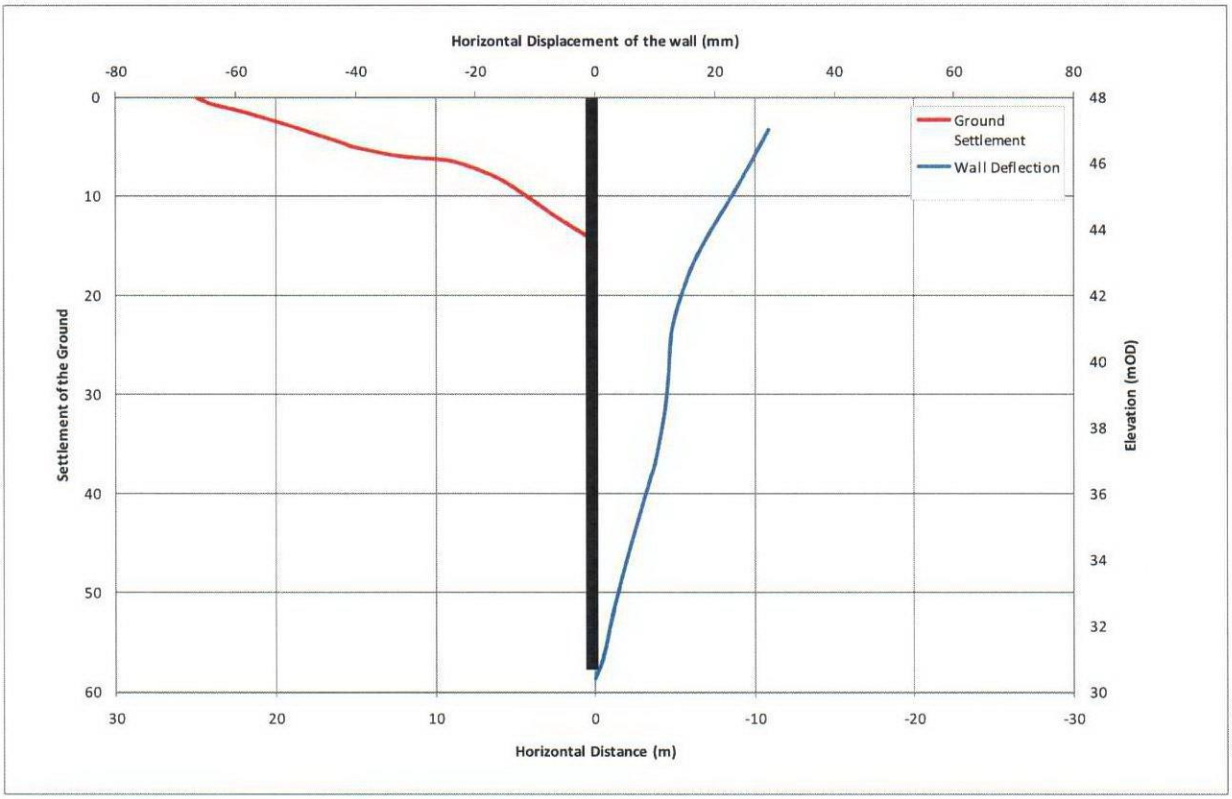


Figure 8 Ground Settlement based on FREW analysis

6.3 Combination of effects

Using the results presented above for the calculated movements due to heave following excavation of the basement and lateral deformation of the retaining wall, it is possible to combine the results to obtain a cumulative ground movement estimate as a results of both effects as the construction of the basement is carried out on site. This combined plot is presented in Figure 9.

The results in Figure 9 show that between 5 and 10mm of movement are expected to occur within the public highway, and the movement could extent to a distance of up to 25m from the excavation.

It is considered that this magnitude of ground movement is small and will not have an adverse effect on the Public Highway.

