

Flood Mitigation Options Appraisal & Strategy

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Land at Trafalgar Square, Long Sutton, Spalding, PE12 9HB

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1. Introduction

The following document is a Flood Mitigation Options Appraisal & Strategy carried out by Oakshire Environmental, and includes details of the site, previous investigations, an evaluation of mitigation options and an assessment of further investigations.

1.1 Project Overview

The client's proposed project involves the construction of a 2 storey dwelling and associated work on land at Trafalgar Square, Long Sutton, Spalding, PE12 9HB. Following the identification of flood linkages at the site, mitigation has been recommended. Oakshire Environmental have carried out a Flood Mitigation Options Appraisal & Strategy, as described below.

2.1 Purpose of Investigation

The objectives of the Flood Mitigation Options Appraisal & Strategy will be to:

- Assess the nature and extent of flood risk at the site.
- Identify suitable flood mitigation option(s).
- Outline a strategy for the implementation of suitable mitigation option(s).
- Determine the requirement or scope of further investigations or monitoring.

2.2 Scope of Work

- Assess the nature and extent of flood risk, identified as part of previous investigations.
- Identify initial feasible options for mitigation at the site, including assessment of potential constraints and generic mitigation objectives, based on the estimated cost, practicality and regulatory implications of their application.
- Conduct a detailed evaluation of mitigation options and develop site-specific mitigation objectives, utilising Environment Agency modelling and LiDAR topographical data, in order to determine which option(s) are most appropriate for the site.
- Outline a strategy for the implementation of suitable mitigation option(s).
- Recommended mitigation option(s) will be assessed to determine the requirement or scope of further investigations at the site.
- Supporting appendix to include photographs, maps and plans of the site.

1.4 Limitations

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This report excludes consideration of potential hazards arising from any activities at the site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities. Oakshire Environmental does not warrant or guarantee that the site is free of hazardous or potentially hazardous materials or conditions. It should be noted that this report has been produced for environmental purposes only.

2. Site

The following section provides a description of the site, location and previous investigations, utilising information obtained from the client and publicly available sources.

2.1 Site Description and Location

The site is located on Trafalgar Square in Long Sutton, Spalding, and is approximately 0.05ha. The site comprises the garden space for the adjacent dwelling and includes lawn and trees. A topographic survey of the site has been undertaken and shows that the site is flat with ground levels between 2.5mAOD and 2.7mAOD.

The site is bordered by dwellings to the north, south and west and Swapcoat Lane to the east with additional dwellings beyond. The surrounding area is predominantly residential.

National Grid Reference: 54291 / 32304

2.2 Proposed Development

The proposed development includes the construction of a two-storey detached dwelling.

2.3 Previous Investigations

A Flood Risk Assessment was carried out by Ellingham Consulting Ltd in February 2023 and the following conclusions were made.

- The site is located within an Internal Drainage Board catchment and through the operation and maintenance of the pumping stations and the channel system the Board seek to maintain a general standard capable to providing flood protection to agricultural land and developed areas of 1 in 20 and 1 in 100 years, respectively.
- The proposed development is in Flood Zone 3. The site benefits from defences on the tidal River Nene and provide protection during the 1% annual probability (1 in 100 chance each year) fluvial event and 0.5% annual probability (1 in 200) tidal event including climate change.
- The South East Lincolnshire SFRA considers the residual risk associated with overtopping and a breach in the defences in 2116 and maps show that the peak flood depth at the site is between 0.5m and 1.0m.
- Flood hazard mapping shows that there would be a 'danger to most' in the event of a breach of flood defences.
- The risk of flooding is lowered as the proposed dwelling has 2 storeys with all sleeping accommodation on the first floor.

3. Mitigation Options

A Flood Mitigation Options Appraisal requires the initial identification of feasible options for mitigation at a site, based on the costs involved and the practicality of their application. Some methods may not be appropriate to a particular site as some can only be used for certain sources of flooding and some may not be cost effective. Other site-specific constraints such as time and access can also determine the feasibility of a particular mitigation option. The following section outlines the generic mitigation objectives for the site, taking into account potential constraints, and includes a selection of feasible mitigation options. These are based on the findings of previous investigations.

3.1 Site Context and Objectives

The site is currently residential and the proposed development involves the construction of a two-storey dwelling. There is a residual risk of tidal flooding at the site in the event of a breach of existing tidal defences, therefore, this report considers the feasibility of implementing suitable mitigation measures to protect the proposed dwelling in the event of a breach of flood defences.

