

Flood Risk Assessment & Drainage Statement

New Rides Solar Farm, Leysdown-on Sea, Kent



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Energiekontor UK Ltd

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Project

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Client Name

Energiekontor UK Ltd

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Executive Summary

Client	Energiekontor UK Ltd
Site	The site is located on approximately 16.5ha of predominantly greenfield land, located on the Isle of Sheppey, approximately 2.5km west of the village of Leysdown-on-Sea, Kent. The site can be located by nearest postcode ME12 4DD and National Grid Reference (NGR) TQ 99150 70068.
Development Description and Planning Policy	The Proposal is for the installation of a standalone Solar PV Array and associated infrastructure. Vehicular access to the site will be via the existing access road for New Rides Farm and New Rides wind farm, off the B2231 (Leysdown Road). The proposal can be classified as 'Essential Infrastructure' in accordance with paragraph 066 of the NPPG.
Flood Sources & Flood Risk	According to the EA 'Flood Map for Planning' the site is in Flood Zone 1, meaning there is a less than 0.1% annual probability of fluvial/tidal flooding occurring. This is the lowest flood zone classification given by the EA and is considered safe from flooding. It therefore automatically passes the Sequential Test. The site is also in an area benefitting from flood defences. The Flood Risk from other sources of flood hazards were also assessed, including: • Ordinary Watercourse Flooding – Very Low Risk • Groundwater Flooding – Very Low Risk • Sewer Flooding – Very Low Risk • Surface Water Flooding – Low Risk • Potential failure of existing artificial infrastructure Failure – negligible risk Flood risk caused by the proposed development elsewhere was assessed to be very low, as the impermeable area of the site will not increase and will not contribute additional flows elsewhere in the catchment. The proposal will also not have cumulative adverse impact on flood risk elsewhere in the catchment, as there are no other significant developments recently or currently taking place in the vicinity.
Flood Risk Management Measures	Although flood risk at the site is assessed to be low, precautionary mitigation measures have been recommended particularly for surface water management. The flood risk management hierarchy found in Section 5 of BS 8533:2017 has been applied to determine the most appropriate mitigation measures. Below is a summary of the precautionary mitigation measures recommended: • The solar panels are to be set above the ground level and will therefore not cause an increase of the impermeable area within the site. • The solar panels are to have regularly spaced breaks (linear slots) to allow water to fall through to the ground. • To reduce the risk of soil compaction, tracked machines are to be used during construction on any new proposed grass tracks. 4x4 vehicles will be used on the existing windfarm access tracks.

	Where new access tracks are proposed within the site for maintenance purposes these will be informal tracks with grass surfacing.
Drainage	As the impermeable area of the site will not significantly increase, the surface water discharge will remain at the current greenfield rate. However, swales are also recommended as a precaution where appropriate to facilitate infiltration drainage methods. These can be located along the southern field boundaries of the site.

1 Introduction

1.1 Overview

Clarkebond (UK) Ltd was commissioned by Energiekontor UK Ltd (Energiekontor) to provide a Flood Risk Assessment (FRA) to support a planning application for the proposed development. This includes for the installation of a standalone Solar PV Array and associated infrastructure.

The report has been undertaken in accordance with flood risk policy contained within the National Planning Policy Framework (NPPF, 2019) and guidance found in the Flood Risk and Coastal Change National Planning Practice Guidance (NPPG). The assessment of flood risk was informed by the Level-1 Strategic Flood Risk Assessment (SFRA) 2015 for the Local Planning Authority (LPA) Swale Borough Council and Lead Local Flood Authority (LLFA) Kent County Council, Environment Agency (EA) data and information available on government websites.

The main purpose of the report is to provide sufficient flood risk information to ensure the development is safe from flooding and would not pose a risk to third parties, with a particular focus on the management of surface water runoff.

1.2 Site Location and Description

The proposed development site is on approximately 16.5ha of predominantly greenfield land, on the Isle of Sheppey, approximately 2.5km west of the village of Leysdown-on Sea, Kent. The site can be located by nearest postcode ME12 4DD and National Grid Reference (NGR) TQ 99150 70068. It has the HM Prison Swaleside to the west, with predominately greenfield land to the north, east and south. There is a solar farm to the immediate southeast, with the nearby village of Eastchurch to the north-west. There are several small structures, as well as 4 wind turbines within/near the site. The site boundary can be seen in **Figure 1**.



Figure 1: Site Boundary

1.3 Proposed Development

The Proposal is for the Installation of a standalone Solar PV Array and associated infrastructure. Vehicular access to the site will be via the existing access road for New Rides Farm and New Rides Wind Farm, off the B2231 (Leysdown Road).

A copy of the proposed layout is included as **Appendix A**.

1.4 Objectives

The main objectives of this FRA report as recommended in the National Planning Policy Framework (NPPF), are:

- To assess the site suitability in terms of the Sequential Test and, if required, the Exception Test;
- To identify the probability of flooding at the development;
- To assess the compatibility of the development with the flood risk zone;
- To identify the consequence of flooding at the development and suitable mitigation measures if required;
- Demonstrate that the development will not increase flood risk elsewhere, and where possible, will reduce flood risk.

1.5 Limitations

The information, views and conclusions drawn concerning the site are based, in part, on information supplied to Clarkebond by other parties. Clarkebond has proceeded in good faith on the assumption that this information is accurate. Clarkebond accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to Clarkebond from others.

2 Planning and Flood Risk Policy Review

2.1 Overview of National Planning Policy Framework (NPPF)

National policy on flood risk is set out in paragraphs 155 to 165 of the NPPF (2019) which is also supplemented by National Planning Practice Guidance (NPPG) for flood risk and coastal change. The overarching aim of the NPPF is to ensure inappropriate development in areas at risk of flooding are avoided, which is achieved via application of the Sequential Test.

2.1.1 Sequential Test Process

In summary this test aims to highlight the areas at lowest probability of flooding (Flood Zone 1) and steer new development to these areas. If the location of the low-risk area is not suitable due to wider sustainability objectives then progressively higher risk areas (Flood Zone 2/Flood Zone 3) can be considered, provided the development will be suitably safe from flooding and does not increase flood risk to other areas.

The process for undertaking the Sequential Test is shown in **Figure 2**. Flood Zones 1-3 relate to the risk of flooding from Main Rivers (rivers managed by the EA) and the sea and are used as the primary indicator of whether land is suitable for development. **Table 1** (taken from Table 1 of NPPG) details the corresponding meaning of flood zones in relation to flood risk.

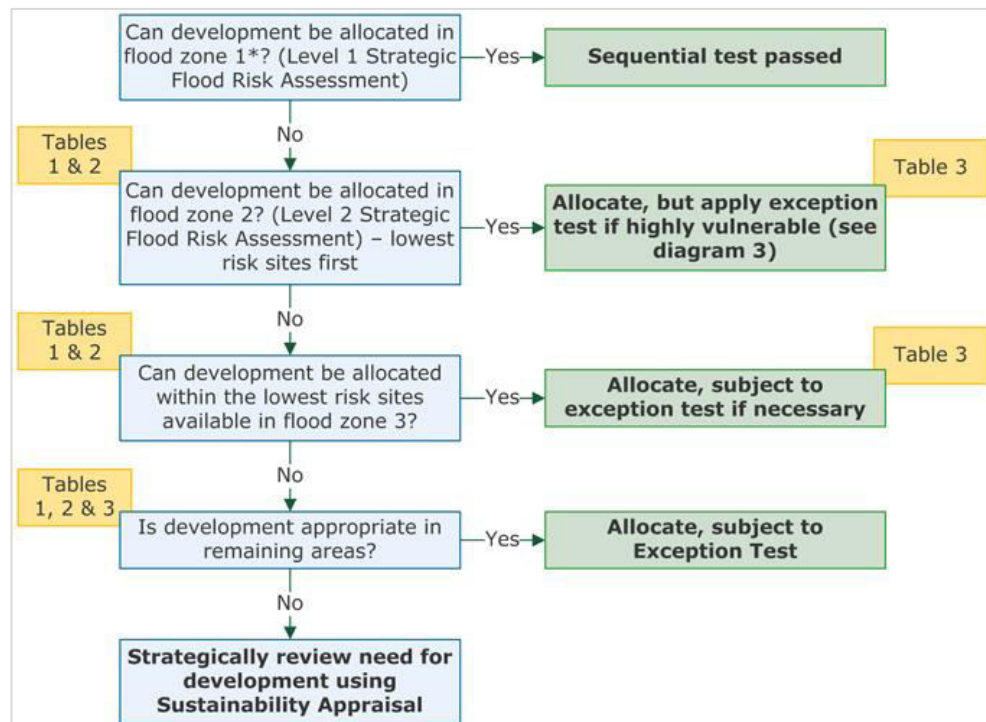


Figure 2: Process of the Sequential Test

Table 1: Definition of Flood Zones (as defined in the NPPG)

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding.
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
Zone 3b The Functional Floodplain	This zone comprises land where water must flow or be stored in times of flood. The Strategic Flood Risk Assessments should identify the areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

The Sequential Test is passed if a site is within Flood Zone 1 or has been allocated in the Council's Local Plan where the Sequential Test has already been undertaken. If neither of these applies, a Sequential Test is required to demonstrate that there are no other available and suitable sites at a lower risk of flooding.

2.1.2 Development Vulnerability, Flood Zone Compatibility, and the Exception Test

After undertaking the Sequential Test, the vulnerability of development to flooding must be considered so that more vulnerable uses are given priority for lower risk land. This exercise is undertaken by referring to Table 2 (Paragraph 066) of NPPG which shows the vulnerability classifications of various land use types and Table 3 (Paragraph 067) of NPPG which shows the compatibility of the different vulnerability categories with the Flood Zones and requirements for the Exception Test.

If a site has a range of flood zones, a sequential approach to development should also be taken within the site itself to direct development to the areas of lowest flood risk (Flood Zone 1 first, followed by Flood Zone 2, and finally Flood Zone 3). If it is not possible to locate all the development in Flood Zone 1, then the most vulnerable elements of the development should be in the lowest risk parts of the site (unless there is an overriding reason to choose a different location).

Certain development may require an Exception Test before it is considered acceptable in Flood Zones 2 and 3. To pass this test, the following needs to be demonstrated:

1. The development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
2. the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

2.1.3 Design Flood Event

The development should be flood resistant and resilient including safe access and escape routes for the following extreme flood events, also known as the 'design flood' (taken from Paragraph 055 of NPPG):

- 1 in 100 year (1%) fluvial flood accounting for climate change
- 1 in 200 year (0.5%) tidal/coastal flood accounting for climate change

Climate change is projected to increase the likelihood of flooding from most flood sources and therefore an assessment of the effects of climate change should be considered over the estimated development lifetime.

The lifetime of solar farms is generally accepted to be accepted as 40 years; from a baseline of **2022** (assumed first date of operation) this means assessing the flood level up to **2062**.

2.1.4 Surface Water Runoff Disposal Hierarchy

Surface water drainage from the proposed development must be dealt with in accordance with the following hierarchy taken from Paragraph 080 of NPPG:

1. Infiltration to the ground using a soakaway or other suitable sustainable drainage system.
2. If this is not feasible, discharge to a watercourse or river; generally, at a controlled rate unless it does not affect flood risk e.g., if to the sea or an estuary.
3. Discharge at a controlled rate to a surface water sewer or drain.
4. Discharge at a controlled rate to a combined sewer system – this will only be considered if the above have all been investigated and it has been proved that none of these options are suitable. The approval for this can only be given by the Water Authority.

Guidance on how surface water runoff should be managed, notably the discharge rate with which it can leave a development site, is taken from the 'Non-Statutory Technical Standards for Sustainable Drainage Systems' (2015).

2.2 Flood Risk Assessment Requirements

Footnote 50 of the NPPF states that a site-specific FRA is required for developments which:

- Are in Flood Zone 2 or 3;
- Are more than 1 hectare (ha) in Flood Zone 1;
- Are in an area which has critical drainage problems as notified by the Environment Agency;
- Land identified in a strategic flood risk assessment as being at increased flood risk in the future;

- Could be affected by sources of flooding other than rivers and the sea (e.g., surface water drains, reservoirs);
- Where a development will introduce a more vulnerable use.

The focus of FRAs for the higher risk zones is to fully assess the extent, depth, and hazard of flood waters, detail the required mitigation to manage flood risk (e.g., floor levels and access, evacuation routes, compensatory storage) and outline a surface water management plan. FRAs for sites where the risk of flooding from rivers or the sea is classified as low (Flood Zone 1) will still need to assess all other sources of flood risk but will have a strong focus on management of surface water runoff.

2.3 Relevant Local Planning Policy

Local planning policy provides more specific detail on development requirements based on the flood risk in the local county or borough. Although these policies will broadly be in line with national policy, where additional requirements are required this will take precedence.

A list of relevant planning policy documents that were consulted during this FRA include:

- The Swale Borough Local Plan (adopted 2017);
- Swale Borough Council Level 1 Strategic Flood Risk Assessment Level – 1 SFRA (2020);
- Kent Local Flood Risk Management Strategy (2017 -2023);
- Swale Surface Water Management Plan (2012);
- Kent Preliminary Flood Risk Assessment (2011).

2.3.1 The Swale Borough Local Plan (2017) – ‘Policy DM 21: Water, Flooding and Drainage’

The Local Plan forms part of the development plan for the borough. The Swale Borough Local Plan will be the most important planning document for Swale, setting out the vision and overall strategy for the area and how it will be achieved for the period from 2014 until 2031. The key policy relating to flood risk is ‘Policy DM 21 – Water, Flooding and Drainage’ (**Figure 3**), which is broadly in line with current national policy however provides some additional detail and requirements.

