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BASEMENT IMPACT ASSESSMENT

REPORT ASSESSING THE IMPACT OF THE PROPOSED

BASEMENT DEVELOPMENT AT

46 INVERNESS STREET

NW1 7HB

Ref: 09166/MT/JO - Rev B

November 2014

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REGISTERED IN ENGLAND 4173590

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1 INTRODUCTION

1.1 EXISTING SITE

The site at 46 Inverness Street, NW1 7HB, measures approximately 5 by 9 metres in plan. The full footprint of the site is currently occupied by a single storey shop building with a flat roof. The site is abutted by: Inverness Street (a public highway) along the southern boundary, the side of a terraced house to the east (44 Inverness Street), and the rear and side of a semi–detached house to the north and west (24 Gloucester Crescent). Both neighbouring properties are Listed Grade II, and are early Victorian load bearing masonry structures with basements under their full above ground footprint.

The site and surrounding area gently slopes downhill towards Camden High Street. There is a sunken courtyard directly behind the main building at 24 Gloucester Crescent, measuring approximately 3 by 3 metres in plan. The ground level of this paved sunken courtyard is 820mm below the site level. There is also a sunken courtyard of a similar size in plan to the rear of 44 Inverness Street. The paved floor level of this courtyard is approximately 1.5 metres below the site level.

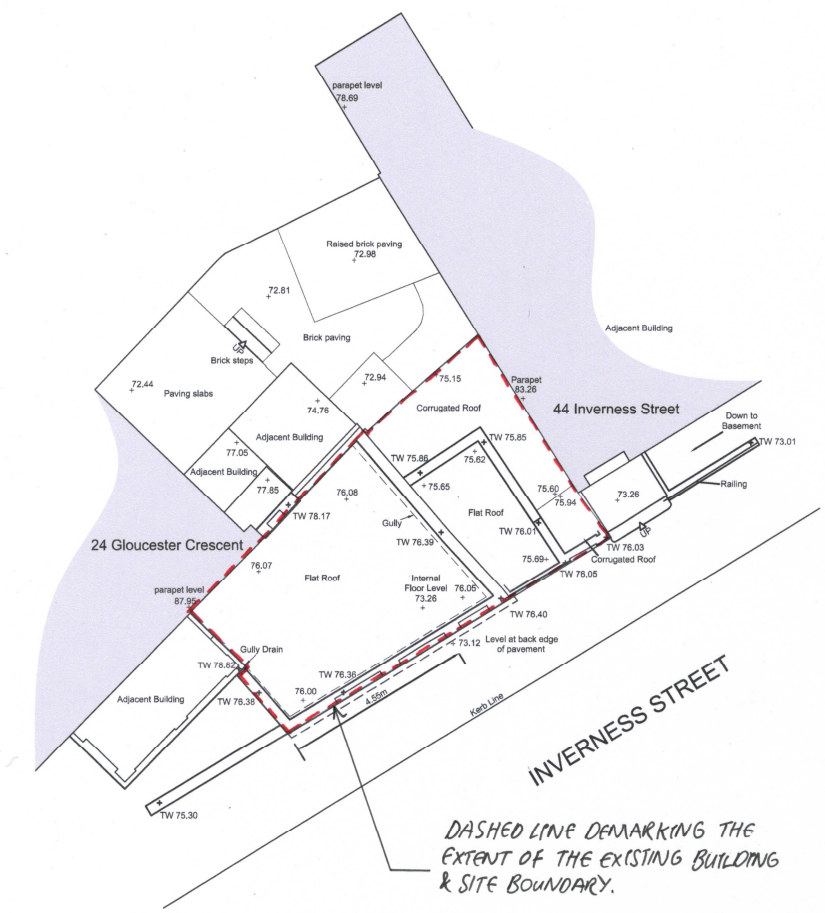


Image 1.1: Existing site plan (note: full size version of the existing site survey is included in appendix B)

1.2 PROPOSED WORKS

It is proposed to entirely demolish the existing single storey building at 46 Inverness Street, and to construct a three storey dwelling arranged over ground, first and basement level. The proposed building will inhabit the full footprint of the site, with habitable spaces at all levels. Waste and rain water will be taken into the Thames Water public sewer running under Inverness Street - as we believe it is at the moment.

1.3 PURPOSE OF REPORT

The purpose of this report is to demonstrate that the proposed basement works will not cause harm to the built and natural environment and local amenity. A factual and interpretative site investigation by Chelmer Site Investigations has been used to inform this report. Key considerations addressed within this report include the impact of the proposed development on groundwater and surface water runoff, and the structural stability of neighbouring Grade II listed buildings.

This report is to be read in conjunction with Geotechnical Desk Study and Interpretative Report, Site Investigation Factual Report and Chemical Interpretative Report, all by Chelmer Site investigations Ltd.

1.4 EXECUTIVE SUMMARY

This report summarises key points from site investigation and desk study reports (provided by Chelmer) within chapters 2 and 3. Chapter 4 of this report considers the risk of flooding, and shows that the proposed development will not result in changes to the profile of the inflows (or quality) of groundwater being received by adjacent properties or downstream watercourses.

Chapters 5 and 6 outline a structural methodology for proposed works that may be completed without causing damage to existing neighbouring buildings. Chapter 6 also identifies key points identified within Chelmer's heave assessment report. The results of the heave and settlement analysis predict settlement in the flank wall to 24 Gloucester Crescent of up to 3mm. On the Burland Scale the rating of 2 allows 1mm-5mm movement and a rating of 3 is for 5mm to 15mm movement. We have separately assessed the Heritage Rating to be 0. For the wall to 44 Inverness Street we anticipate that actual heave will not be more than 5mm, giving a rating of 2 on the Burland Scale. We have separately assessed the Heritage Rating to be 0.

2 SYNOPSIS OF SITE INVESTIGATION AND DESK STUDY BY CHEMER SITE INVESTIGATIONS.

A desk study and site investigation was completed by Chelmer Site Investigations on the 15th and 16th of September 2014. They were appointed to complete a desk study for the site and surrounding area along with 3 trial pits taken to a depth of 2.4 and 1.3 metres, and 2 boreholes taken to a depth of 10m.

Section 7.0 of the desk study summarises most of the information required for the Impact Assessment and also for the design of the sub-structure. The full report is appended and is to be read in full, but the key points are listed below.

- Soil strata comprise made ground between 0.45m and 1.8m thick over London clay. Clay is weathered and is firm to very stiff with partings of silt and fine sand.

- Tree roots were found to a depth of 1.8m.

- Standpipe monitoring shows that the existing groundwater level is consistently lower than the lowest point of proposed excavation. At the level of the proposed basement the soil is clay, and typically impermeable. Therefore, the proposed basement will not influence the flow of groundwater around and under the site. The site is not within the catchment area of the pond chains on Hampstead Heath.