The South East Lincolnshire SFRA requires that non-major developments in areas where there is considered to be a 'danger to most' are accompanied by a Flood Risk Assessment which contains evidence that appropriate mitigation measures/flood resilience techniques have been incorporated into the development.

3.2 Potential Constraints

There are residential dwellings bordering the site to the north, south and west, therefore, there are sensitive receptors bordering the site. There are no specific time constraints with regards the implementation of flood mitigation measures, however, there is considered to be a risk of flooding at the site so it would be prudent to implement mitigation measures prior to occupation of the dwelling.

3.3 Generic Mitigation Objectives

The following table outlines the generic objectives of mitigation at the site.

Table 1: Summary of Generic Objectives

Mitigation Objective	Objective Type
Ensure that the site is safe from flooding for its lifetime	General
Ensure that flood risk off-site is not increased	General
Enable development of a mitigation strategy that meets regulatory requirements	Management
Enable development of a mitigation strategy that meets the owner's requirements	Management
Avoid unacceptable environmental impacts from implementation of mitigation strategy	Management

3.4 Feasible Mitigation Options

Residual tidal flooding risk has been identified at the site, therefore, a number of mitigation options have been discounted as they are inappropriate for the site the identified flood risk.

Options that would require work to be carried out off-site will be discounted as the client does not own this land.

The following remaining mitigation options are considered appropriate for the site and will be subject to a more detailed evaluation in the following section.

Table 2: Summary of Feasible Mitigation Options

Mitigation Method	Mitigation Option
Avoidance	Raise finished floor levels
Permeant resistance	Low permeability materials up to 0.6m
	Flood resistant doors
	Anti-backflow valves for sewer pipes and Non-return valves (NRVs) for appliance waste-pipes
Temporary resistance	Temporary barriers for doors and windows
Resilience	Using flood resilient materials
	Raising all sensitive electrical equipment, wiring and sockets
	Provide access to all spaces to enable drying and cleaning

4. Detailed Evaluation of Mitigation Options

Following the identification of feasible mitigation options, a detailed evaluation of options, including development of site-specific mitigation objectives, is required to determine which option(s) are most appropriate for the site.

Table 3: Summary of Site-Specific Objectives

Mitigation Objective	Objective Type	Evaluation Criteria
Ensure that the site is safe from flooding for its lifetime	General/Technical	Implement mitigation measures to protect the site from the 0.5% AEP flood event, including an allowance for climate change, for up to 100 years
Ensure that flood risk off-site is not increased	General/Technical	Mitigation measures to protect the site from flooding while not increasing flood risk off-site
Enable development of a mitigation strategy that meets regulatory requirements	Management	Mitigation strategy to be agreed with Local Authority and carried out in accordance with relevant regulations
Enable development of a mitigation strategy that meets the owner's requirements	Management	Mitigation strategy to be agreed with site owner
Avoid unacceptable environmental impacts from implementation of mitigation strategy	Management	Limit the impact on site users including wildlife in areas where work is proposed

4.1 Avoidance

The most effective method of flood mitigation is through the use of avoidance measures to include setting building floor levels above modelled flood levels, including an allowance for climate change.

In this instance, it is not considered practical to raise the finished floor level of the dwelling to 1m above the ground level as it would result in the development being aesthetically out of place given that no other developments in the area are raised to such a level (including recent residential developments). Developments in the area that are raised above the external ground level are raised no more than 300mm, therefore, this same level will be applied for the proposed development.

The first floor level will be situated above the modelled tidal breach level in the 0.5% AEP and 0.1% AEP events and will provide safe refuge in the event of a breach of tidal defences. In addition, all sleeping accommodation will be situated on the first floor to mitigate the risk to residents.

4.2 Permanent Resistance

Low permeability materials should be used for the construction of the dwelling up to 600mm above the external ground level (300mm above FFL) and all external doors should be flood resistant. Flood resistant doors should be compliant with BS 851188-1:2019 - 'Flood resistance products'. This would provide an unobtrusive flood mitigation option that will mitigate against flood depths up to 0.6m.

The implementation of anti-backflow valves for sewer pipes and non-return valves (NRVs) for any appliance waste-pipes is also recommended. These will need to meet BS EN 13564 standards - 'Anti-flooding devices for buildings'.