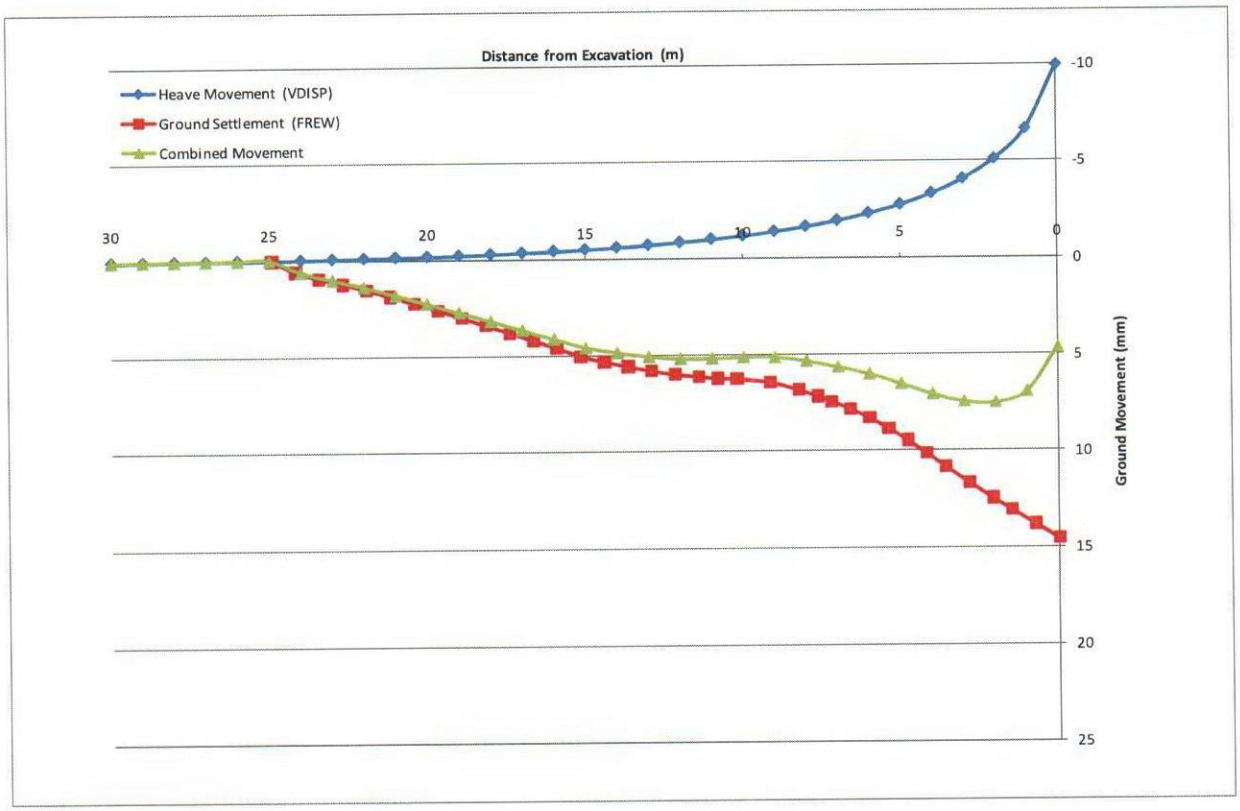


Figure 9 Combined Ground Movement Estimates

7 Summary

This note presents details of the proposed basement solution at 40 Queens Grove and considers the potential impact on the Public Highway.

The design ground conditions at the site have been presented and the calculation approach for estimating ground movements has been described.

Movement is expected from two sources:

- Heave due to unloading of the ground following excavation of the basement
- Settlement behind the basement wall due to lateral deflection of the wall