- Ground water was not found but perched water is likely, emanating from the silty partings, leading to a requirement for the basement to be designed for hydrostatic pressure on retaining walls and for buoyancy pressures on the structure. The basement will also need to be waterproofed.

- Recommendations for pumping during construction is mentioned should a small amount of water enter the excavation.

- No railway tunnels or underground workings are present beneath the site.

- Information and design parameters are given for the foundations and for retaining walls.

- A heave and settlement analysis has been carried out, showing recommendations for the amount of heave that might be expected. This predicts up to 3mm of heave / settlement beneath the flank wall to 24 Gloucester Crescent and up to 6mm heave in the vicinity of 44 Inverness Street. It gives a prediction of a heave force beneath the slab for designing a void former and the basement slab reinforcement.

- A section on ground movement and temporary works is included to emphasise the need for well-designed and detailed temporary works, and the need for a Contractor who is experienced in this type of work to manage the project and ensure best practice prevails. With a combination of clear information and expertise the risk of ground movement can usually be controlled.

- The summary gives a recommendation for the mix and sulphate resistance for buried concrete of DC-3 and ACEC Class AC-2s.

3 CONTAMINATION

Chelmer Site Investigations has written a commentary on findings from contamination testing and this is appended and is to be read in full but the key points are listed below.

- Low concentrations of land borne gas were found. Since this is likely to be coming from made ground and the basement excavation will remove most or all of it, the classification has been given Green status and no protective measures are required to the building.

- Elevated levels of Arsenic and Lead have been found in the made ground. As above, since most or all of the made ground will be removed to make way for the basement, the risks to occupants is felt to be low. In addition, there is no outside space for growing plants or vegetables or where the occupants could come into contact with any remaining contaminated soil and therefore the risk here is also low. If this were to change, protection measures would be required.

- There is a risk to ground workers and construction workers and protection measures compliant with Health and Safety Regulations will be needed on site to keep the risk of harm low.

- Waste from site will need to be removed to an appropriate land-fill facility. WAC test results contained in the report can be used by the contractor to obtain prices for disposal.

- New pipework to the building bringing water services into the site should be checked for compliance with Water Regulations Advisory Service to ensure the material used in pipework protects the occupants from any remaining contaminants in the soil.

- An asbestos survey of the building is recommended before demolition takes place.

4 FLOOD RISK.

The site is located in 'South Camden' as defined by the report entitled 'Managing Flood Risk in Camden – The London Borough of Camden Flood Risk Management Strategy'. This document states that there is a low risk of flooding from local rivers and water bodies (i.e. Regent's Canal). It also says that:

- Inverness Street was not flooded during the floods of 1975 and 2002. (Ref. Figure 5.1 – map of flooded roads in 1975 and 2002 floods.)

- The site and surrounding area is shown to be outside of areas believed to be especially vulnerable to groundwater flooding. (Ref. map by The Environment Agency contained on page 55 of 'Managing Flood Risk in Camden – The London Borough of Camden Flood Risk Management Strategy'.)

The proposed development will not increase the extent of hard surfaced / paved external areas. The site is currently entirely occupied by a single storey building with a flat roof. The proposed scheme matches this building footprint. There are currently no external areas to drain, and this condition will not be changed by the proposed development. Therefore the proposed development will not result in changes to the profile of the inflows (or quality) of groundwater being received by adjacent properties or downstream watercourses.

5 STRUCTURAL PROPOSALS

The proposed basement is to be formed by constructing a rigid reinforced concrete (RC) 'box'. This RC 'box' is to have three distinct boundary conditions:

- Along the boundary where the site meets the building at 44 Inverness Street the new reinforced concrete basement wall will abut the existing masonry wall currently forming the side of the existing basement (to 44 Inverness street). The proposed basement slab level is approximately 0.7 metres below the level of the existing neighbouring basement. Underpinning is to be used to allow formation of the rigid RC 'box' along this boundary. Underpinning along this line is to be extended to the end of the wall to 44 Inverness Street. This is so that a consistent foundation depth is achieved along the full length of the existing wall.

- Where the site meets 24 Gloucester Crescent, we propose underpinning existing walls prior to construction of the rigid RC 'box'. Along this boundary the existing neighbouring basement is approximately 2.1 metres above the level of the proposed basement slab.

- Where the site runs alongside the public footpath to Inverness Street, a sequentially cast RC wall will be used to retain lateral forces induced by the earth, groundwater, and potential surcharge from the public highway.

A sketch follows defining these distinct zones.