It should be noted that tidal breach modelling shows that flood depths at the site would be between 0.5m and 1m, therefore, permanent resistance measures alone may not be sufficient and it is recommended that resistance measures are implemented alongside resilience measures to mitigate against more common flooding events.

4.3 Temporary Resistance

Flood barriers could be put in place across external doors and permanent fixings could be placed on the building to allow quick and easy placement of these temporary barriers. To be effective, these products would need to be installed before a flood event so flood alerts and warnings should be observed. The Environment Agency's flood warning system and Met Office's National Severe Weather Warning Service should be followed to ensure that these are put in place when necessary.

Given that the risk to the site is from a breach or overtopping of tidal flood defences, the onset of flooding could be rapid, therefore, it may not be practical to install temporary barriers in advance of a flood event.

4.4 Resilience

Based on the modelled flood depths at the site, flood resilience measures are recommended. These are aimed at allowing a building to flood, while using materials that are not significantly damaged by water to ensure that no permanent significant damage is caused, the structure of the building is protected and drying and cleaning are quickened. Resilience measures should be implemented up to 1m above the finished floor level in order to provide a 300mm freeboard above the maximum modelled flood depth.

Resilience measures to be implemented at the site should include constructing the ground floor of the dwelling with flood resilient materials such as Lime plaster or Magnesium Oxide board as a replacement for standard plaster board. For example, Magnesium Oxide board is granite based and absorbs very little water, allowing it to dry out quickly in the event of a flood.

Furthermore, all sensitive electrical equipment, wiring and sockets should be raised to at least 1m above the finished floor level.

It is also recommended that the resident take measures to reduce the damage caused by flood water, including making sure there is access to all spaces to enable drying and cleaning and keeping/moving valuables to high shelves or in upstairs rooms.

5. Mitigation Strategy

Following a detailed evaluation of feasible mitigation options, the final flood mitigation option(s) are selected, taking into account site-specific factors and the constraints outlined previously.

In order to mitigate the residual risk to the development from tidal flooding, a range of avoidance, resistance and resilience measures should be implemented. It should be noted that these measures are only required for the ground floor of the proposed dwelling.

Flooring

A Damp Proof Membrane (d.p.m.) should be included to minimise the passage of water through the ground floor. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping and should include overlaps of 300mm or taping with mastic tape with an overlap of 50mm minimum. Care should be taken not to stretch the membrane in order to retain a waterproof layer. Floor insulation should be of the closed-cell type and placed above the floor slab to minimise the impact of flood water and allow easier replacement, if necessary.

Floor materials that are likely to withstand exposure to floodwater without significant deterioration should be used and these include ceramic or concrete-based floor tiles, marble or stone. All tiles should be set on a bed of sand and cement render and water resistant grout should be used. Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material. Suitable materials for skirting boards include ceramic tiles and PVC, however, ceramic tiles are likely to be more economically viable and environmentally acceptable. Under floor services using ferrous materials should be avoided.

Walls

Low permeability external wall materials should be used for the construction of the dwelling up to at least 300mm above the finished floor level. Low permeability materials effective for flood resistance include engineering bricks, cement-based materials including water retaining concrete and dense stone.

Above this level, flood resilient external wall materials should be used and these include facing bricks, concrete blocks, sacrificial or easily removable external finishes or internal linings.

Cavity wall insulation should incorporate rigid closed cell materials as these retain integrity and have low moisture take-up.

Internal cement renders should be avoided as these can prevent effective drying. Instead, lime plaster/render should be used as this is breathable and will aid drying following a flood event.

Doors and Windows

External door thresholds should be raised as high as possible, while complying with level access requirements.

Sealed PVC external framed doors should be used and, where the use of wooden doors is a preferred option, all effort should be made to ensure a good fit and seal to their frames.

Special care should be taken to ensure adequate sealing of any PVC window/door sills to the fabric of the dwelling. Double glazing conforming to the relevant standards would in principle adequately resist the pressures generated by flood waters.

Fittings

Durable fittings should be implemented that are not appreciably affected by water and can be easily cleaned. Fittings should also be placed as high as practical above the floor to minimise the impact of flood water and allow easier drying and cleaning.

Providing gaps behind kitchen units will facilitate drainage and will allow access for forced drying, if necessary.

Services

Closed cell insulation should be used for pipework within 1m of the ground level and anti-backflow valves should be implemented for sewer pipes along with non-return valves (NRVs) for any appliance waste-pipes. These should meet BS EN 13564 standards - 'Anti-flooding devices for buildings'.