Policy DM 21

Water, flooding and drainage

When considering the water-related, flooding and drainage implications of development, development proposals will:

1. Accord with national planning policy and planning practice guidance;
2. Avoid inappropriate development in areas at risk of flooding and where development would increase flood risk elsewhere;
3. Provide site specific flood risk assessments, as required, carried out to the satisfaction of the Environment Agency and, if relevant, the Internal Drainage Board. These will, where necessary, include details of new flood alleviation and flood defence measures to be installed and maintained by the developer;
4. Include, where possible, sustainable drainage systems to restrict runoff to an appropriate discharge rate, maintain or improve the quality of the receiving watercourse, to enhance biodiversity and amenity and increase the potential for grey water recycling. Drainage strategies (including surface water management schemes) for major developments should be carried out to the satisfaction of the Lead Local Flood Authority;
5. Integrate drainage measures within the planning and design of the project to ensure that the most sustainable option can be delivered, especially where, exceptionally, development is to be permitted in an area of flood risk;
6. Within areas at risk of flooding, submit a suitable flood warning and emergency plan that has been approved by the relevant emergency planning regime and, where appropriate, the emergency services;
7. Where necessary, demonstrate that adequate water supply and wastewater connection and treatment infrastructure is in place before construction commences and that these details have been approved by the appropriate water company and funded by the development where appropriate;
8. Ensure future unconstrained access to the existing and future sewerage and water supply infrastructure for maintenance and up-sizing purposes;
9. Make efficient use of water resources and protect the yield of local public water supplies. For new residential development, all homes to be designed to achieve a minimum water efficiency of 110 litres per person per day, in line with the Government's Housing Optional Technical Standard for water efficiency; and
10. Protect water quality, including safeguarding ground water source protection zones from pollution, to the satisfaction of the Environment Agency.

Figure 3: Policy DM21 of the Local Plan 2017

2.3.2 Swale Borough Council Level 1 Strategic Flood Risk Assessment Level – 1 SFRA (2020)

The current Level-1 SFRA (2020) replaces the previous Level 1 & 2 report published in 2009. The 2020 SFRA provides flood risk evidence and long-term strategy to support the management and planning of development, protect the environment, deliver infrastructure, and promote sustainable communities within the Local Plan area. It also supports the selection of site allocations in the emerging Local Plan and provides information and guidance to be used in the preparation of Flood Risk Assessments in support of site-specific planning applications. The Level 1 SFRA provides a baseline assessment of the flood risk within the borough of Swale as well as provides guidance for how site-specific flood risk assessments should be completed.

2.3.3 Kent Local Flood Risk Management Strategy (2017 -2023)

As the LLFA, Kent County Council (KCC) must produce a Local Flood Risk Management Strategy that sets out how local flood risks will be managed in the county by the authorities involved. This

strategy is an important tool in understanding the Council's management of flood risks throughout Kent, in particular the responsible authorities and objectives in place.

2.3.4 Swale Surface Water Management Plan (2012)

This report sets out the long-term plan for reducing the risk of surface water throughout the borough of Swale, including a methodology for the identification and assessment of risk and recommended mitigation methods. The specific purpose of this SWMP is to identify what the local flood risk issues are, what options there may be to alleviate the risk and who should take these options forward.

2.3.5 Kent County Council Preliminary Flood Risk Assessment (2011)

As a Lead Local Flood Authority (LLFA) the Council has produced this report to meet its duty to manage local flood risk. This provides an additional information source and baseline assessment of flood risk for the county of Kent. The aim of the Preliminary Flood Risk Assessment (PFRA) is to provide an assessment of local flood risk across the study area, including information on past floods and the potential consequences of future floods.

3 Background Information

3.1 Site Levels

The topography of the site was assessed using government Lidar data from 2017. The highest level on site can be found in the north-west corner, at 27.2m AOD. The lowest level on site can be found at the southern corner at approximately 9.0m AOD. The northern area of the site contains the steepest slope gradient, which gradually levels off as the site progresses southward.

3.2 Public Sewers

Sewer Asset Records were obtained from the sewerage undertaker for the area, Southern Water. These records have been provided in **Appendix B**.

3.3 Hydrology

According to the EA's 'Main Rivers Map' and 'Catchment Data Explorer', the site is in the operational catchment of a main river, the Swale and one of its tributaries (the Windmill Creek). A main river refers to those watercourses under the jurisdiction of the EA. **Figures 4a to 4d** show the catchments of tributaries of the River Swale and the local hydrological setting that includes numerous field ditches and drains south of the site boundary.

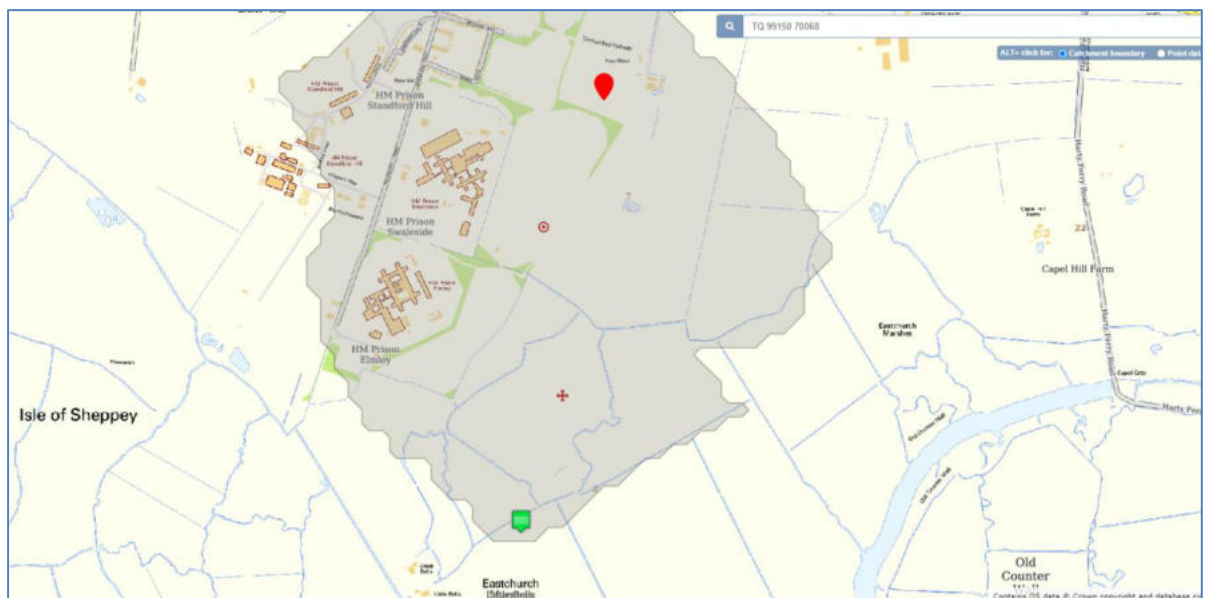


Figure 4a: Tributary of the Windmill Creek and River Swale

As discussed in Section 3.1, the gradient of the site slopes southward, so surface water would be expected to flow in this direction.

Surface water on the site would be expected to drain via natural infiltration methods. During intense storms, where either the ground has become saturated or following a period of intense dryness, surface water would be expected to drain overland to the south of the site.

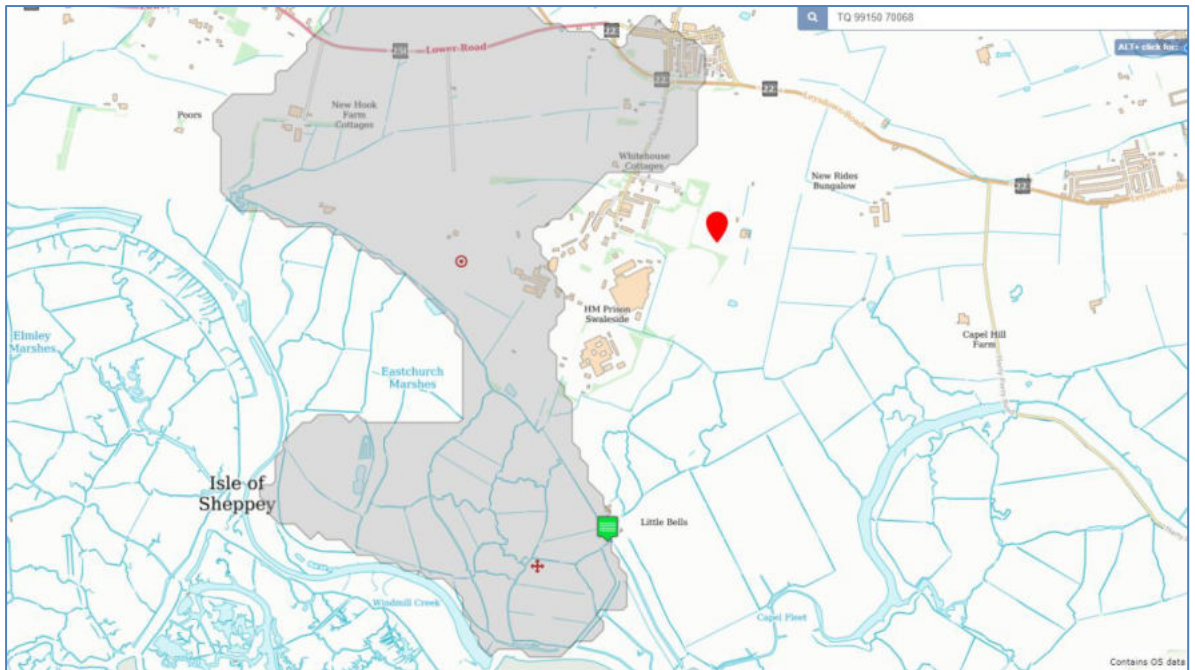


Figure 4b: Another Tributary of the Windmill Creek and River Swale

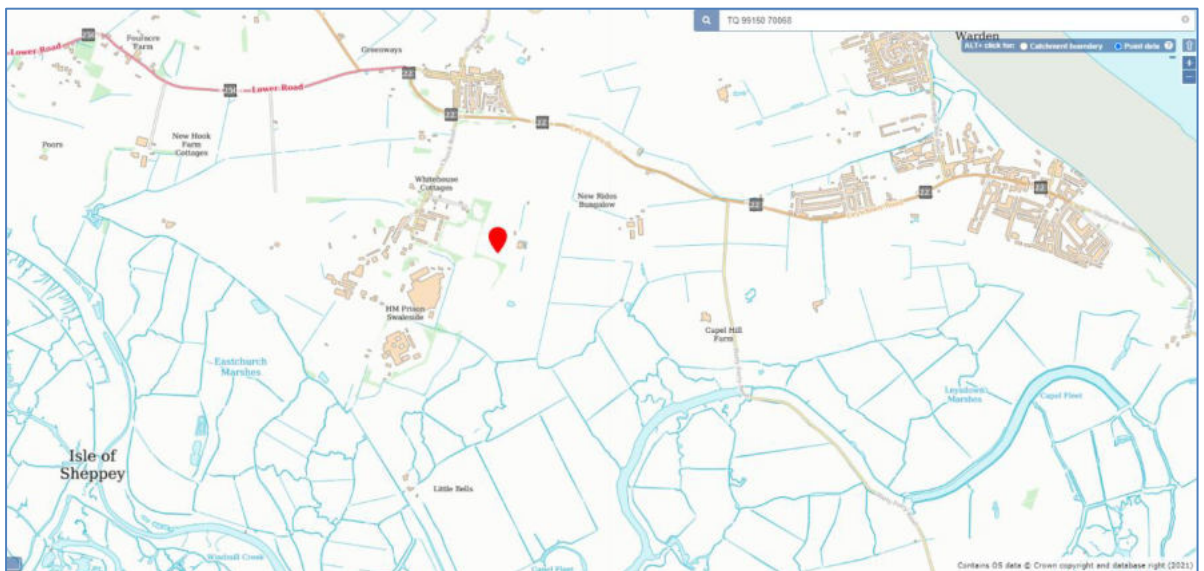


Figure 4c: Showing the Local Hydrological Setting Including Watercourses and Ditches/Drains

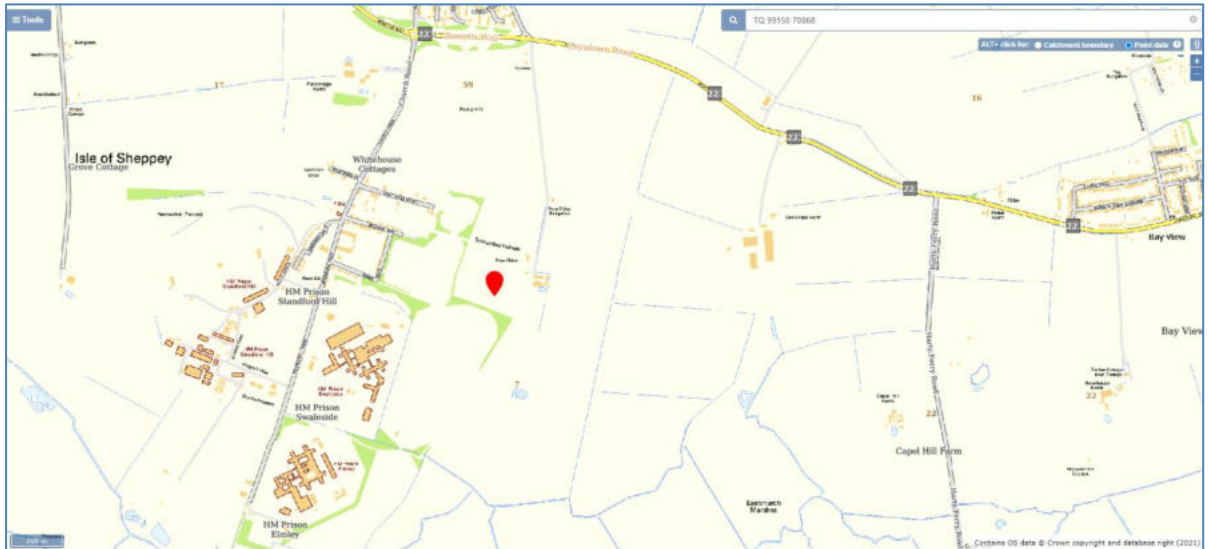


Figure 4d: Showing the Actual Drains and Ditches on Site

3.4 Geology, Groundwater and Soils

The geology of the site is shown on the 1:50,000 scale British Geological Survey (BGS) map and on the BGS website's Geology of Britain viewer. A review of the available data indicates the anticipated geology at the site can be summarised as follows:

Superficial Deposits

- None Recorded

Bedrock

- London Clay Formation - Clay and Silt.