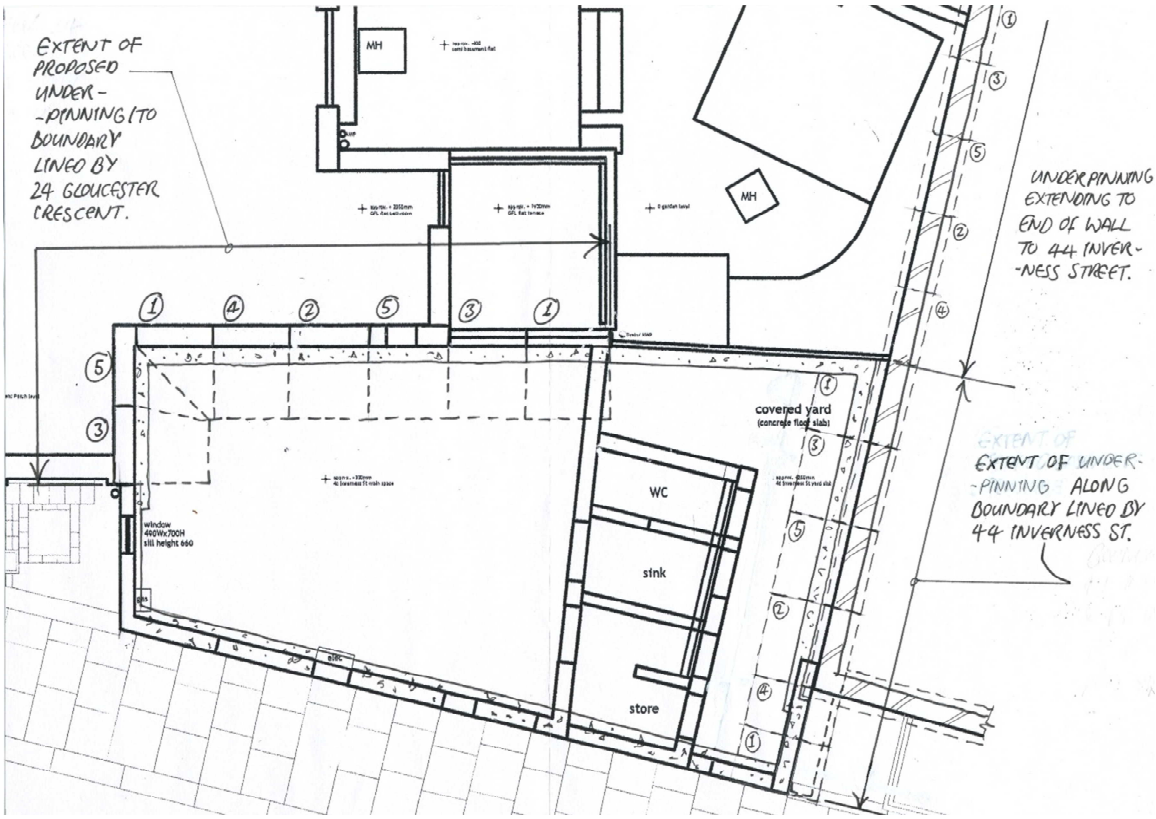


Image 5.1: The extent of differing structural solutions applied to varying site boundary conditions.

RC walls are to be designed to resist lateral loads by spanning vertically between slabs at their head and base at ground floor and basement levels. Beams will span horizontally across openings where the slab at ground floor level has to span across a stair void and light-wells, thus propping the head of walls.

Lateral forces will thus be taken into RC slabs at basement and ground floor levels and from here transferred to RC walls to the opposite side of the site. Passive earth pressure to the lower half of the wall will resist sliding induced by active earth, hydrostatic and surcharge forces applied to the wall opposite (and vice versa). Considering global lateral stability along the longer site axis: active earth, hydrostatic and surcharge forces applied to the lower portion of the RC wall along the Gloucester Crescent boundary will ultimately be resisted by passive earth pressures formed behind the underpinning elements along the boundary to 44 Inverness Street.

Although the water table has been shown to be below the proposed basement level, the basement level slab and RC walls will be designed to resist hydrostatic pressures in accordance with Chelmer Site Investigation recommendations. This is so that structural integrity will be retained in the case of an accumulation of ground water passing through silty partings in the clay and from, for example, a burst water main in the local vicinity leading to a rise in the water table.

The building will be designed for possible buoyancy and the proposed substructure and superstructure will be sufficient to resist uplift pressure.

Axial load applied to the RC 'box', and axial load occurring due to the self-weight of the 'box', will be taken to ground through slab thickenings to the full perimeter of the basement level slab. Slab reinforcement together with a compressible void former laid beneath the thinner basement area will provide a suitable means of mitigating adverse effects due to ground heave and uplift.

RC elements are to be designed in accordance with BS8110, BS8002, BS8004 and BS8500 or the equivalent Eurocodes.

6 CONSTRUCTION METHODOLOGY

6.1 HEAVE, SETTLEMENT AND HERITAGE ASSESSMENT

Buildings on either side of 46 Inverness Street are Listed Grade II and movement resulting from the construction of the new building should be kept within reasonable limits to ensure the risk of damage to the Listed buildings is low.

An assessment of heave and settlement has been carried out and the results of this are to be considered in conjunction with a Heritage Assessment of the Listed buildings. Predicted movement is compared against the Burland Scale which gives a category of damage, a rating and a description of typical damage and forms of repair. The Heritage Assessment gives a separate rating for three categories; Structure, Heritage Features and Condition, and their sensitivity to ground movement.

The two ratings must be assessed together and given a total score that is to be taken into account in the development of a methodology for the construction and in temporary works design.

24 GLOUCESTER CRESCENT:

The results of the heave and settlement analysis predict maximum heave in the flank wall to 24 Gloucester Crescent of up to 3mm. On the Burland Scale the rating of 2 allows 1mm-5mm movement and a rating of 3 is for 5mm to 15mm movement. We have separately assessed the Heritage Rating to be 0.

The building is Listed Grade II. The Listing details for 24 to 29 Gloucester Crescent, extracted from English Heritage website, are below.

Terrace of 6 houses. Mid C19. Yellow stock brick with channeled stucco ground floors and stucco first floor bracketed window cornices, third floor cornice and main cornice. 4 storeys and basements. 2 windows each; No.29 with additional window in recessed entrance bay. No.24 has entrance in single storey extension on return, Nos 25 & 26 and 27 & 28 paired; doorways flanked by pilasters; paneled doors with overlights. Recessed ground floor sashes tripartite with bracketed mullions, except end houses which have 2 sashes with margin glazing each. All have keystones and bracketed sills. Upper floor sashes mostly with glazing bars, diminishing in height to top floor; bracketed balconies with geometrically patterned cast-iron railings to 1st floor sashes. INTERIORS: not inspected.

The new building at 46 Inverness Street will be alongside the entrance to 24 and alongside the rear annex. The entrance area and flank wall of the building and the annex has been recently re-rendered. The rear annex lacks the features described in the Listing details.

Structure: The structure is a masonry structure with lime mortar, regular openings in the front and rear elevation and no openings along the flank wall. The structural sensitivity is therefore 0.

Heritage features: All features Listed are on the outside of the building and the most sensitive in the front elevation – remote from the work. In assessing the sensitivity to calculated movement it is felt there are no particularly sensitive features.

Condition: The condition is Good/Fair and not affecting the sensitivity of structural heritage features.

It will be important in the detailed design, temporary works and the sequence of construction and methodology to try to maintain the predicted heave to 44 Inverness Street at Burland rating 2.

The results of the heave and settlement analysis predict a maximum heave / settlement in walls of 24 Gloucester Crescent of 3mm, or a rating of 2 on the Burland Scale. We have separately assessed the Heritage Rating to be 0.

<u>44 INVERNESS STREET:</u>

Heave and settlement analysis was completed considering an excavation extending to -3.8metres along this boundary. The excavation considered was profiled at 45 degrees below horizontal from the toe of the existing footing (thus not directly undermining the existing wall). Analysis of this condition predicts a maximum heave of 6mm adjacent to the existing wall, and a heave of 1.5mm to the flank wall to 44 Inverness Street.

We are now proposing to underpin the wall to 44 Inverness Street as per the methodology outlined on drawing SQ3 and to construct the RC 'box' as shown on drawing SQ4 in Appendix A. As the underpin element extends beneath the existing foundation and the area adjacent to the existing wall, we may safely state that maximum anticipated heave will be between 1.5 and 6mm.

In reality we anticipate that actual heave will not be more than 5mm, or a rating of 2 on the Burland Scale. We have separately assessed the Heritage Rating to be 0.

The building is Listed Grade II. The Listing details, extracted from English Heritage website, are below.