Water, electricity and gas meters should be located no lower than 700mm above the finished floor level.

Electrical sockets, boiler units and ancillary devices should also be installed no lower than 700mm above the finished floor level and wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

6. References

Department for Communities and Local Government. *Improving the Flood Performance of New Buildings*. ISBN 978 1 85946 287 4.

Ellingham Consulting Ltd, 2023. *Flood Risk Assessment*.

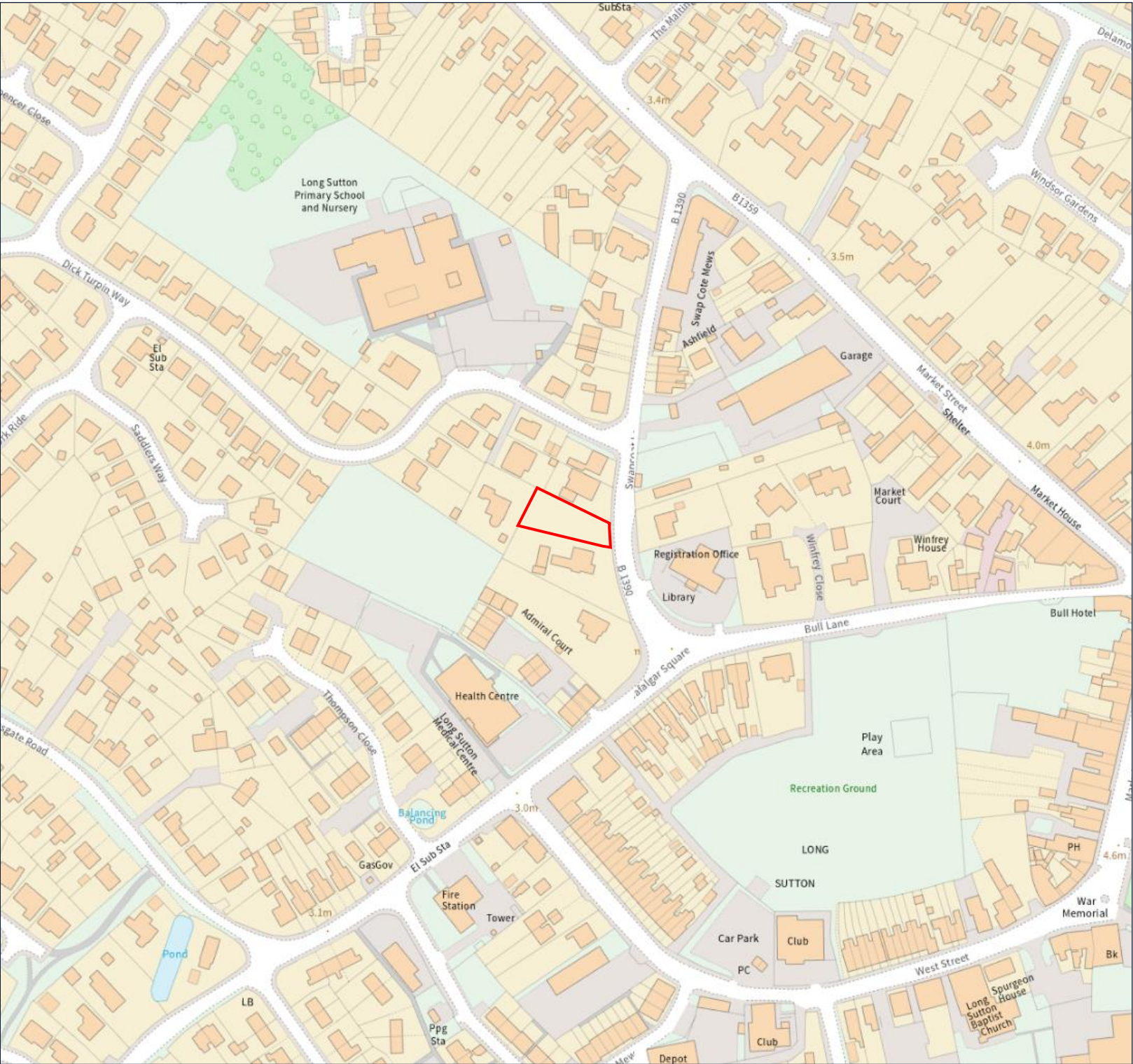
Environment Agency, 2022. *Flood risk and coastal change*. [online] Available at: <gov.uk/guidance/flood-risk-and-coastal-change>.