With regards to groundwater vulnerability, the site is in a 'Unproductive Aquifer' area. These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river baseflow. The site does not fall within a Source Protection Zone (SPZ).

According to LandIS 'Soilscales', the entire site is underlain by 'Soilscape 18 – Impeded Drainage'. Impeded drainage refers to soils with a tight, compact deep subsoil that impedes downward water movement. A review of available historic borehole data does not indicate a high groundwater table.

4 Flood Risk Assessment

4.1 Flood Zones and Development Compatibility

The EA 'Flood Map for Planning' shows that the site is located within Flood Zone 1 (see **Figure 5**). This means the site has annual probability of flooding of less than 0.1% (1 in 1000-year return period) from both fluvial and tidal sources.



Figure 5: EA 'Flood Map for Planning'

The Proposal can be classified as an 'Essential Infrastructure' development, in accordance with Paragraph 066 of the NPPG. All forms of development are compatible in Flood Zone 1 in accordance with **Table 2** (taken from Table 3 of the NPPG). Therefore, the Proposal automatically passes the Sequential Test and is not required to undertake an Exception Test.

Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zones	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	X	Exception Test required	✓
	Zone 3b	Exception Test required	✓	X	X	X

Where ✓ means the development is appropriate and X means the development should not be permitted

4.2 Impact of Climate Change

Although the site is not identified as being within a high-risk zone for fluvial/tidal modelled flood data, the NPPF states that the FRA should assess the increased risk posed by climate change over the development lifetime. The site will also be affected by the projected increased risk of surface water and sewer flooding and so the drainage for the site should accommodate the projected increase in surface water flows over the development lifetime.

EA guidance on climate change allowances to support the NPPF came into effect in February 2016. The proposed development site is situated within the South East River Basin district with an assumed development lifespan of ~40 years. Based on NPPG guidance for 'Essential Infrastructure' development in Flood Zone 1, the central allowance should be used to assess a range of allowances for fluvial flood events, as shown in **Table 3**.

Table 3: Peak River Flow Allowances for South East River Basin District

	Total Change 2015-2039	Total Change 2040-2069	Total change 2070-2115
Upper End	25%	50%	105%
Higher Central	15%	30%	45%
Central	10%	20%	35%

While for fluvial the impact of climate change will result from increased flow, for tidal the impact will be because of sea-level rise. To calculate sea-level rise over the development's lifetime, **Table 4** should be used (taken from EA guidance). Note that sea-level rise incrementally increases with each epoch.

Table 4: Sea Level Allowance (upper end) for each Epoch in millimetres per year

	2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2125	Total (mm)
South East	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1220

Table 5 shows the recommended allowances for peak rainfall intensity for different statistical likelihoods. The upper end allowance should be used in areas where there are known flooding issues and there is highly vulnerable development in the downstream sewer network.

Table 5: Peak Rainfall Intensity Allowance in Small and Urban Catchments

	Total Change 2015-2039	Total Change 2040-2069	Total change 2070-2115
Upper End	10%	20%	40%
Central	5%	10%	20%

4.3 Fluvial Flood Risk

As previously mentioned, the site is in Flood Zone 1 which is the lowest risk classification given by the EA. It is an area where safe refuge can be sought from flooding and therefore can be considered safe.

The SFRA indicates that the site lies outside of any fluvial flood extent boundaries of the 1 in 100-year and 1 in 1000-year fluvial flood events, presenting no risk to the site. Therefore, the risk of fluvial flooding at the site is **very low**.

4.4 Tidal Flood Risk

As previously mentioned, the site is in Flood Zone 1 which is the lowest risk classification given by the EA.

The Level-1 SFRA indicates the presence of tidal and coastal flood defences located along most of the coastline and tidal watercourses surrounding the Isle of Sheppey to south and east of the site. The location, flood defence type, standard of protection and condition are presented in **Appendix C** of this report. The defences south of the site provide protection up to the 1% and 0.1% tidal flood extents. Flood defences located at the east of the Isle of Sheppey provide protection up to the 0.5%, 1% and 1.3% tidal flood events. Despite this, the defences located south of the site are reported by the SFRA to be in poor condition, with the defences located to the east indicated to be in fair condition.

The EA flood map in **Figure 5** also indicates that the site is not at risk of flooding from tidal sources, which means that each year this area has a chance of flooding of between 0.1% and 1%. This considers the effect of any flood defences in the area. However, these defences reduce but do not completely stop the chance of flooding as they can be overtopped or breached. The predicted flood extent does not account for climate change.

The SFRA modelled the extent of flooding for the 0.5% AEP 2070 tidal event (which considers the predicted effects of future climate change), this indicated that the flood extent does not extend to reach the southern boundary of the site.

Assessment of Defence Breach

Breaching occurs following a constructional or operational failure. It is most likely at high water level events when loads on the defence are at their greatest. A breach can result in rapid inundation and cause significant depths of flooding, especially in low lying areas. The Level-1 SFRA has assessed the impact of breaching (**Appendix D**) and has indicated that a modelled breach event located slightly southwest of the site at Windmill Creek (NGR: TQ 97728 67408) will not result in any flooding at the site.

Therefore, the risk of tidal flooding at the site is assessed to be **low**.

4.5 Other Sources of Flood Risk

Other sources of flooding assessed are:

- Ordinary watercourses (watercourses not under jurisdiction of EA)
- Groundwater
- Surface water
- Sewers (sewer and drain exceedance and pumping station failure)
- Reservoirs, canals, and other artificial waterbodies.

4.5.1 Ordinary Watercourse Flooding

Multiple drains and ordinary watercourses are present near the site. One occurs at the eastern border as well as a field drain that courses through the centre of the site, although none of these field drains are on the 'development parcels' allocated for the solar panels. Based on the low vulnerability of the proposed development, flooding from ordinary watercourses is assessed to pose a **low risk** to the development.

4.5.2 Groundwater Flooding

Groundwater flooding typically occurs when water levels rise above surface elevations from underlying rocks or springs following prolonged rainfall. The two most common mechanisms of groundwater flooding are:

1. Bedrock Flooding – Occurs following extended periods of rainfall in areas underlain by a permeable bedrock outcrop. Typically, chalk aquifers pose the greater risk, where the large pore spaces in the rock allow the water table to rise rapidly. Settlements most at risk are those in low-lying areas and at the base of steep-sided valleys at the interface between permeable and impermeable strata (where the groundwater table is naturally closer to the ground surface).
2. Superficial Deposit Flooding – Occurs in permeable unconsolidated deposits (e.g., gravel) which lie on river floodplains following high in-bank river levels.

The Level-1 SFRA provides a general assessment of groundwater flood risk in the borough of Swale, providing a map of areas with varying susceptibility to groundwater (**Appendix D**). The site is in an area where there is no risk of groundwater flooding. It should be noted that this provides an assessment of the ability for groundwater to emerge (based on ground conditions) and not the probability of occurrence. The presence of historic flooding provides a better measure of probability.

As discussed in Section 3.4, the underlying bedrock does not have significant groundwater present.

While this gives an indication of where the conditions conducive for groundwater emergence are, it is an unreliable assessment of groundwater flood risk. A more reliable measure of groundwater flood risk is whether there have been recorded groundwater flood events in the past. The Level-1 SFRA makes no mention of any recorded flood events within the vicinity of the site attributed to groundwater.

Although the solar panel supporting structure will be piled, the Proposal will not be developing in a manner sensitive to groundwater flooding, and for the reasons discussed above, the risk from groundwater flooding is assessed to be **very low**.

4.5.3 Sewer Flooding

Southern Water is the statutory water undertaker for the site. According to data presented in the Level-1 SFRA, there have been 10 reported incidences within the ME12 Postcode. Despite this, new developments may in fact create betterment, from the application of SuDS.

It has been established that based on historic flood records the probability of sewer flooding is relatively low at the site. Furthermore, the development proposal will not be contributing any additional surface water or foul flows to any public sewer network.

For the reasons discussed, and the relationship between probability and impact, the risk from sewer flooding is determined to be **very low**.

4.5.4 Surface Water Flooding

Surface water flooding is caused by heavy rainfall events that cause significant surface runoff and ponding of accumulated water. The probability and impact of flooding is heavily dependent on the topography of a site, as well as the ground conditions and its infiltration capability.

As can be seen from the EA surface water flood map (**Figure 6**), most of the site is at very low risk of surface water flooding. This represents a less than 0.1% annual probability of occurrence. There is a large area of low risk, representing a 1% annual probability of occurrence, extending from the north of the site to the south-west.

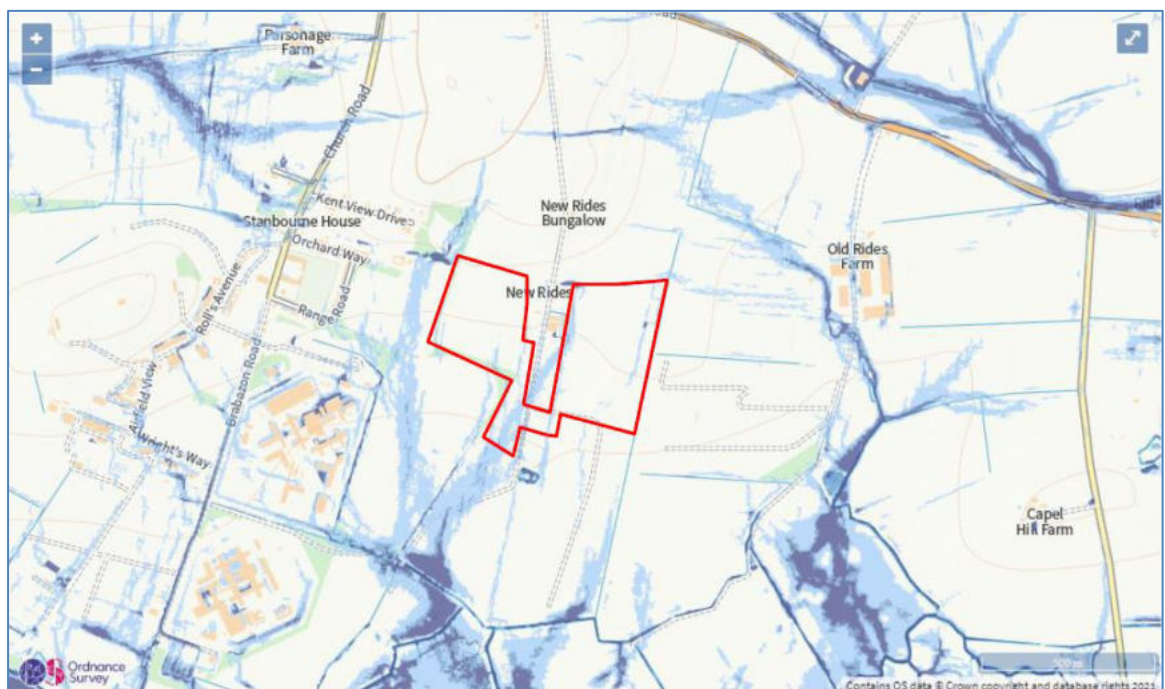


Figure 6: EA Surface Water Flood Map

For the purposes of detailed assessment, the 'medium' level of risk will be considered, as this is the same probability as the design fluvial flood event (>1% AEP). From both the modelled velocity and depth for this event, a flood hazard rating can be determined.

Figure 7 shows the modelled depth for the medium risk scenario. Under this scenario, the site is not modelled to experience any surface water flooding at any depth. Furthermore, according to the EA surface water flood map, this site will not experience surface water flooding.



Figure 7: Medium Surface Water Flood Risk (Depth)

Considering both velocity and depth of flooding, a flood hazard can be determined. As the site is not modelled to be affected by surface water flooding under the EA 'medium risk' scenario, when applied to the flood hazard matrix (**Figure 8**), this would result in a low hazard in accordance with FD2320/TR2 assessment methodology, as recommended in the FD2321/7400/PR supplementary note (2008). It should be noted that this method applies the precautionary principle that can be considered conservative.

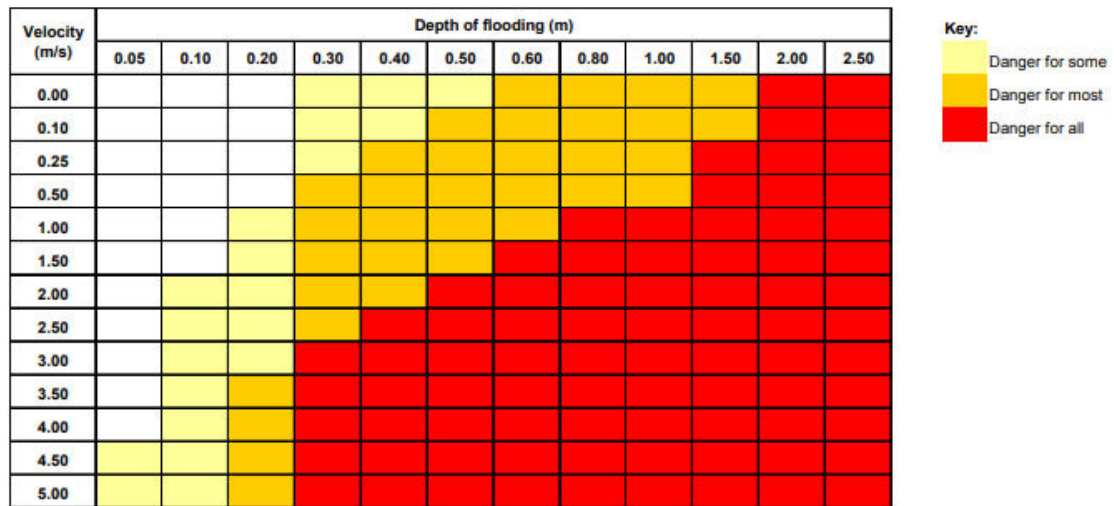


Figure 8: Flood Hazard Matrix (FD2320/TR2, DEFRA, 2005)

In previous discussions with the Environment Agency regarding similar solar park schemes, a procedure was developed to further assess the site to identify potential risks factors which contribute to surface runoff. This procedure also proposed a decision matrix to determine whether mitigation is required and the scope and scale of mitigation if required.