Terrace of 3 houses. Mid C19. Yellow stock brick with stucco dressings and channeled stucco ground floor with 1st floor band. 3 storeys and basements. 2 windows each. Square-headed entrances with paneled doors and overlights. Architraved sashes: 1st floor with console bracketed cornices and cast-iron balconies; 2nd floor, originally with lugged sills. Cornice and blocking course. INTERIORS: not inspected. SUBSIDIARY FEATURES: attached cast-iron railings with spearhead finials to areas.

Structure: The structure is a masonry structure with lime mortar, regular openings in the front and rear elevation and no openings along the flank wall. The structural sensitivity is therefore 0.

Heritage features: All features Listed are on the outside of the building. In assessing the sensitivity to calculated movement it is felt there are no particularly sensitive features.

Condition: The condition is Good/Fair and not affecting the sensitivity of structural heritage features.

6.2 SITE AND ACCESS

The site may be accessed from Inverness Street only, with existing buildings tightly abutting all other sides of the site (see site plan contained in Chapter 1). Existing buildings abutting the site are both Grade II listed buildings.

Materials arising during demolition and excavation will be transported over the pavement to a skip located within one of the parking bays located directly in front of the site. Whilst some material / spoil may be temporarily stored on site, there is limited scope for storage on site due to its size.

6.3 PROPOSED WORKS SEQUENCE

The first stage of works entails demolition of the existing building above ground (with the ground floor level slab to be retained). Neighbouring buildings do not rely upon the existing building for assistance with lateral stability, and therefore will not need to be propped during demolition.

Once the existing building has been demolished, underpinning to party walls along all site boundaries with 24 Gloucester Crescent may commence.

Underpinning is a well-established building technique, which is relatively low tech and is not a complex operation. Even so poor methodology is possible and this can lead to problems. It should only be carried out by a contractor who is experienced with this work and associated temporary works, and aware of the Health and Safety issues, and who has a well-trained work-force. Underpinning is to be completed according to the numbered sequence identified on image 5.1. A suggested working methodology for underpinning is included below, which is to be read in conjunction with the methodology drawings contained on drawing SQ1 in Appendix A:

a) Locally demolish existing (75mm thick unreinforced) ground floor level slab where the excavation for underpinning is to be carried out.

b) Excavate to -0.9 metres below existing ground level for underpin elements denoted by number (1) on Image 5.1. Props are to be utilised at the base of the excavation to laterally prop the base of the existing wall. Refer to step 1 on SQ1 in Appendix A.

c) Excavate to -3.8 metres, providing propping to shore up the ground as excavation proceeds. Whilst excavating during this stage, clean the underside of the existing foundation to remove any dirt and loose material.

d) Place reinforcement and cast 300mm thk. RC toe to underpin. See step 2 of the diagrammatic sequence provided on drawing SQ1 in Appendix A. Leave the toe to cure for at least 24 hours before proceeding to the next step.

e) Tie reinforcement for the wall element and cast the wall to a minimum of 75mm below the base of the existing foundation. Allow the wall to cure for 24 hours before proceeding.

f) Insert well rammed dry pack between the head of the RC wall and underside of the existing footing (max. 75mm), and allow to cure for 24 hours, as shown in step 3 of the diagrammatic sequence provided on drawing SQ1 in Appendix A.

g) Repeat steps a) to f) for underpin elements in the next stage of the sequential process.

h) On completion of underpinning, the existing masonry corbel may be carefully cut away and removed on the side of 46 Inverness Street.

After completion of underpinning along all site boundaries with 24 Gloucester Crescent the excavation along the boundary with 44 Inverness Street (shown on drawing SQ2 provided in Appendix A) may be completed to facilitate

construction of underpinning to the site boundary with 44 Inverness Street. A suggested working methodology for construction of underpinning is included below, which is to be read in conjunction with the methodology drawings contained on drawing SQ3 in Appendix A:

i) Demolish all remaining areas of (75mm thick unreinforced) ground floor level slab.

j) Excavate to -2.4m, propping the vertical lines of excavation running parallel to the road and to the garden area to the rear using horizontal props. See drawing SQ2 and step 1 of the diagrammatic sequence provided on drawing SQ3 in Appendix A.

k) Excavate to -3.8m, providing propping to shore up the ground as excavation proceeds. Whilst excavating during this stage, clean the underside of the existing foundation to remove any dirt and loose material.

l) Place reinforcement and cast 300mm thk. RC toe to underpin. See step 2 of the diagrammatic sequence on drawing SQ3 provided in Appendix A. Leave the toe to cure for at least 24 hours before proceeding to the next step.

m) Tie reinforcement for the wall element and cast the wall to a minimum of 75mm below the base of the existing foundation. This wall shall be cast in stages to avoid excessive lateral loading to the existing masonry wall. Allow the wall to cure for 24 hours before proceeding.

n) Insert well rammed dry pack between the head of the RC wall and underside of the existing footing (max. 75mm), and allow to cure for 24 hours, as per step 3 of the diagrammatic sequence shown on drawing SQ3 provided in Appendix A.

o) Repeat steps k) to n) for underpin elements in the next stage of the sequential process.

p) On completion of underpinning, the existing masonry corbel may be carefully cut away and removed on the side of 46 Inverness Street.

After completion of underpinning to the boundary with 44 Inverness Street, the remaining site may be excavated to full depth to allow formation of the submerged reinforced concrete ‘box’. Drawing SQ4 in Appendix A shows a detailed section showing the RC ‘box’ cast alongside proposed underpinning.

The contractor is to ensure that the side of the excavation running parallel to the road, and alongside the short length of garden area to the rear are suitably propped during this stage of excavation. It will also be necessary to ensure that lateral struts propping underpinning elements are maintained until

the full RC 'box' has been cast, achieved by sequentially rearranging props in conjunction with phased wall pours.

6.4 MONITORING

Indicative target locations are shown on figure 6.3 below.