Environment Agency, 2022. *Preparing a flood risk assessment: standing advice*. [online] Available at: <gov.uk/guidance/flood-risk-assessment-standing-advice>.

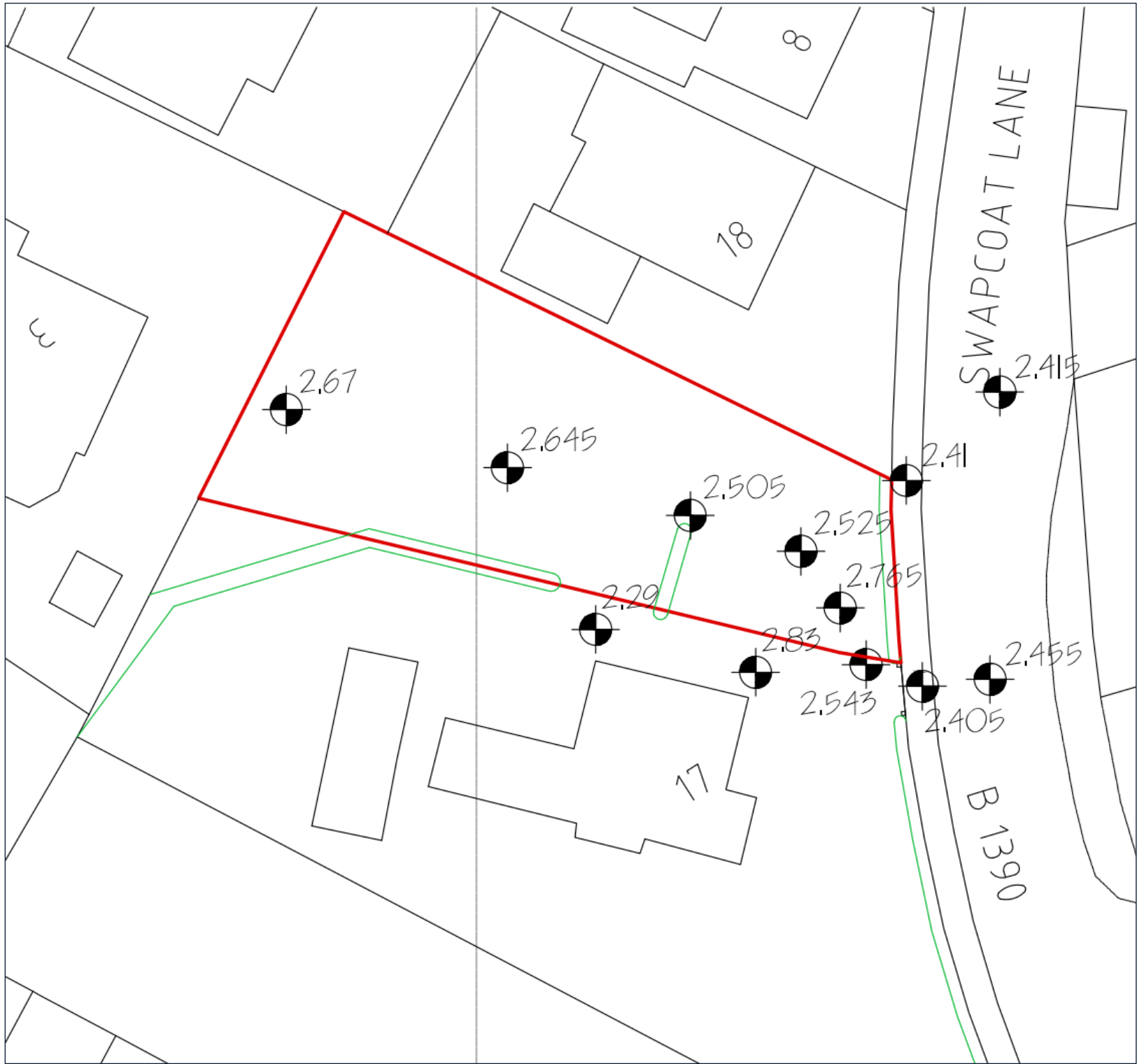
Environment Agency, 2023. *Provision of Flood Risk Information for land off Trafalgar Square, Long Sutton - CCN-2023-329886*.