The EA commented that there needed to be more robust surface water management techniques to ensure that surface water runoff does not exceed the existing rates and secondly, to reduce possibility of any pollution caused by soil erosion. The rationale was the risk posed by the compaction of soils during the construction process and the likelihood that it could adversely influence the surface water runoff.

Four areas were identified by the EA:

- Site Area
- Site Gradient
- Soil Type
- Downstream Receptors

Site Area

The site occupies an area of approximately 16.5ha. The EA considers a site greater than 5ha as a large site.

The field will remain mostly grassed and due to the height and orientation of the panels, grass will be able to remain beneath the panels. Risk for impact on the surface water flows is therefore considered to be low.

As the site is currently used for agricultural purposes, it is likely to be maintained with artificial treatment, which can result in increased levels of phosphates, nitrates and pesticides washed into, and therefore polluting, nearby watercourses. This commonly causes algal blooms, which produce toxins and can have severe impacts on aquatic ecosystems, a process known as eutrophication. Post-construction, these activities will cease, resulting in an increase in water quality of the surface runoff from the site, due to the absence of agricultural pollutants. This is considered a key benefit over the sites current use and therefore the risk for impact on the surface

water flows is assessed to be low.

Site Gradient

In general, the site levels generally decrease southward, with the gradient between the highest level in the north and the lowest level in the south approximately 1:36. This gradient is sufficiently shallow to allow the natural infiltration of surface water down the prevailing slope.

Soil Type

The soil type has been previously identified as impeded drainage, indicating that it likely has a high compaction. To reduce the risk of soil compaction, tracked machines are to be used during construction on any new proposed grass tracks. These have been a requirement in the past on other sites as the tracks spread the load of the vehicle over a wider area than wheeled vehicles, reducing the point load on any one location and reducing compaction. However, 4x4 vehicles will be used on the existing windfarm access tracks. Therefore, the likelihood of compaction of soils during construction having an adverse impact on surface water run-off is assessed to be low.

Downstream Receptors

There is a network of drains and ordinary watercourses immediately downslope to the south of the site.

The post development site will remain a Greenfield site comprising rows of solar panel tables. The ground below each table will remain permeable or in its natural state as grass. The installation of solar panel tables will not therefore materially impact on the surface water runoff, with the site development area remaining permeable and will be largely the same as the existing situation post development.

Where new access tracks are proposed within the site for maintenance purposes these will be informal tracks with grass surfacing. The new access tracks will not therefore impact on site surface water runoff, with the site development area remaining permeable post development. There will be no new areas of permanent vehicle parking associated with the proposed development. Considering the above points, there is assessed to be a negligible increase in surface water runoff potential for this site which would be mitigated by the construction methods noted above.

Flood Mitigation

The Solar panels will be set above the ground level and will therefore not cause an increase in the impermeable area within the site. The proposed development does not therefore impact adversely on flood risk elsewhere and does not need to incorporate any mitigation.

Exceedance

Surface water falling on the site currently drains via natural infiltration methods. The surface water flow paths will not be altered post-development.

The risk from surface water flooding to the site is therefore assessed to be **low**.

4.5.5 Flooding from Artificial Infrastructure Failure

The proposed development site is not within an area at risk of flooding from reservoirs, therefore the risk posed to the site from Artificial Infrastructure Failure is **negligible**.

4.6 Impact of Development on Flood Risk Elsewhere

A key requirement of this FRA, along with assessing flood risk to the site, is to adequately assess the impact of the Proposal on flood risk elsewhere. This involves determining the source of risk (e.g., changes to the site), the pathway of risk (e.g., re-direction of flow) and the receptors to the risk (e.g., nearby properties).

As the site is not expected to be affected by the 1% AEP fluvial flood event, any changes on site will not displace floodwater. Therefore, the Proposal will not increase fluvial flood risk elsewhere. The Proposal does not have the potential to adversely affect surface water flood risk elsewhere as the impermeable area will not materially increase, and there are no preferential flow pathways on site.

4.7 Cumulative Impact on Flood Risk

Under the new NPPF guidelines, the cumulative impact on flood risk from both the Proposed Development and surrounding developments must be assessed. This should involve determining where there are common flood sources, pathways and receptors and assessing the scale and timings of any impacts likely.

Apart from the existing neighbouring solar farm to the east of the site, there are no new large-scale developments taking place within the vicinity of the site according to the Council's planning portal. Any changes to the drainage of neighbouring sites will be subject to the same policy as this proposed development; therefore, for most of the surrounding area there is likely to be a beneficial cumulative impact from the implementation of local drainage policy.

Therefore, it is judged that there is limited cumulative impact from the Proposal and other developments as previously consented schemes would have had to assess this risk and effectively mitigate the risk if required.

4.8 Safe Access and Egress

The SFRA stipulates that safe access and egress should be maintained for the lifetime of the development. As the site is in Flood Zone 1, and is at limited risk from other flood sources, safe access and egress is possible over the lifetime of the development.

4.9 Mitigation and Management Requirements

Flood risk mitigation and management measures for the development are determined by way of the hierarchical process outlined in Section 5 of the BS 8533:2017 'Assessing and Managing Flood Risk in Development – Code of Practice'. Application of this hierarchy is as follows:

1. **Stage 1 – Assessing and understanding the flood risk:**
A sound understanding of the sources of flood risk and how it varies over the site has been achieved.
2. **Stage 2 – Avoiding the Risk:**
As the site automatically passes the Sequential Test, this is not required.

3. **Stage 3 – Substitution:**

As the site automatically passes the Sequential Test, this is not required.

4. **Stage 4 – Land raising, flood control/surface water management incorporation:**

The Solar panels will be set above the ground level and will therefore not cause an increase in the impermeable area within the site. The solar panels will also have regularly spaced breaks (linear slots) to allow water to fall through to the ground. To reduce the risk of soil compaction, tracked machines are to be used during construction on any new proposed grass tracks, and 4x4 vehicles will continue to be used on the existing windfarm access tracks.

As a precaution, swales are also recommended where appropriate to facilitate infiltration drainage methods. It is recommended that these be located along the southern field boundaries of the site.

5. **Stage 5 – Resistant/resilient building techniques:**

This is not required as appropriate mitigation is provided by way of Stage 4 measures.

6. **Stage 6 – Safety:**

Safe access and egress are possible to and from the site, as well as it will be a place of safe refuge during a tidal flood event.

4.10 Proposed Drainage

As the impermeable area of the site will not significantly increase, the surface water discharge will remain at the current greenfield rate.

As a precaution, swales are also recommended where appropriate to facilitate infiltration drainage methods. It is recommended that these be located along the southern field boundaries of the site.

4.11 Summary Table

Flood Source	Current Level of Risk	Mitigation Required	Residual Risk
Tidal		Solar panels set above the ground level and will have linear slots) to allow water to fall through to the ground.	
Fluvial		None Required	
Ordinary Watercourse		None Required	
Groundwater		None Required	
Sewer		None Required	
Surface Water		Solar panels set above the ground level and will have linear slots) to allow water to fall through to the ground. To reduce the risk of soil compaction, tracked machines are to be used during construction on any new proposed grass tracks. 4x4 vehicles will be used on the existing windfarm access tracks. Where new access tracks are proposed within the site for maintenance purposes these will be informal tracks with grass surfacing.	
Artificial Infrastructure		None Required	
Flood Risk to Elsewhere		None Required	
Key		High Risk – Major constraint to development requiring active consideration in mitigation proposals	
		Moderate Risk – Issue requires consideration but not a significant constraint to development	

		Low – Issue requires some consideration and is not a significant constraint to development
		Very Low - Issue requires little to no consideration and is not a significant constraint to development
		Negligible Risk - No noticeable impact to site and not considered to be a constraint to development

4.12 Summary & Conclusion

According to the EA 'Flood Map for Planning' the site is in Flood Zone 1 and is therefore assessed to be safe from fluvial flooding. It therefore automatically passes the Sequential Test.

The site is located within Flood Zone 1, meaning there is a less than 0.1% annual probability of fluvial/tidal flooding occurring. This is the lowest flood zone classification given by the EA and is considered safe from flooding. The SFRA modelled the extent of flooding for the 0.5% AEP 2070 tidal event, which indicated the flood extent may extend northwards over southern boundary of the site.

The Level-1 SFRA has assessed the impact of breaching and has indicated that a modelled breach will not result in any flooding at the site.

It has also been assessed that the impact of climate change will not significantly change the probability of flooding at the site.

The Flood Risk from other sources of flood hazards were also assessed, including:

- Ordinary Watercourse Flooding – Very Low Risk
- Groundwater Flooding – Very Low Risk
- Sewer Flooding – Very Low Risk
- Surface Water Flooding – Low Risk
- Artificial Infrastructure Failure – Negligible Risk

The proposal will also not have a cumulative impact on flood risk elsewhere in the catchment, as there are no other significant developments recently or currently taking place in the vicinity.

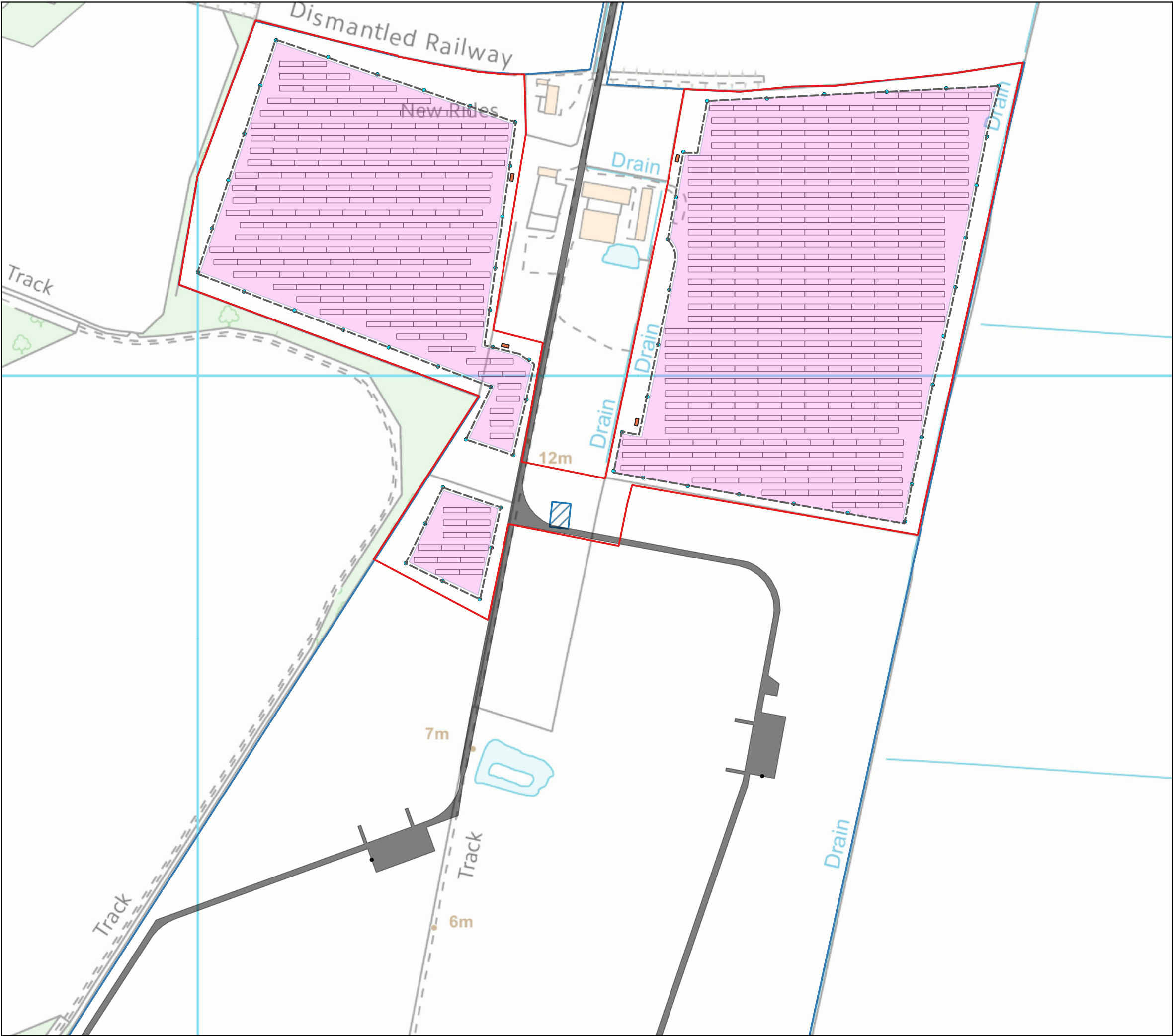
The following mitigation measures have been recommended to reduce flood risk at the site:

- The solar panels to be set above the ground level and will therefore not cause an increase of the impermeable area within the site.
- The solar panels will also have regularly spaced breaks (linear slots) to allow water to fall through to the ground.
- To reduce the risk of soil compaction, tracked machines are to be used during construction on any new proposed grass tracks. 4x4 vehicles will continue to be used on the existing windfarm access tracks.
- Where new access tracks are proposed within the site for maintenance purposes these will be informal tracks with grass surfacing.
- As a precaution, swales are also recommended where appropriate to facilitate infiltration drainage methods. It is recommended that these be located along the southern field boundaries of the site.

This report has satisfied the objectives set in Section 1.4, demonstrating that the site is not at a significant level of flood risk from any of the sources of flood hazards assessed and that the

Proposal will not increase flood risk elsewhere. Appropriate mitigation and flood management measures have been recommended for the proposed development.