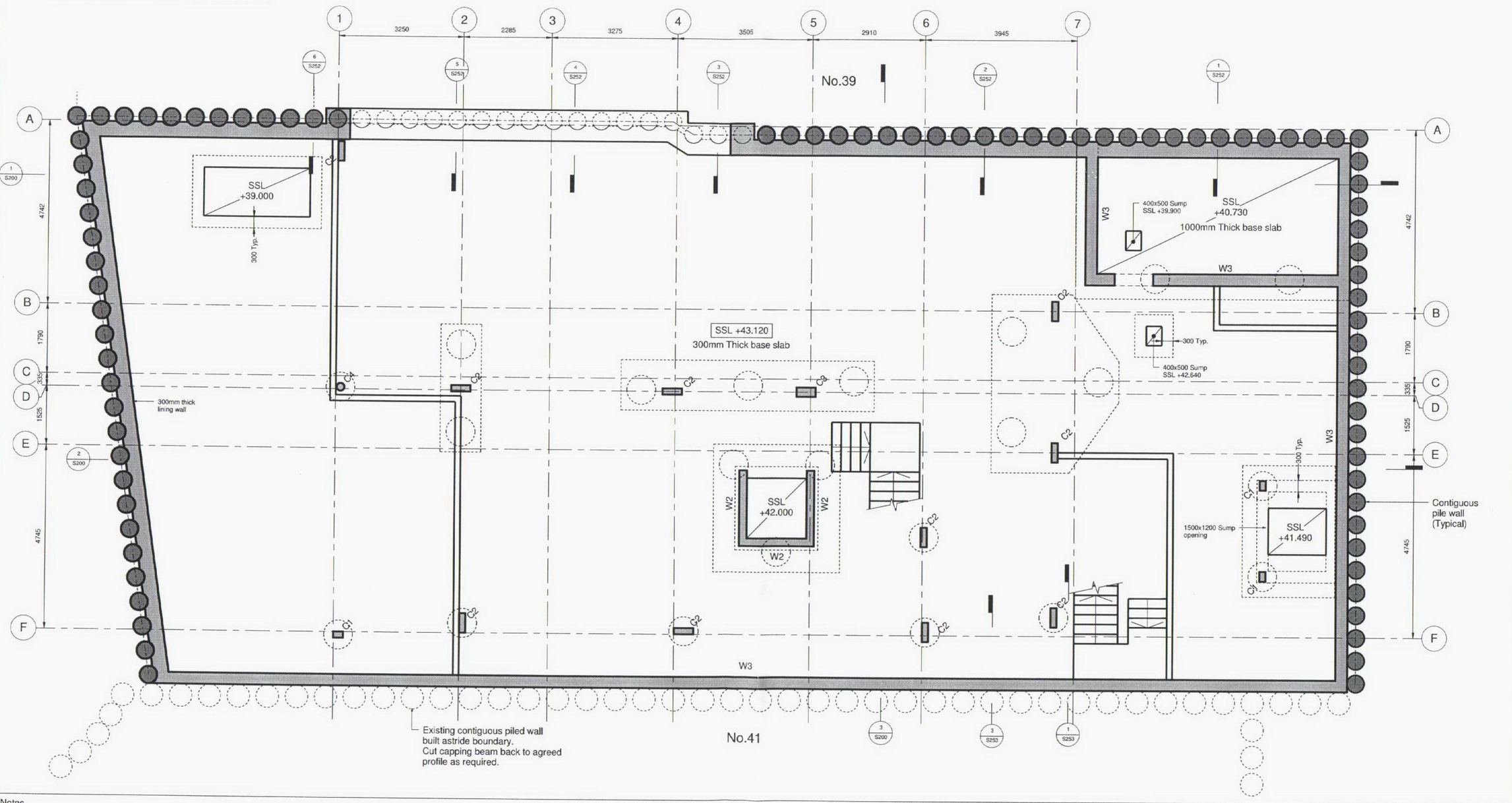
The results of analyses carried out to investigate the two effects have been presented which show that up to 10mm of heave and 15mm of settlement can be expected.

Finally the results of the two analyses were combined to get an overall calculation of potential ground movement. These results show that between 5 and 10mm of movement are expected to occur within the public highway, and the movement could extent to a distance of up to 25m from the excavation.

It is considered that this magnitude of ground movement is small and will not have an adverse effect on the Public Highway.

Column Schedule	
Ref.	**Size**
C1	160 x 250mm
C2	160 x 500mm
C3	240 x 500mm
C4	200mmØ

Wall Schedule	
Ref.	Size
W1	160mm Thick R.C.
W2	200mm Thick R.C.
W3	300mm Thick R.C.