Ordnance Survey [online] Available at: <ordnancesurvey.co.uk/>.

Oakshire Environmental Available at: <oakshireenvironmental.co.uk>



Appendix - Site Maps & Plans	
Description	
Site location plan	
Sources	
Contains OS data © Crown copyright and database rights	
Key	
	Site boundary
	North



Appendix - Site Maps & Plans

Description

Existing site plan and topographical survey

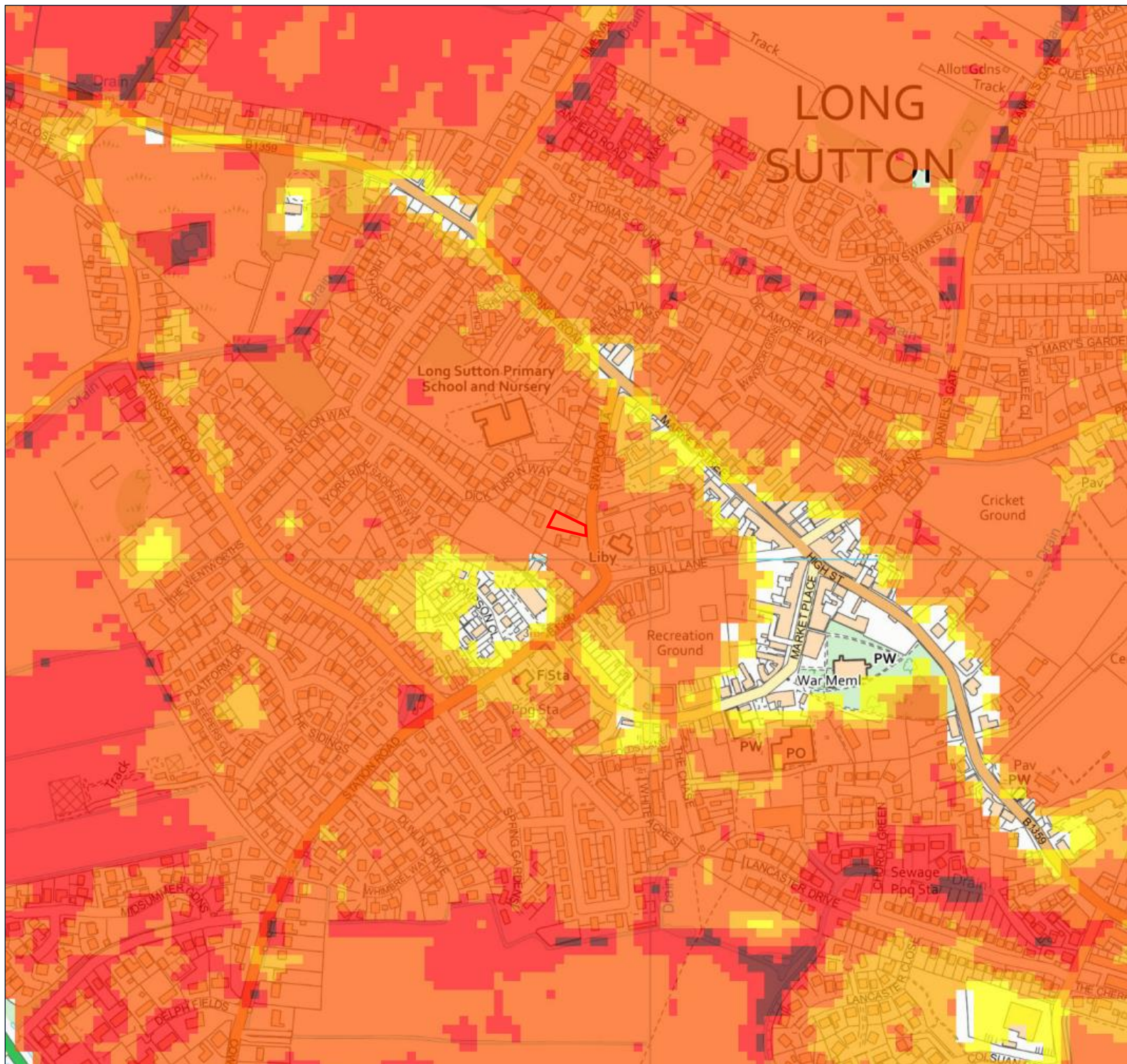
Sources

G. R. Merchant Ltd

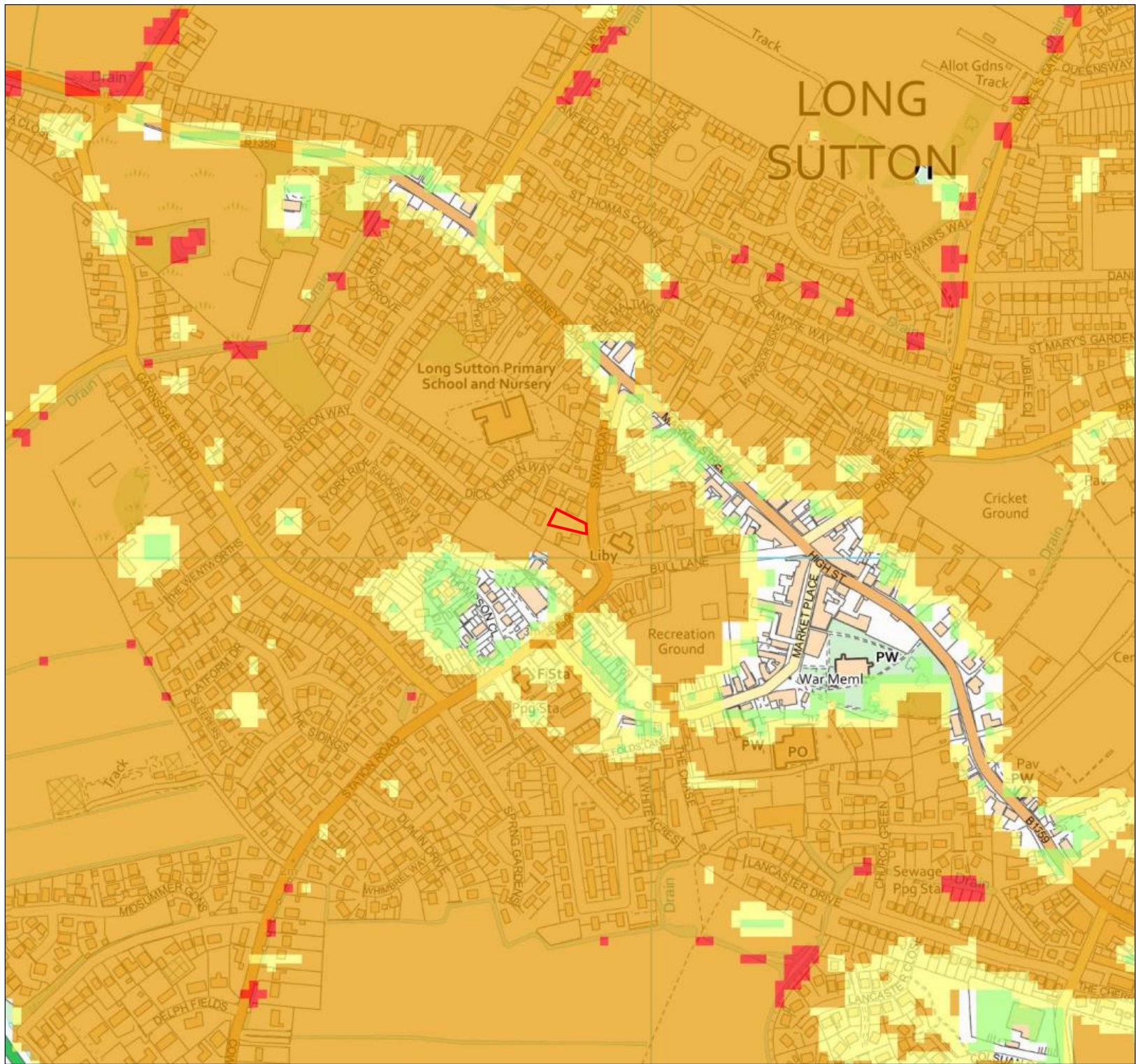
Key

Site boundary

North



Appendix - Flood Risk Maps	
Description	
Maximum depth map from the Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping	
Sources	
Environment Agency	
Key	
	Site boundary
	0m - 0.25m
	0.25m - 0.50m
	0.50m - 1.0m
	1.0m - 1.6m
	>1.6m
	North



Appendix - Flood Risk Maps

Description	
Maximum hazard map from the Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping	
Sources	
Environment Agency	
Key	
	Site boundary
	Low Hazard
	Danger for Some
	Danger for Most
	Danger for All
	North