Appendix A – Proposed Development (x2 pages)



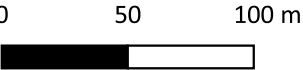
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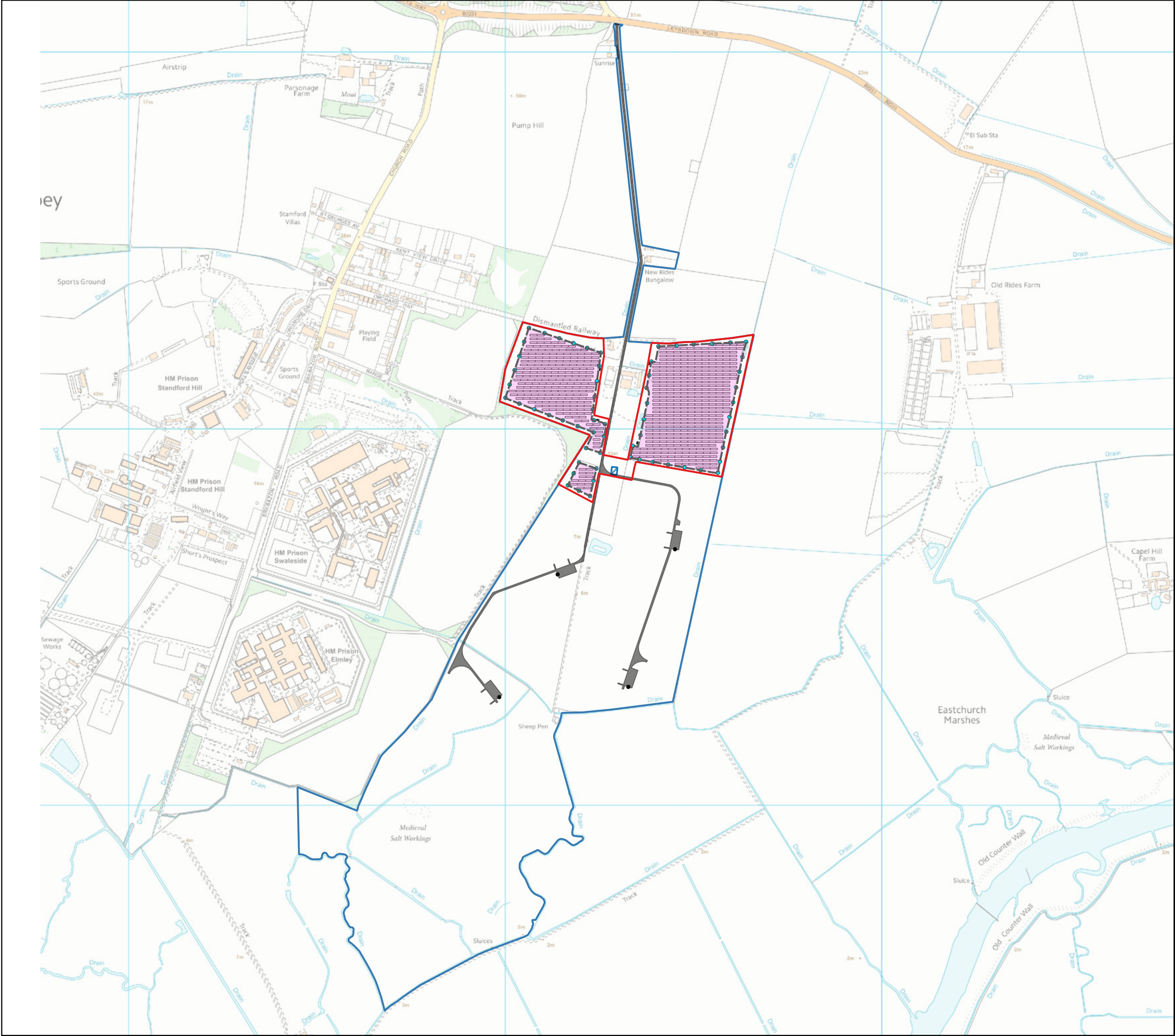
Site Layout

- Key:**
- Site Boundary
 - Land Under Applicants Control
 - Development Parcels-Represent Maximum Area for siting of Solar Panels
 - Indicative Solar PV Array Layout
 - Indicative Transformer Location
 - Fencing
 - Proposed CCTV Camera Location
 - Existing Wind Farm Substation
 - Existing Wind Farm Turbines
 - Existing Wind Farm Access Tracks and Hardstanding



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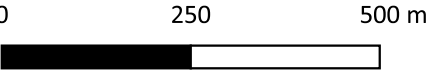


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Site Layout with Access

- Key:**
- Site Boundary
 - Land Under Applicants Control
 - Development Parcels-Represent Maximum Area for siting of Solar Panels
 - Indicative Solar PV Array Layout
 - Indicative Transformer Location
 - Fencing
 - Proposed CCTV Camera Location
 - Existing Wind Farm Substation
 - Existing Wind Farm Turbines
 - Existing Wind Farm Access Tracks and Hardstanding

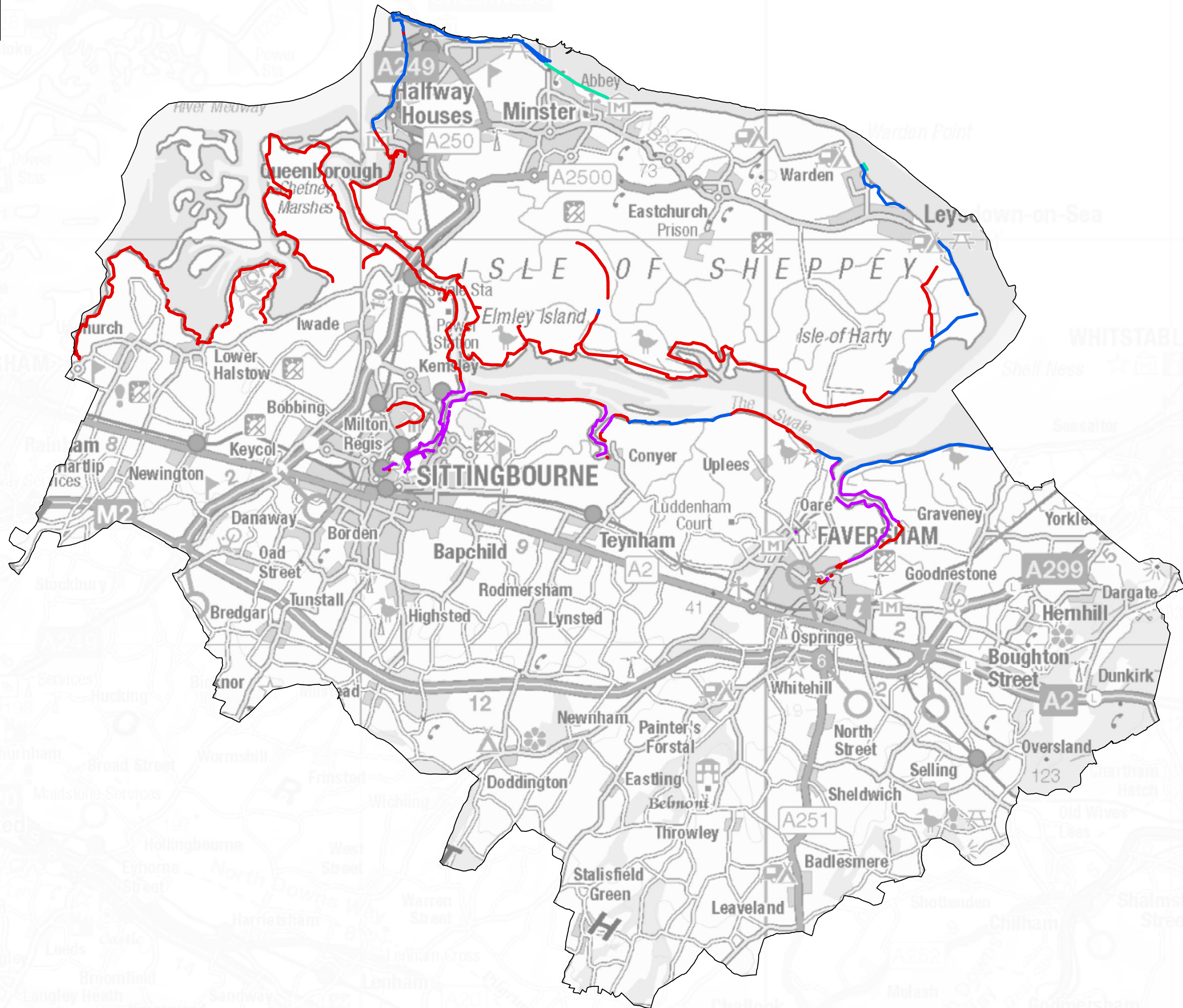


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Appendix B – Southern Water Sewer Plans (x1 Page)

Appendix C – Flood Defence Location, Type, Standard of Protection and Condition



Key Plan



Legend

 Swale Borough

Swale Borough Council defence protection type

 Coastal

Environment Agency defence protection type

 Coastal

 Fluvial and Tidal

 Tidal

Notes

Environment Agency defences are shown with a standard of protection which is against a 5% AEP event or more. Man-made and natural defences which may arise, for instance due to the presence of naturally high ground adjacent to a settlement, have been considered.

Many of the defences around the coastline are coastal defences. With climate change, it is likely that many of the coastal defences will need to become tidal defences in the future.

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Kilometres

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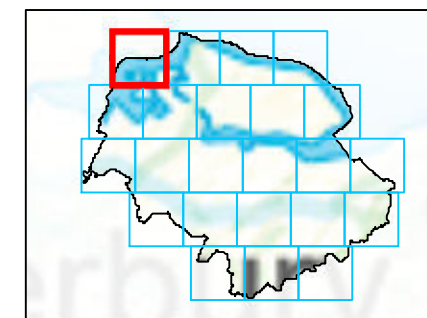
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Key Plan



Legend

Swale Borough

Environment Agency defence standard of protection (AEP)

5%	1.30%	0.5%	0.10%
4%	1%	0.4%	
2%	0.75%	0.2%	

Notes

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year. Although flood defences are designed to a standard of protection it should be noted the actual standard of protection provided by the defence may decrease over time, for example due to deterioration in condition or increases in flood risk due to climate change. Environment Agency defences are shown with a standard of protection which is against a 5% AEP event or more. Man-made and natural defences which may arise, for instance due to the presence of naturally high ground adjacent to a settlement have been considered.

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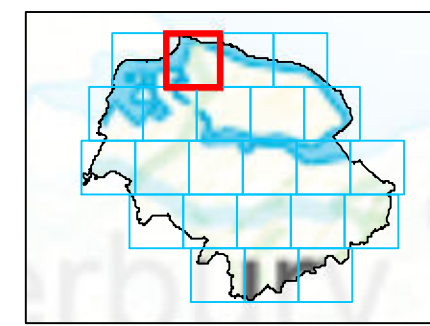
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Key Plan