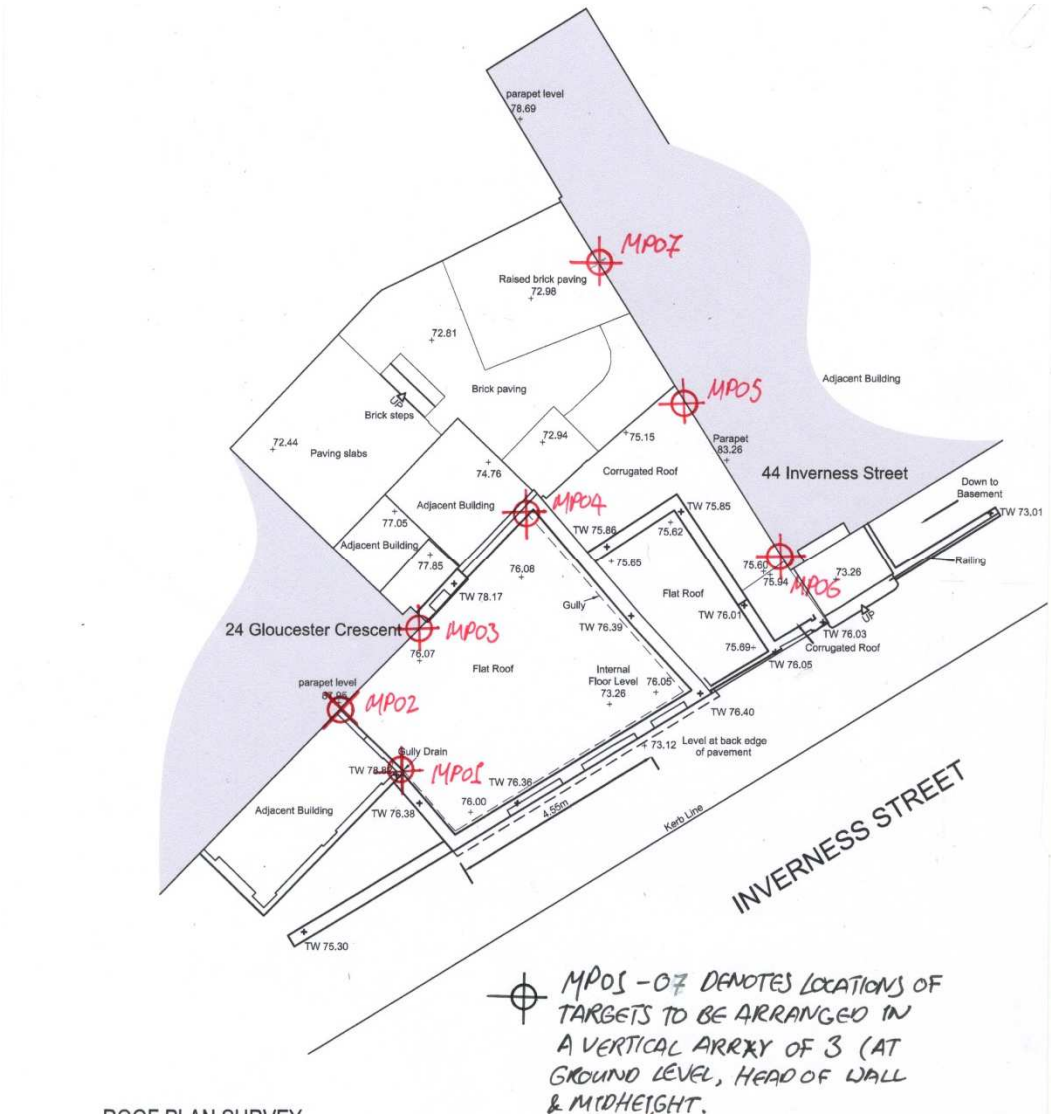


Image 6.3: indicative monitoring target locations.

Existing buildings are to be monitored during and after completion of the works for displacement in horizontal and vertical planes. Monitoring will be accomplished by using attached targets fixed to neighbouring buildings read from a fixed stationary point. Some of these will become hidden as the building at 46 Inverness Street is constructed and target locations will need to be carefully considered to ensure consistency of readings during the whole monitoring period.

Reported results of monitoring shall be presented as graphs showing vertical and horizontal movement with time (as well as a standard tabulated format). The frequency of readings shall typically be weekly during critical construction phases i.e. during underpinning, excavation and casting of the submerged RC 'box'. Monthly monitoring shall be completed for a phase of 6 to 12 months following construction. On completion of each cycle of readings the data should be compiled in a report and issued within 24 hours.

Detailed monitoring proposals are to be agreed between the selected contractor, and the various interested parties (i.e. Party Wall Engineer, Contract Administrator), and to the satisfaction of the Structural Engineer. Trigger values are to be established and a traffic light warning system put into place so that the Contract Administrator, Contractor and Structural Engineer may be alerted, and necessary actions may be undertaken when recorded movement approaches trigger values. The following table, based on the Burland Scale, lists a set of trigger values for existing elements in terms of green, amber and red limits:

ELEMENT	GREEN ZONE	AMBER ZONE	RED ZONE
Existing masonry walls to 24 Gloucester Crescent and 44 Inverness Street	Vertical settlement or heave: up to 5mm Lateral deflection: up to 3mm	Vertical settlement or heave: 5mm to 10mm Lateral deflection: 3mm to 6mm	Vertical settlement or heave: up to 10mm Lateral deflection: up to 6mm

Settlement and / or movement has been predicted to be within the Green zone, possibly within the lower range of the Amber zone and although this would lead to 'negligible to slight' category of damage as defined by the damage category chart from CIRIA C580 (or Burland category), it is clear a strict regime for the temporary works will be required for the construction phase. No remedial action is required if readings are all within the green zone.

Should recorded movement reach the amber zone further excavation is to cease until the following points have been addressed.

- The frequency of monitoring is to increase to daily recordings to predict the rate of movement, and if predicted movement is expected to exceed the upper limit of the amber zone.
- A strategy to minimise movement, such as jacking the structure using hydraulic struts, and adjusting the temporary works proposals is to be proposed by the Contractor for review by the Structural Engineer.

Should recorded movement reach the red limit work on site is to cease until

- A strategy to proceed is to be agreed between the Contractor and the Structural Engineer.
- The frequency of monitoring is to remain daily.

Monitoring is to be carried out by an organisation independent of all parties involved in the design and construction.