Notes

1. Refer to Drg. S001 for General Notes.

P3	23/06/10	DSP	MT	MT
Issue for Information				
P2	20/05/10	DSP	MT	MT
Issue for Information				
P1	30/04/10	DSP	MT	MT
Issue for Information				
Issue	Date	By	Chkd	Appd

Client

Job Title: 40 Queens Grove

Scale at A1: 1 : 50

Discipline: Structural

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Drawing Title: Basement Plan

Drawing Status: For Information

Job No	Drawing No	Issue
207509	S099	P3

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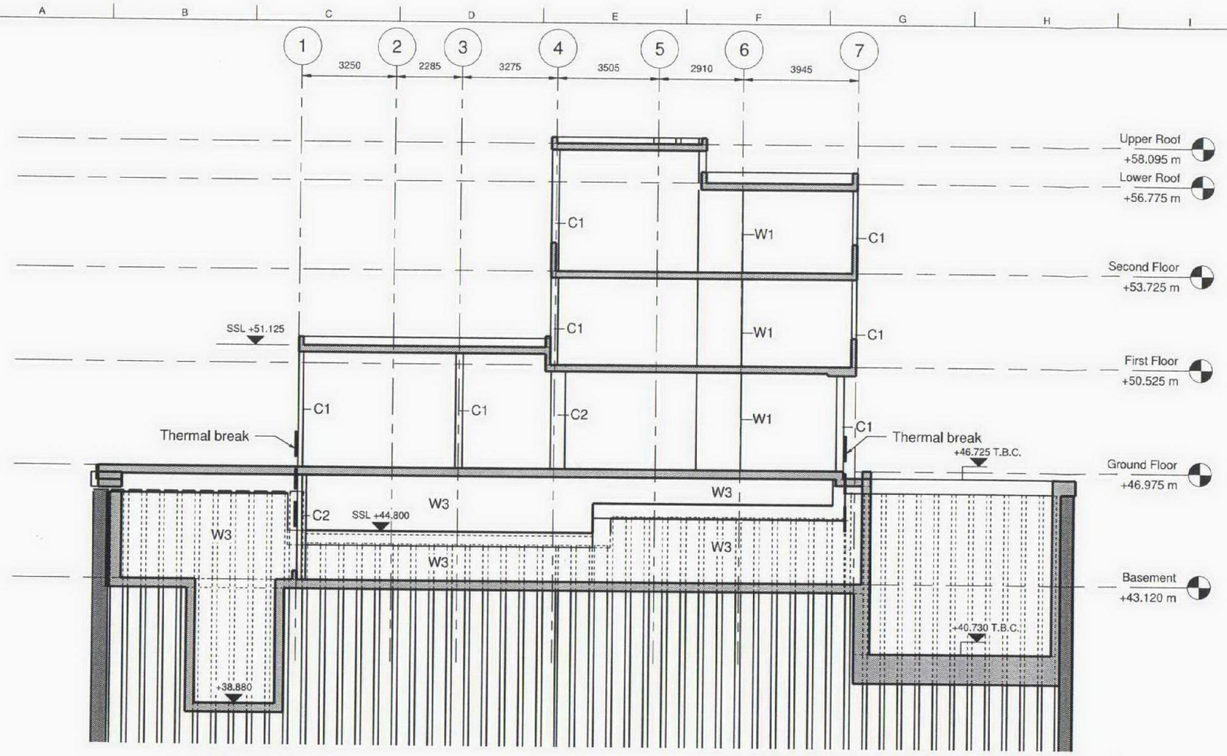