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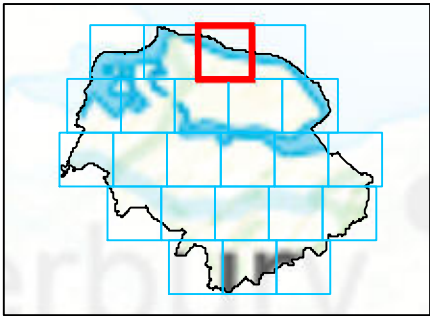
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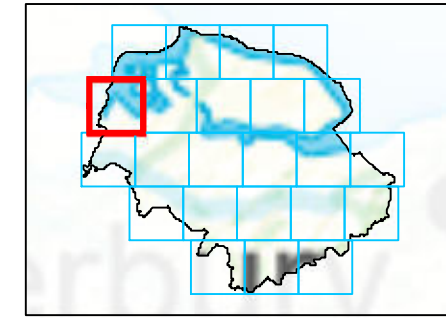
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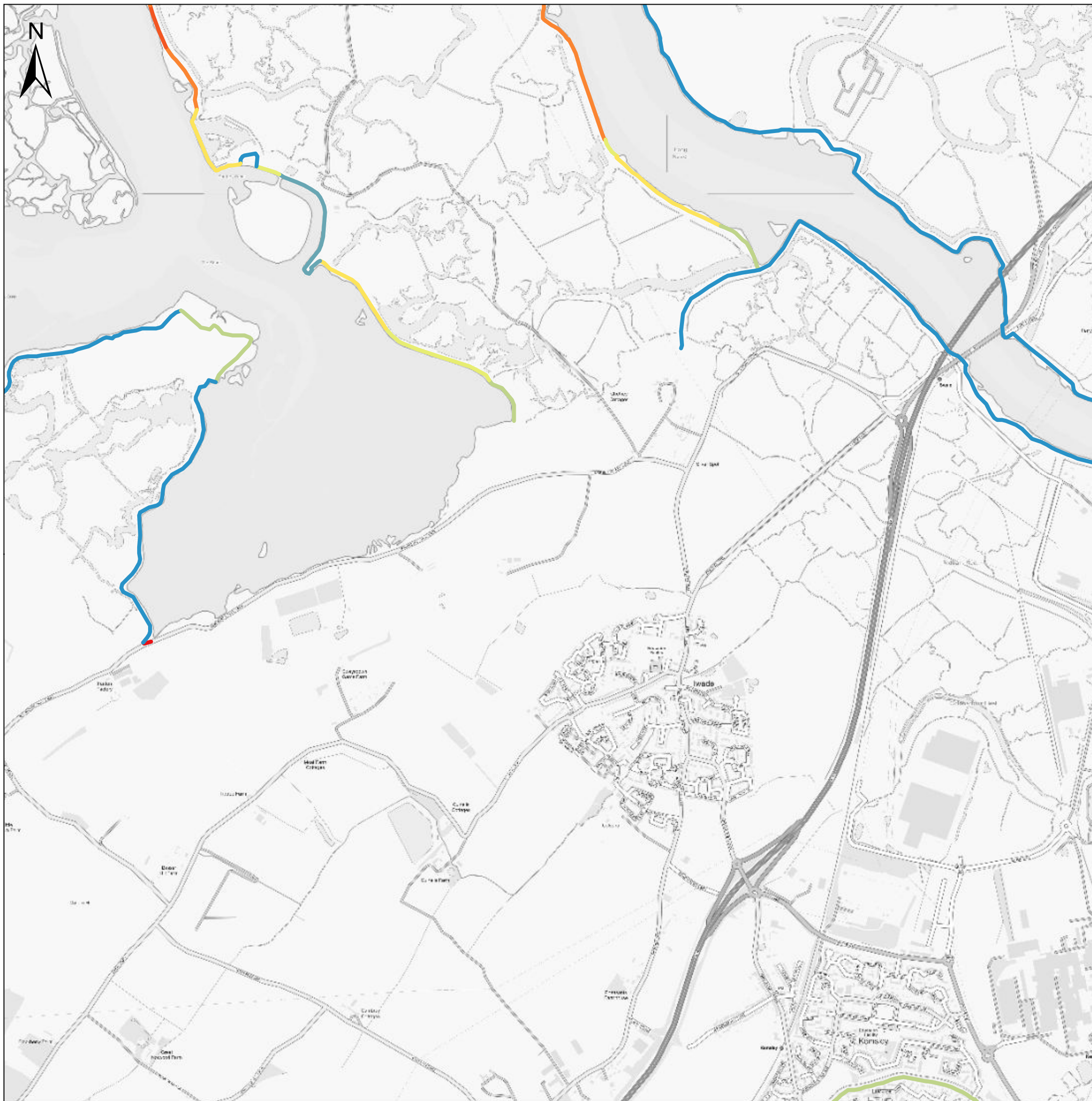
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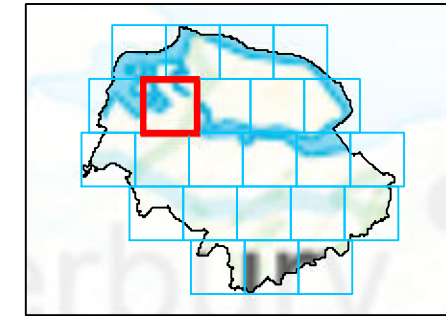
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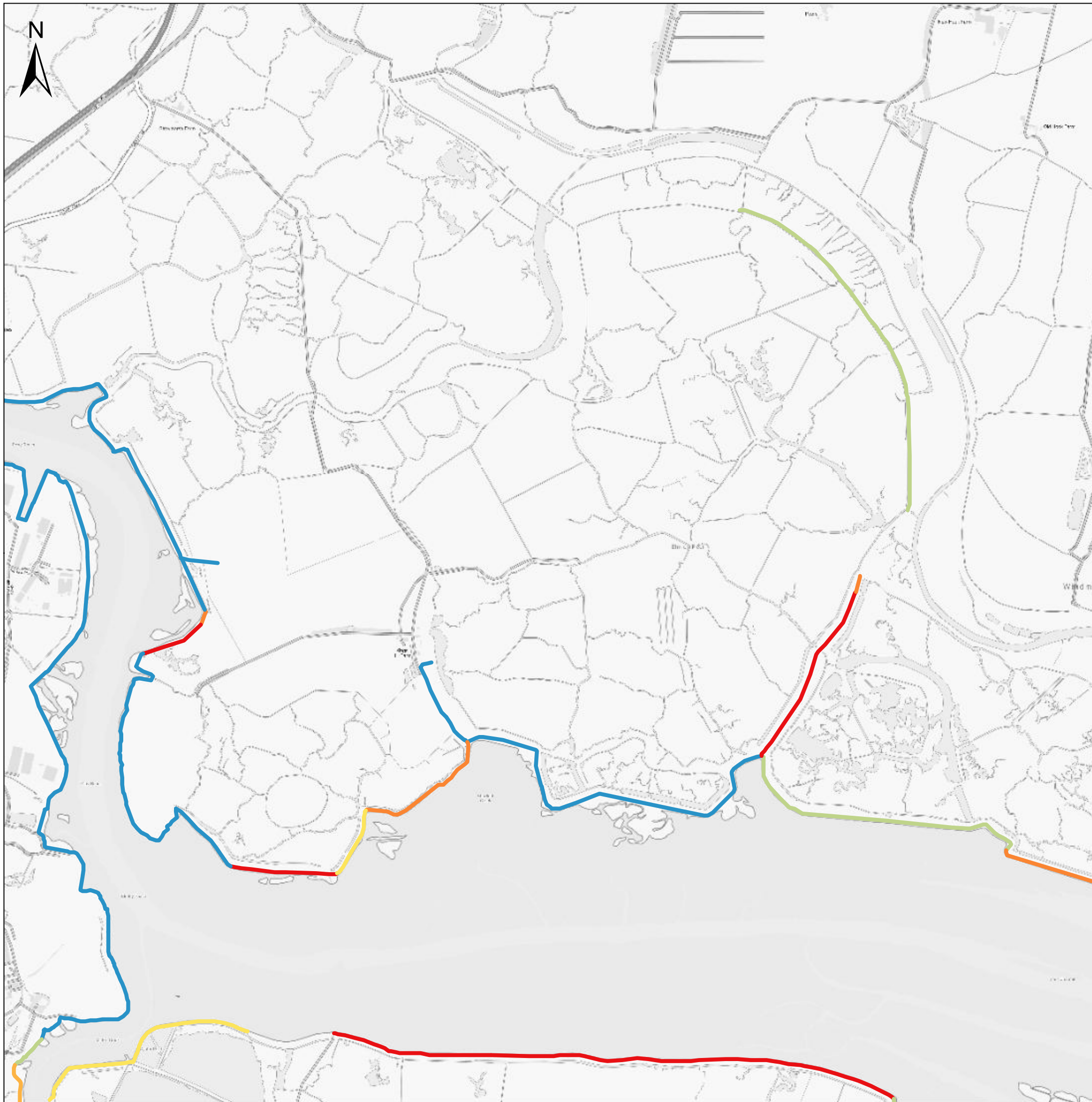
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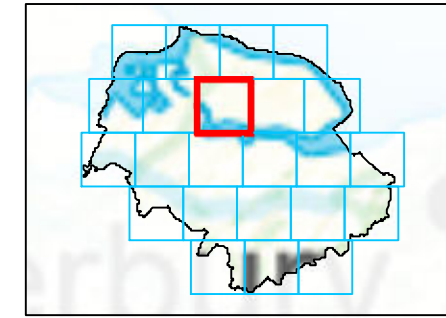
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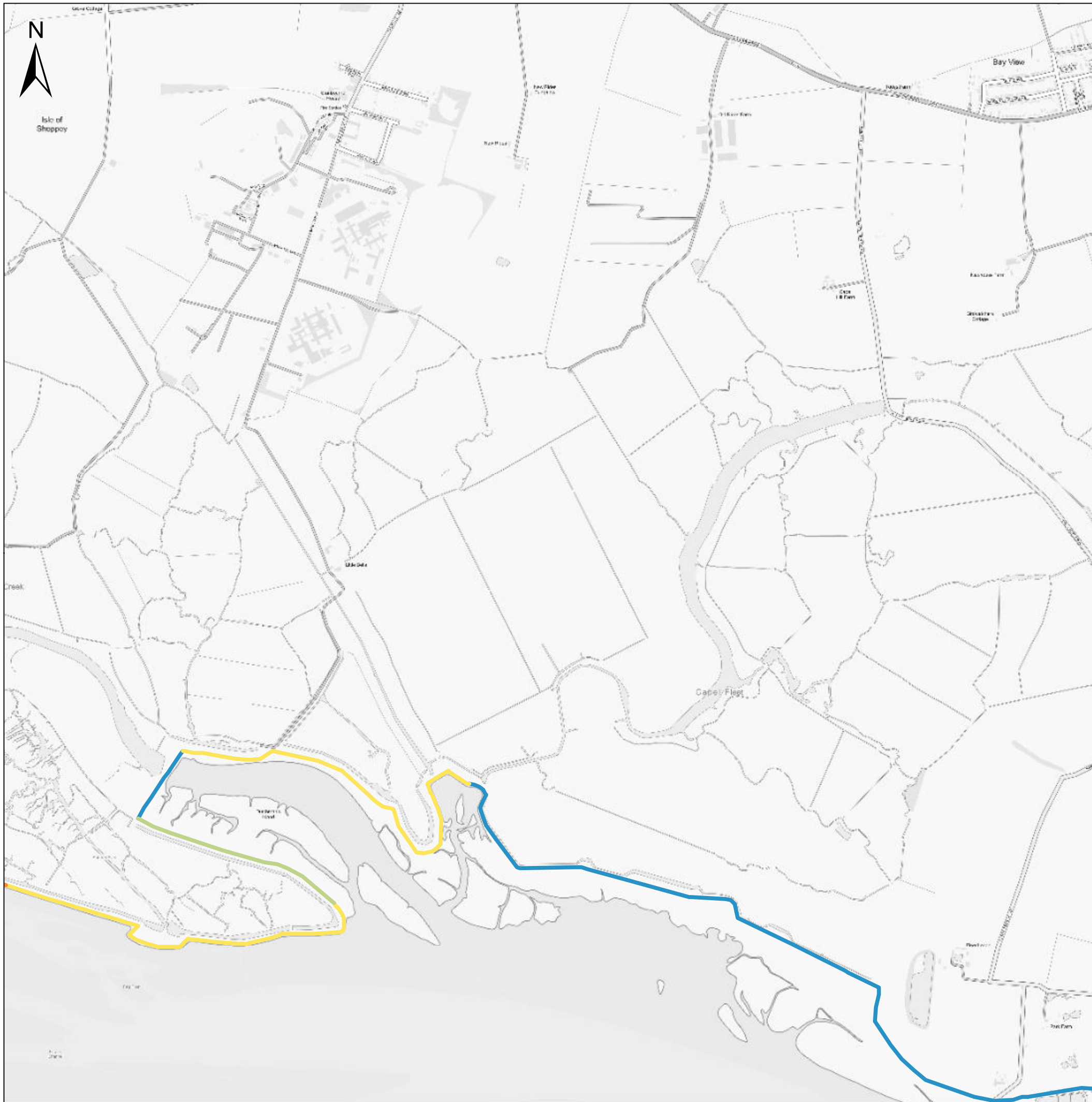
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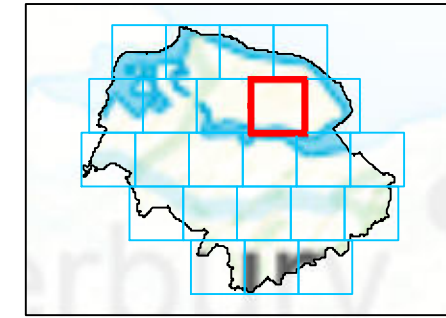
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Key Plan



Legend

Swale Borough

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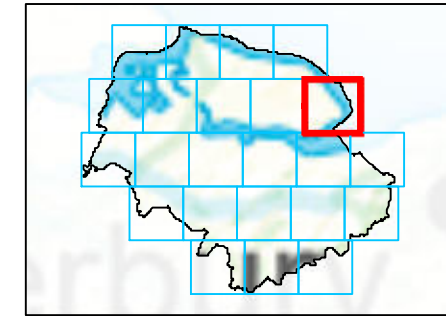
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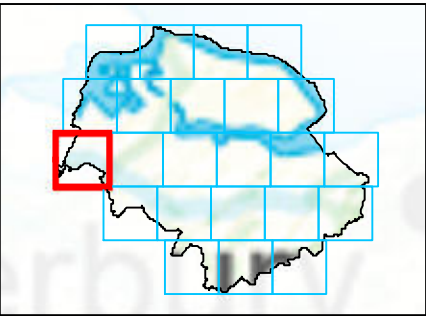
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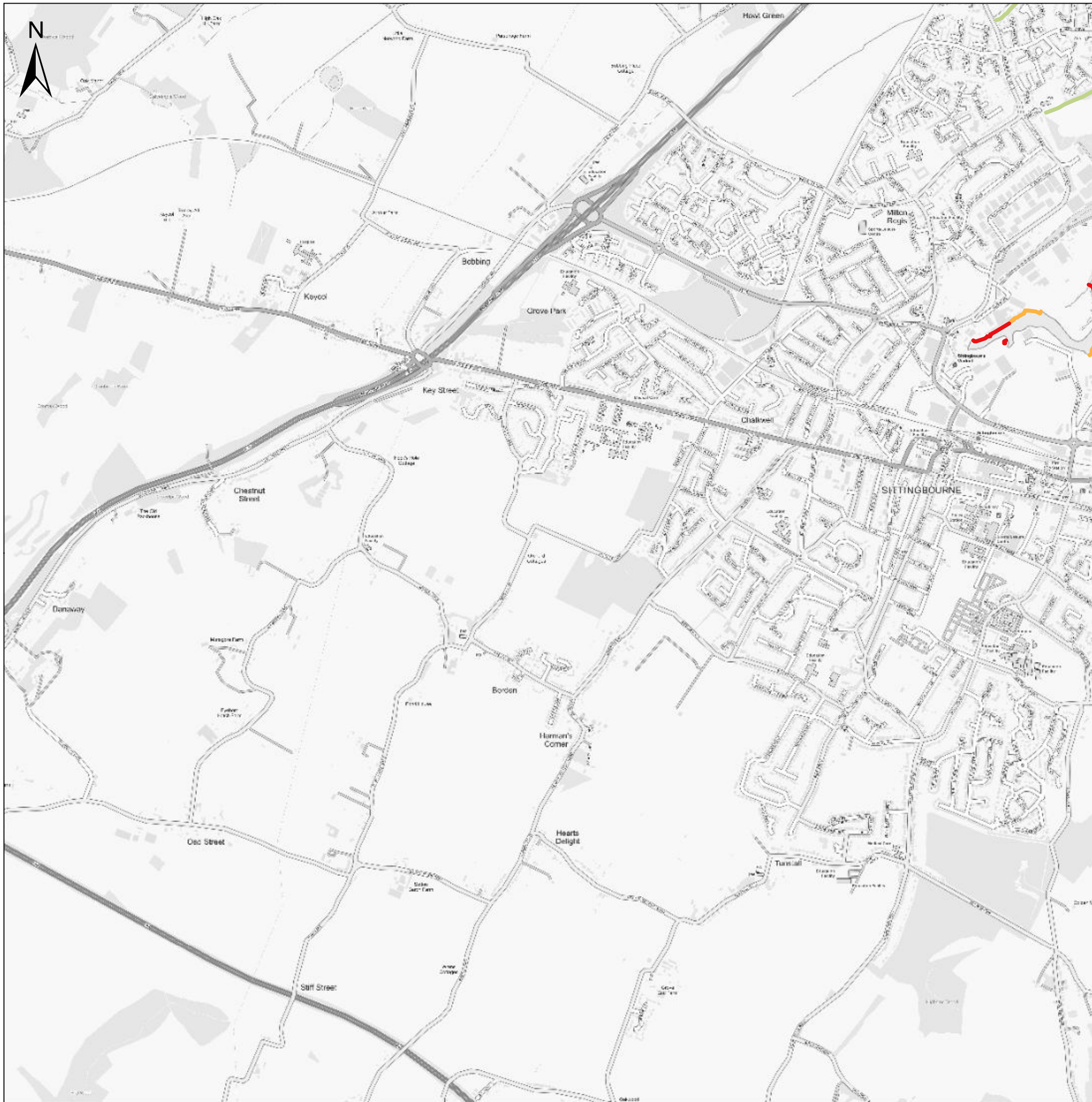