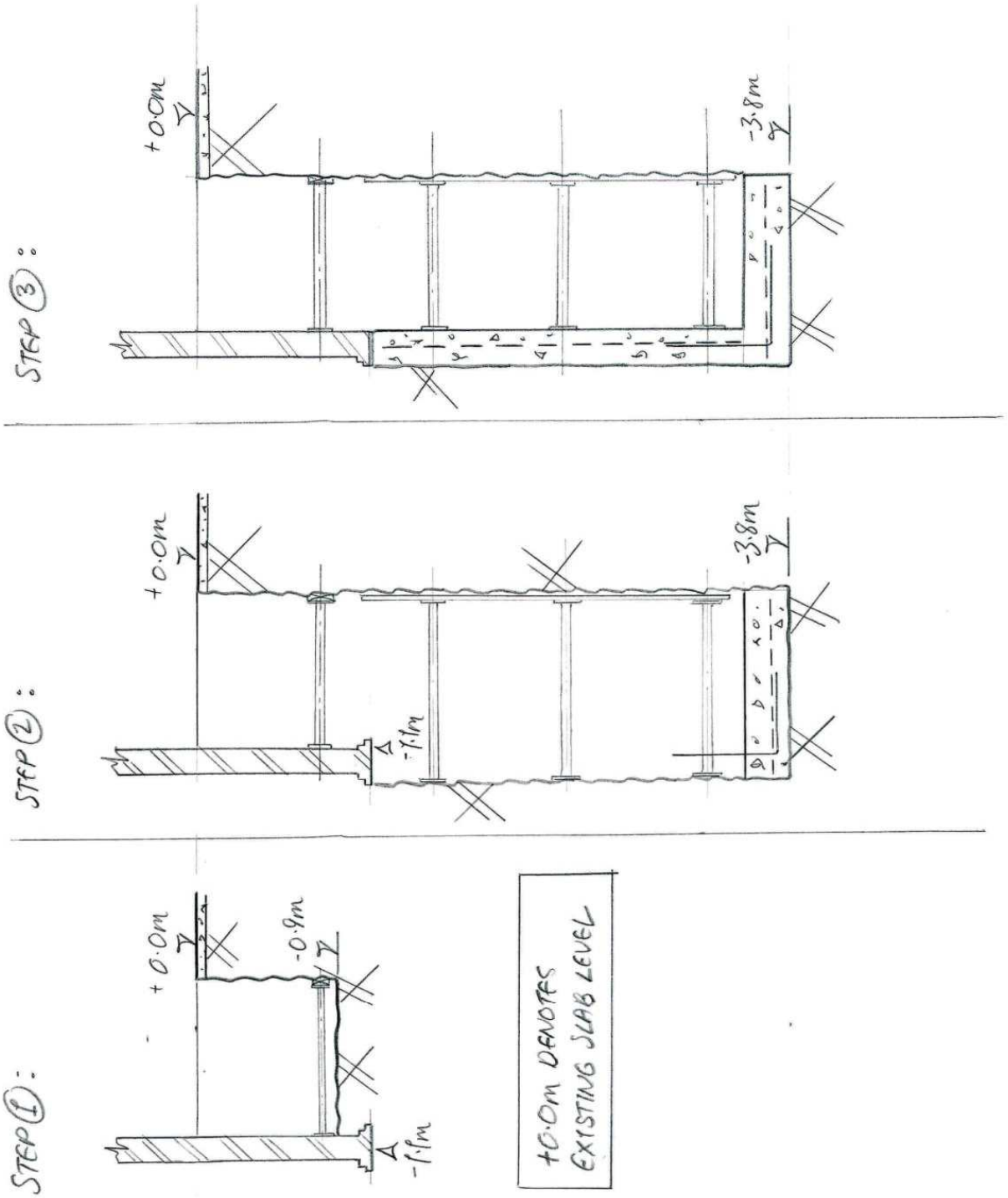
7 DRAINAGE

An asset location search by Thames Water (centred on OS coordinates 528699, 183872) shows a public combined sewer running centrally under Inverness Street at a depth of approximately 2.2metres below existing road level. It is proposed to make a new connection to this public sewer. Waste water from basement level will need to be pumped to a higher level to allow discharge into the public sewer.

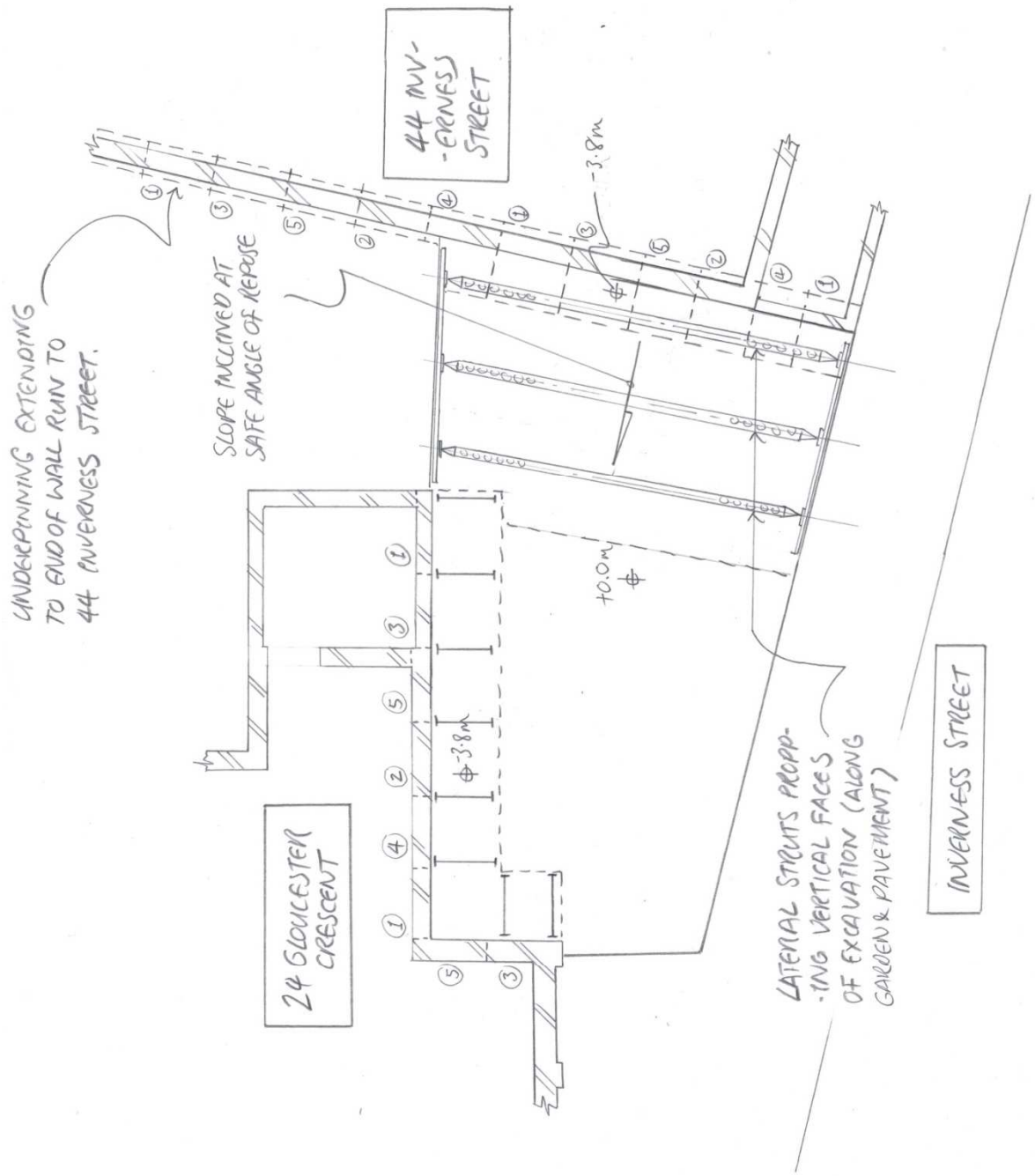
The roof area of the proposed building is the same as that of the existing building, and no additional areas of hard standing are proposed. Thus, the surface water runoff from the proposed site will be no more onerous than the existing condition.