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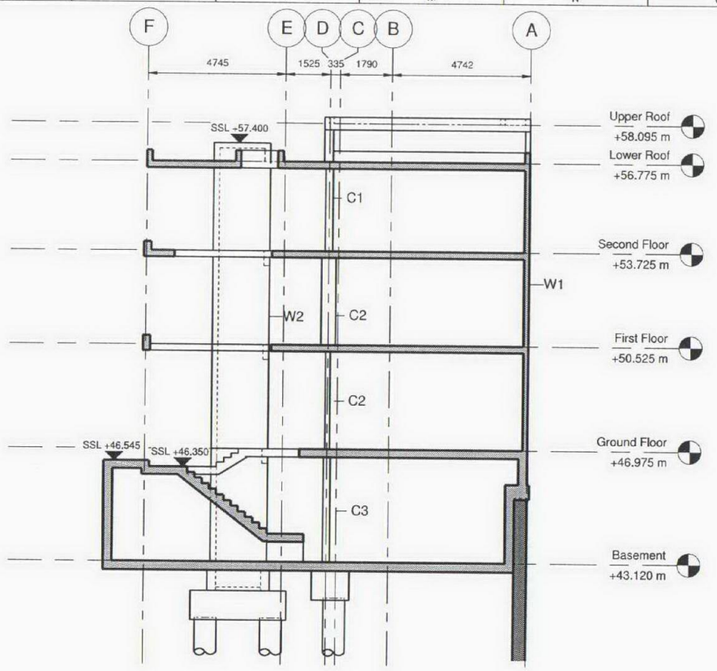

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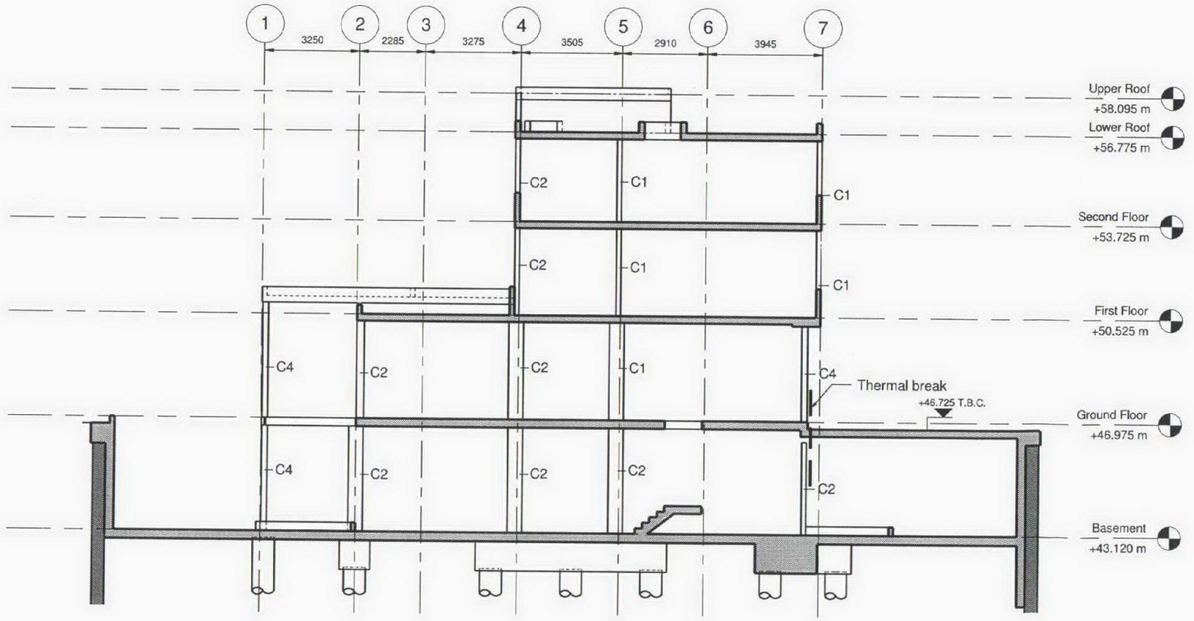

2 Building Section 2-2
1 : 100

Column Schedule	
Ref.	**Size**
C1	160 x 250mm
C2	160 x 500mm
C3	240 x 500mm
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Wall Schedule	
Ref.	Size
W1	160mm Thick R.C.
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Issue for Information				
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Issue for Information				
P1	30/04/10	DSP	MT	MT
Issue for Information				

Client

Job Title
40 Queens Grove

Scale at A1 1 : 100

Discipline
Structural

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Drawing Title
Building Sections
Sheet 1

Drawing Status
For Information

Job No	Drawing No	Issue
207509	S200	P3

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