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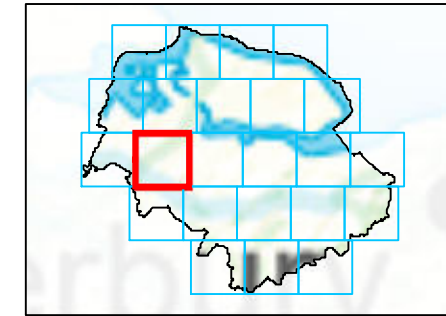
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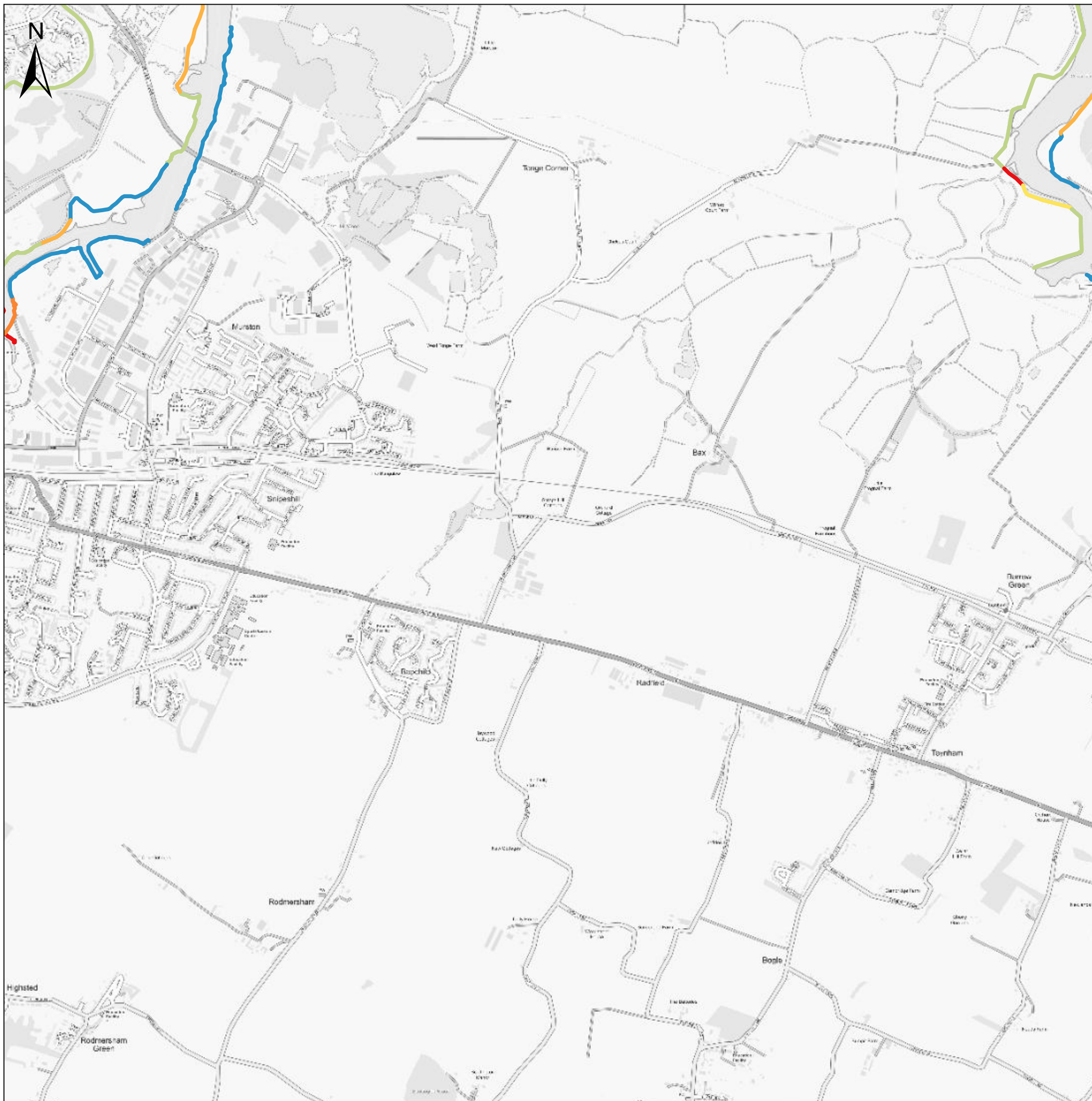
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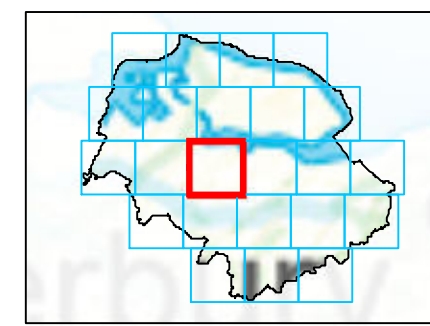
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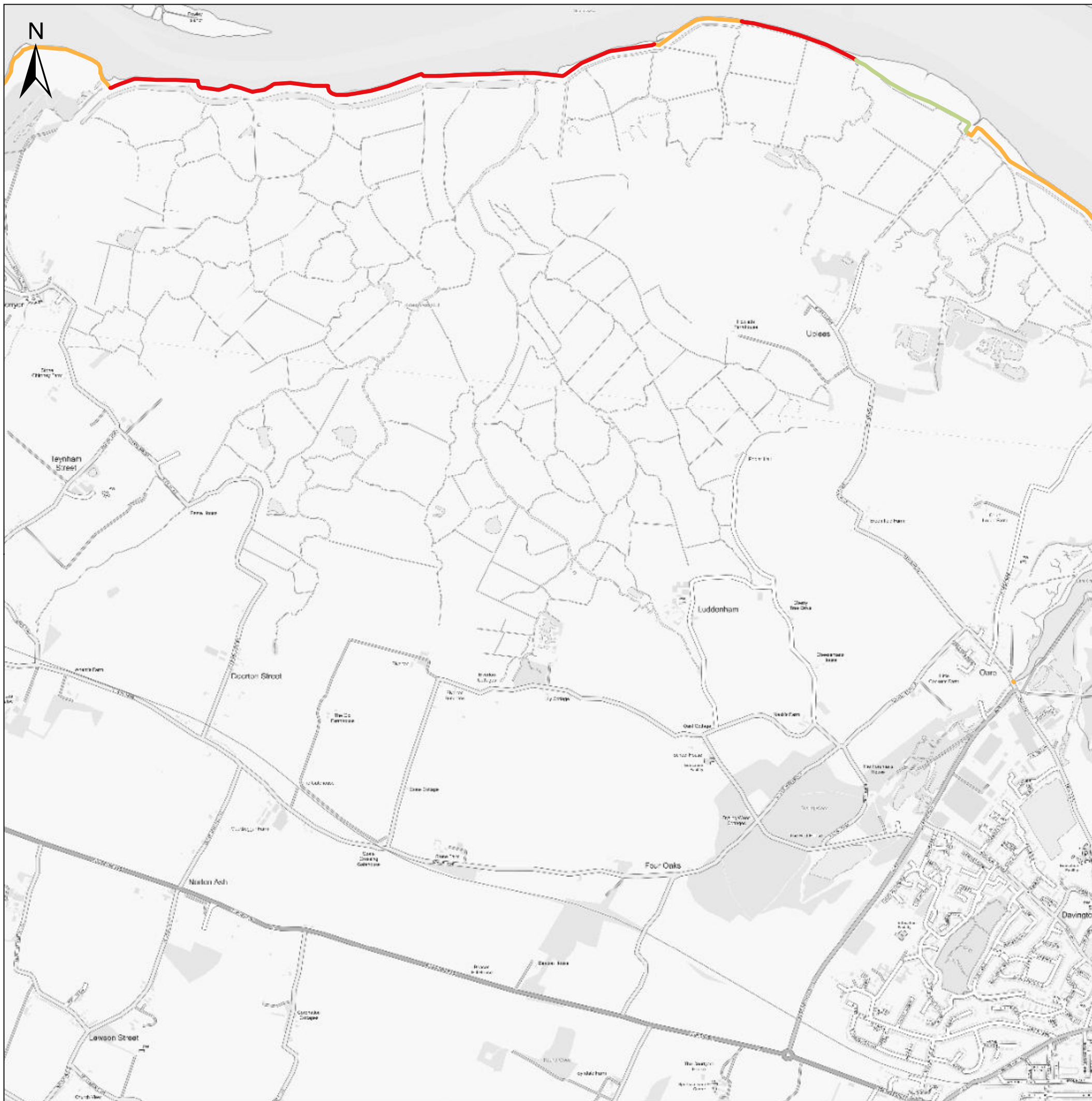