APPENDIX A

Construction Methodology Drawings



Osborne Edwards Ltd CONSULTING STRUCTURAL ENGINEERS OMNIBUS BUSINESS CENTRE 39/41 NORTH ROAD LONDON N7 9DP TELEPHONE 020 7226 2444	PROJECT TITLE 46 INVERNESS STREET		JOB NO 09166
	DRG TITLE PROPOSED WORKS SEQUENCE -UNDERPINNING		DRG NO SQ1
	SCALE N/A	DATE SEPT '14	REV P1



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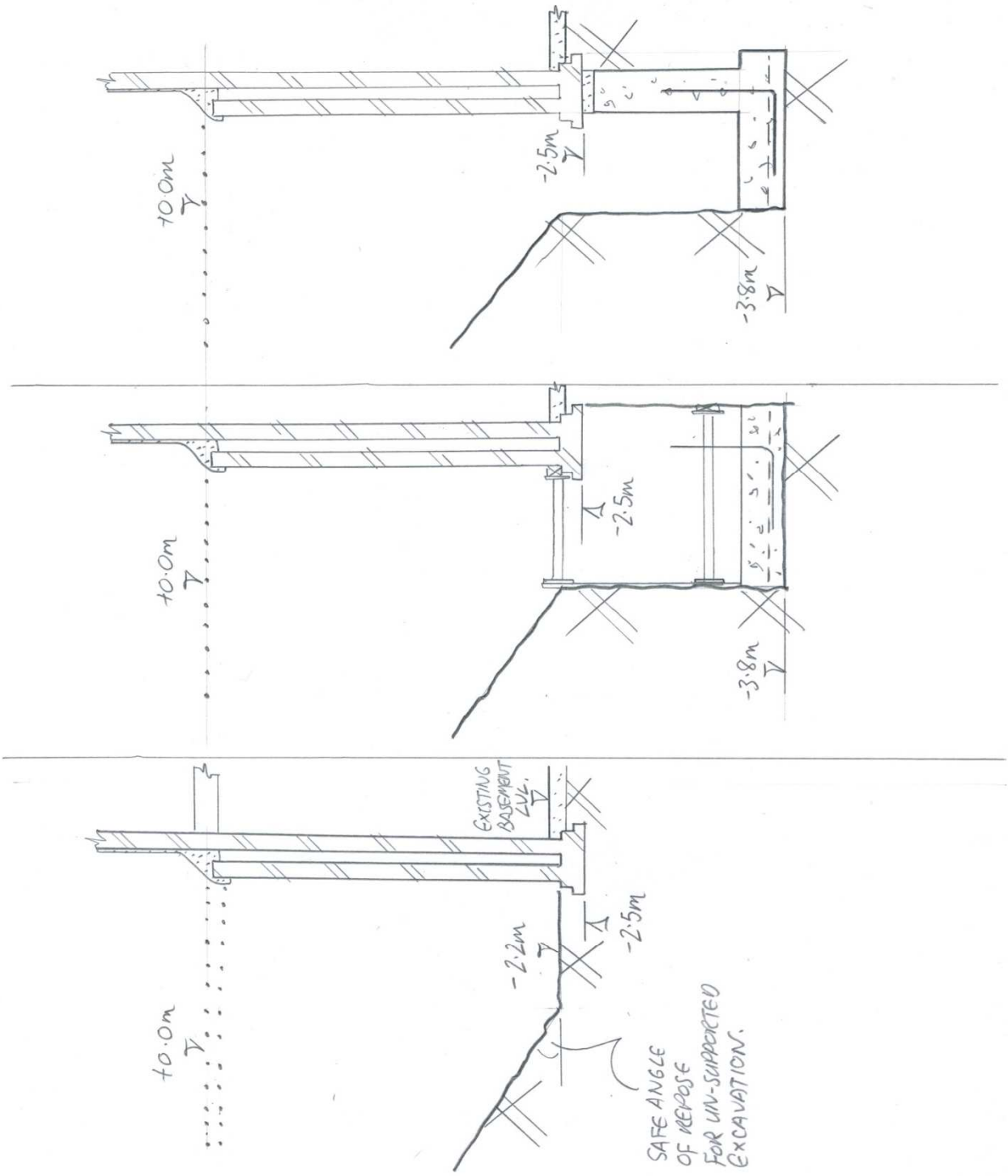