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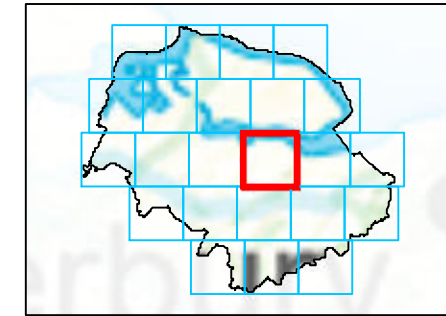
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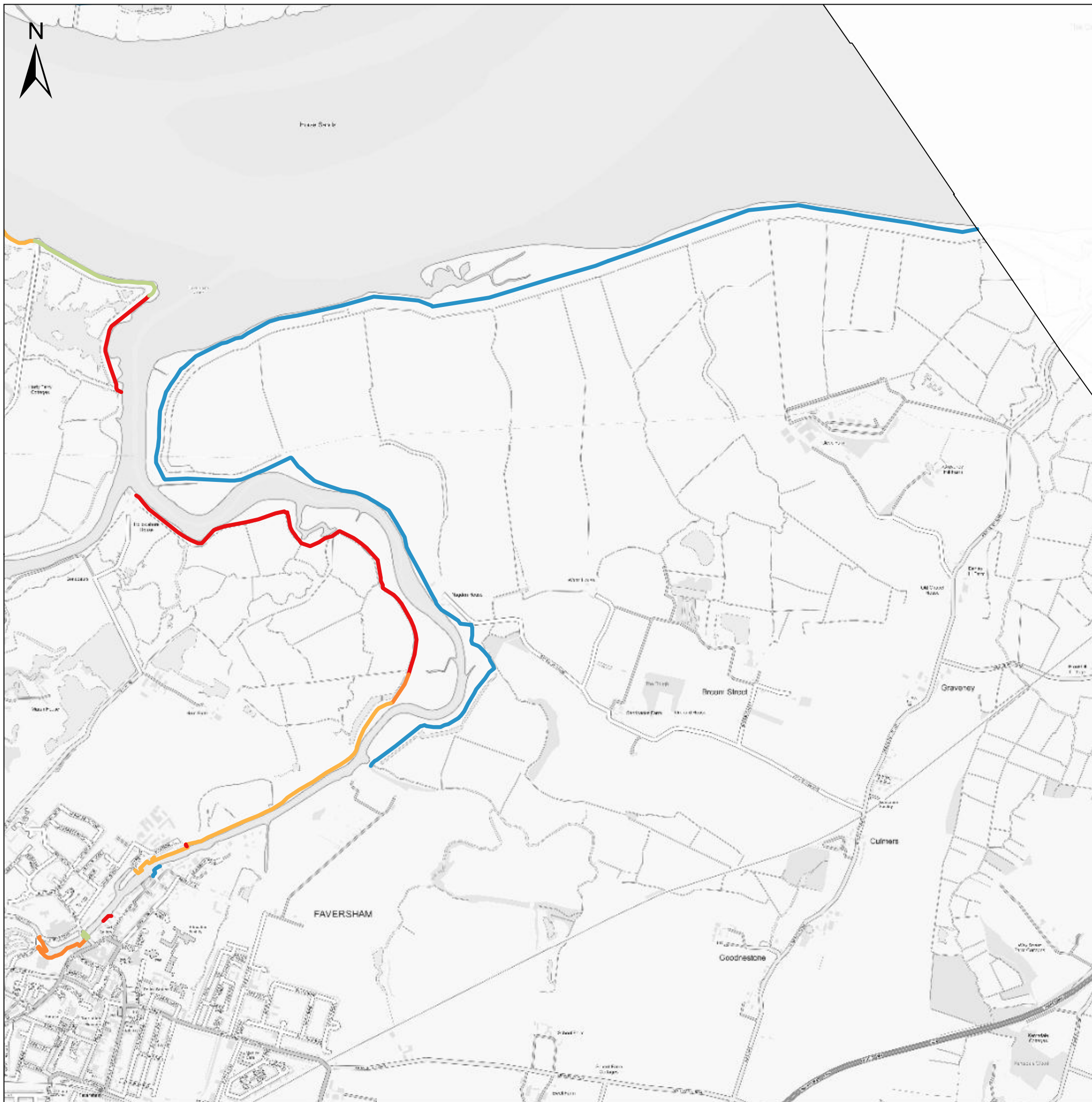
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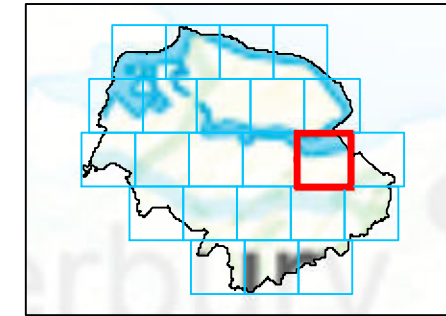
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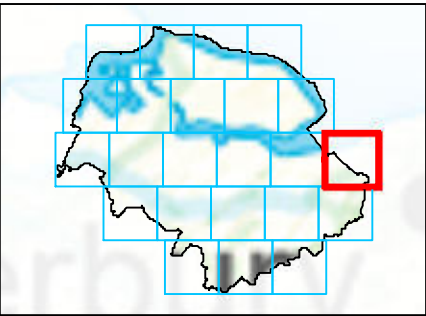
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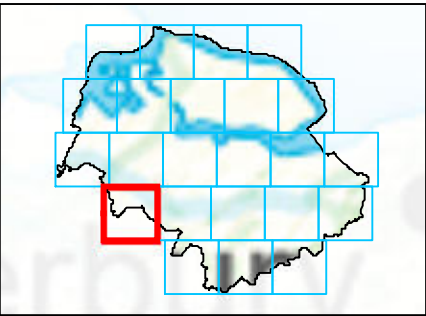
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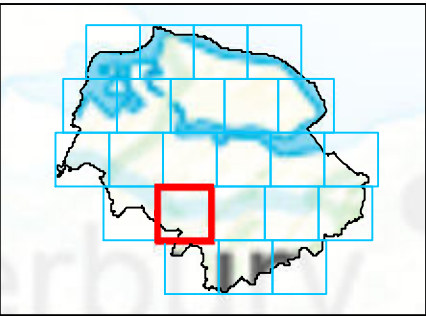
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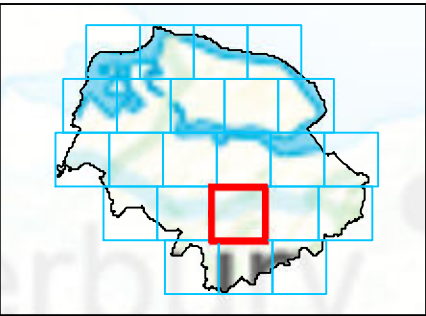
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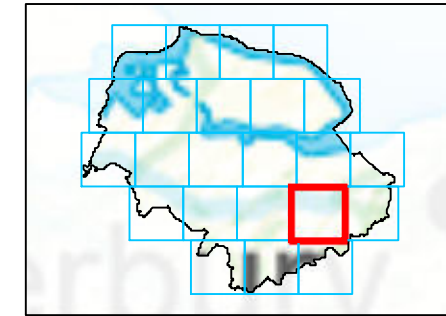
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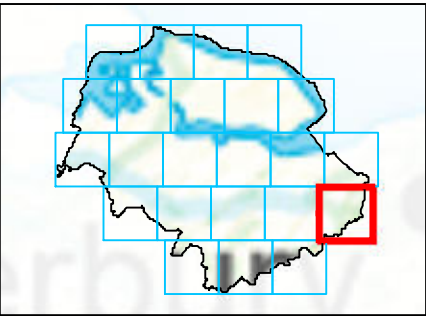
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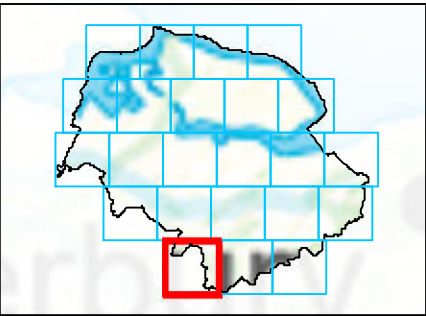
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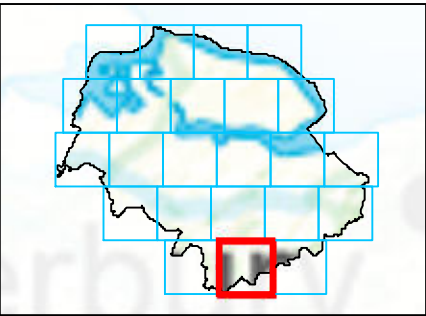
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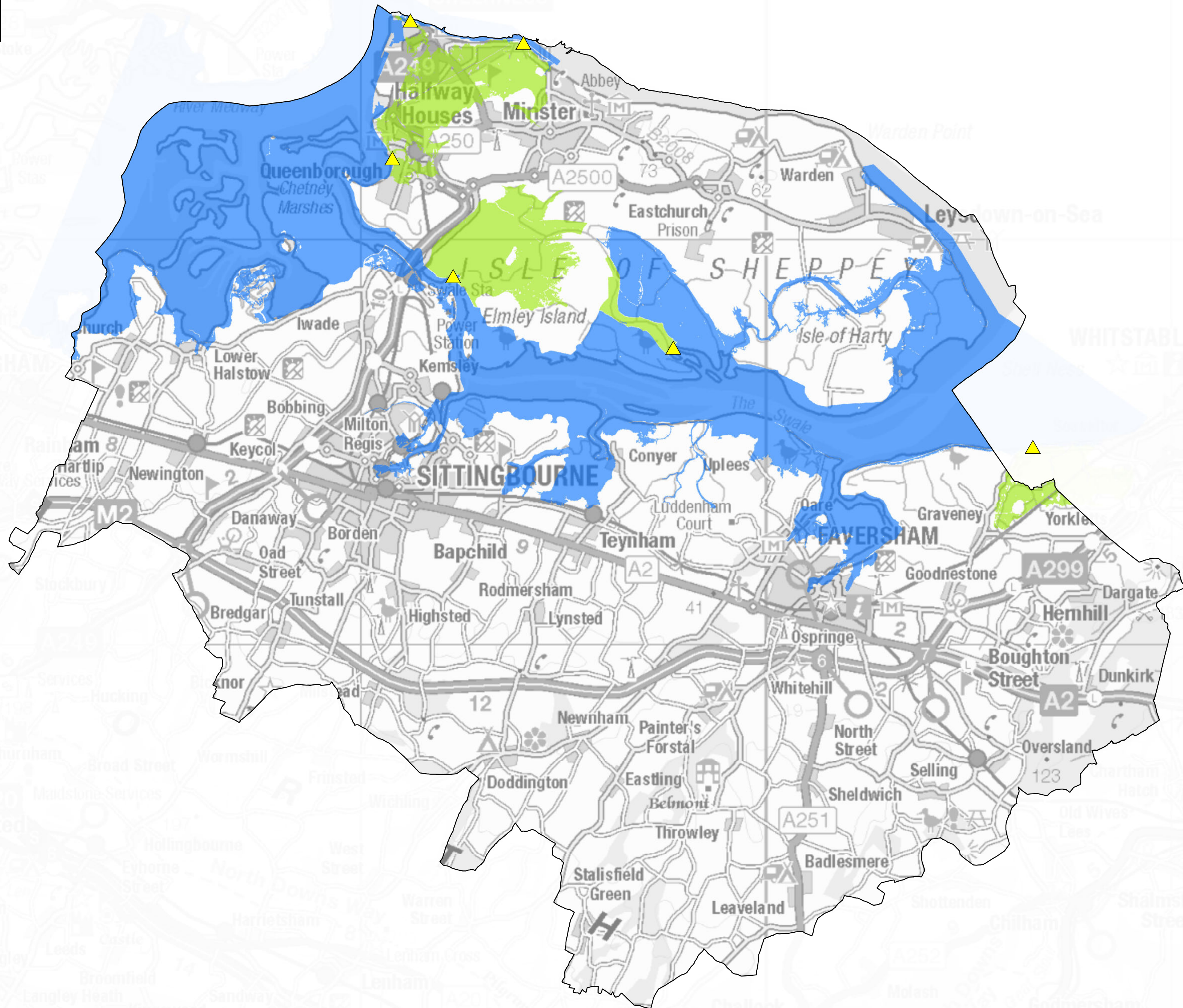
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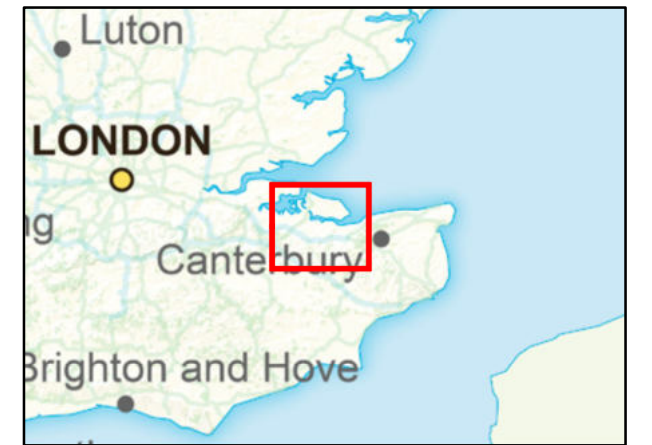
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Appendix D – Level-1 SFRA Breach Extent (x1 page)



Key Plan



Legend

- Swale Borough
- Locations of modelled breaches
- Modelled breach flood extents
- Baseline flood extents (0.5% AEP)

Notes

Breaches modelled as part of the North Kent Coast modelling study (2019) that are predicted to impact flooding within the Local Plan area are shown. The total area predicted to be impacted by the breaches is represented as the areas shaded green. For further information on the predicted extents for individual breaches the modelling study should be referred to.

The locations selected for testing of breach failure were based on where the Environment Agency had identified area where a defence failure could have a high impact. The possibility of breach failure at other locations is plausible and further analysis should be undertaken as part of site-specific flood risk assessments where defences are present and sites may therefore be at risk of a breach event.



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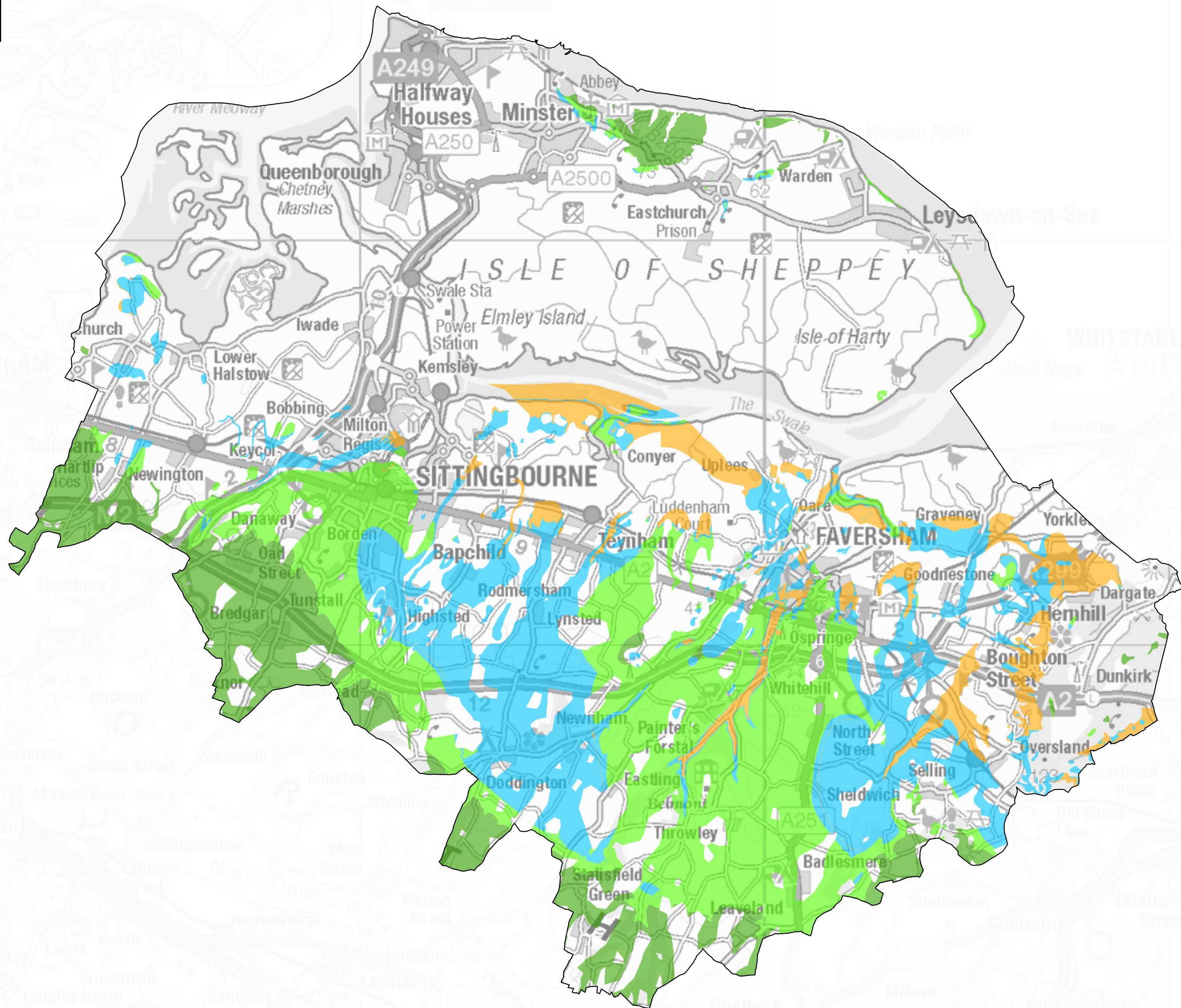
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SFRA: APPENDIX I MODELLLED BREACH EXTENTS

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Appendix E – Level-1 SFRA Groundwater Flood Map (x1 Pages)



Key Plan



Legend

 Swale Borough

JBA Groundwater Flood Map Depths

- No risk.
- Groundwater levels are either at or very near (within 0.025m of) the ground surface.
- Groundwater levels are between 0.025m and 0.5m below the ground surface.
- Groundwater levels are between 0.5m and 5m below the ground surface.
- Groundwater levels are at least 5m below the ground surface.

Notes

The modelled groundwater levels are not predictions of typical groundwater levels, rather they are flood levels. The 5m resolution JBA Groundwater Flood Map categorises the head difference (m) between the predicted groundwater levels and the surface level into five feature classes based on the 100-year flood model outputs.

It should be noted that the JBA Groundwater Flood Map is suitable for general broad-scale assessment of the groundwater flood hazard in an area, but is not explicitly designed for the assessment of flood hazard at the scale of a single property.

0 1.25 2.5 5 Kilometres

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SWALE BOROUGH COUNCIL
SFRA: APPENDIX F
JBA GROUNDWATER FLOOD MAP

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