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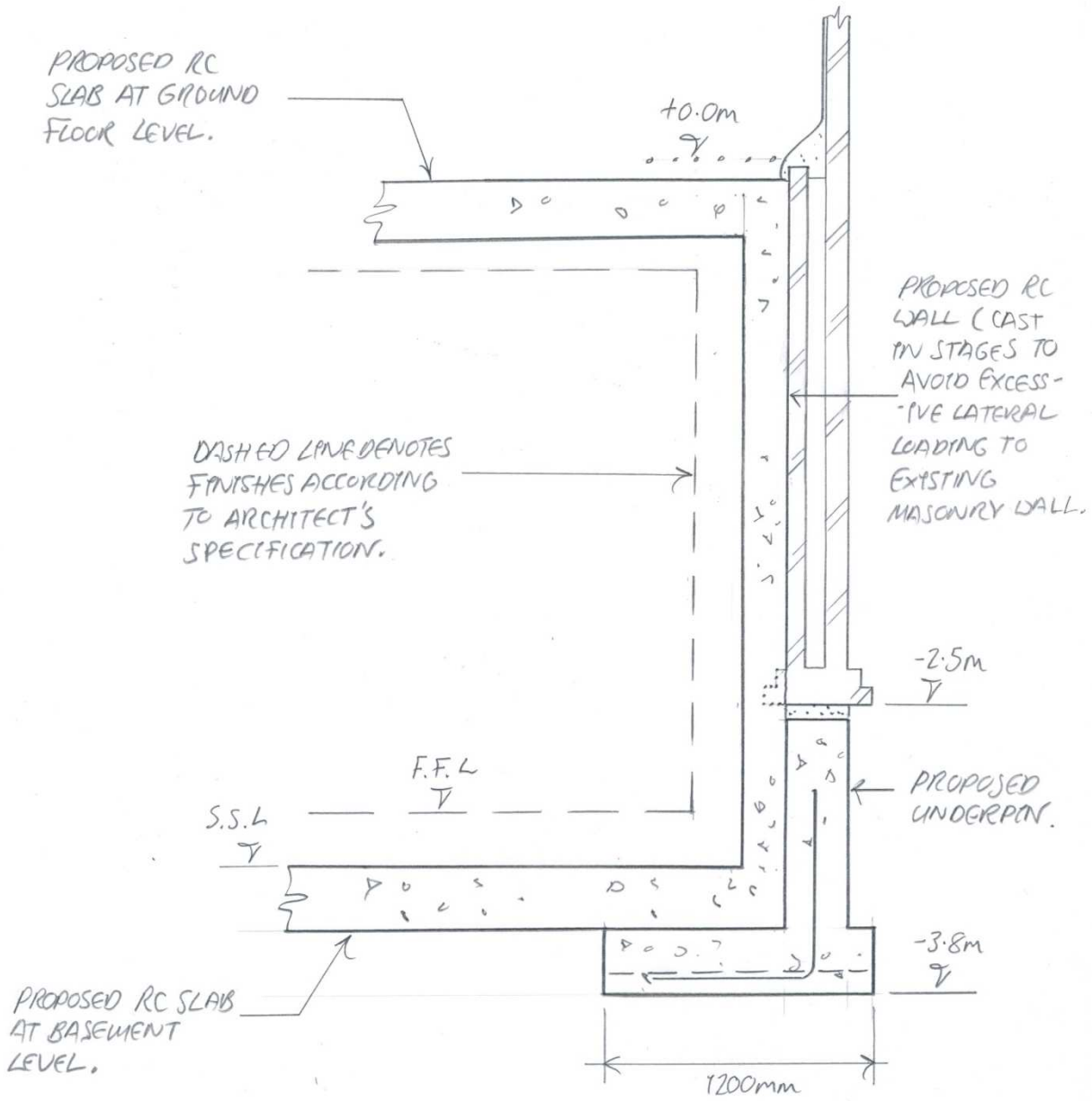
PROJECT TITLE 46 INVERNESS STREET		JOB NO 09166
DRG TITLE UNDERPINNING TO BOUNDARY WITH 44 INVERNESS STREET		DRG NO SQ3
SCALE N/A	DATE DEC '14	REV P1



Osborne Edwards Ltd CONSULTING STRUCTURAL ENGINEERS OMNIBUS BUSINESS CENTRE 39/41 NORTH ROAD LONDON N7 9DP TELEPHONE 020 7226 2444	PROJECT TITLE 46 INVERNESS STREET		JOB NO 09166
	DRG TITLE STRUCTURAL SECTION BOUNDARY WITH 44 INVERNESS STREET		DRG NO SQ4
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APPENDIX B

Miscellaneous Documents

- Existing site survey plan
- Extract from Thames Water Asset Location Search

Figure B1: Site Survey Plan.

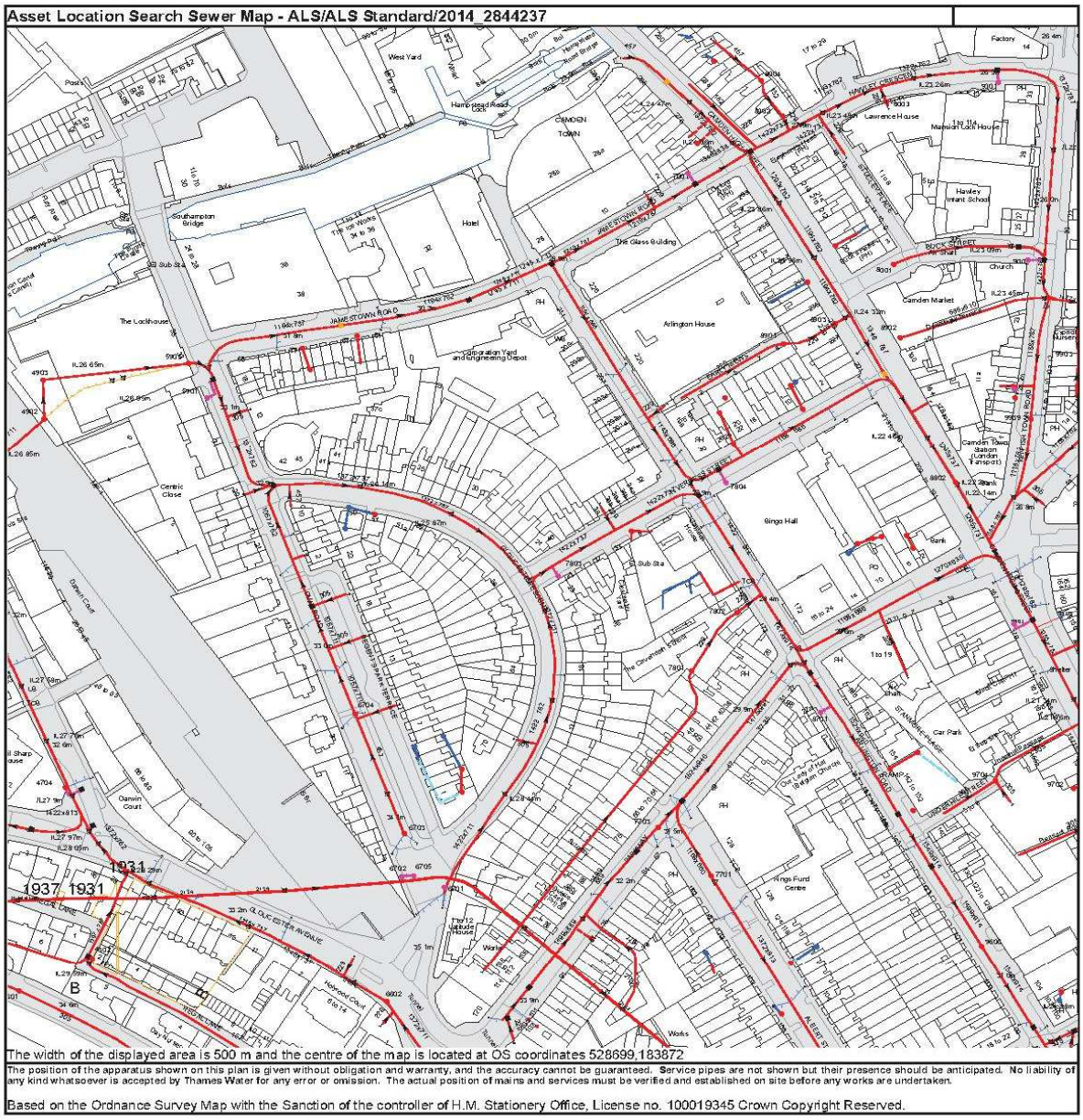

Figure B2: Thames Water Asset Plan.