

## REPORT

### **NPPF Flood Risk Assessment**

Site E Dering Industrial Park, Dering Way, Gravesend,  
Kent DA12 2FP

Client: Optimus Access Limited (OAL)

Reference: 6682-AEA-ZZ-XX-RP-Z-0001

Status: A1/P01.01

Date: 31 May 2022

**HASKONINGDHV UK LTD.**

Sussex Innovation Centre  
Science Park Square  
Brighton  
East Sussex  
BN1 9SB  
Water & Maritime  
VAT registration number: 792428892  
  
+44(0)1273 006 900 **T**  
info@ambiental.co.uk **E**  
ambiental.co.uk **W**

Document title: NPPF Flood Risk Assessment

Subtitle: Site E Dering Industrial Park, Dering Way, Gravesend, Kent DA12 2FP  
Reference: 6682-AEA-ZZ-XX-RP-Z-0001  
Status: P01.01/A1  
Date: 31 May 2022  
Project name: Buchanan\_Gravesend\_FRA\_SWDS  
Project number: 6682

Classification

Project related

*Unless otherwise agreed with the Client, no part of this document may be reproduced or made public or used for any purpose other than that for which the document was produced. HaskoningDHV UK Ltd. accepts no responsibility or liability whatsoever for this document other than towards the Client.*

*Please note: this document contains personal data of employees of HaskoningDHV UK Ltd.. Before publication or any other way of disclosing, consent needs to be obtained or this document needs to be anonymised, unless anonymisation of this document is prohibited by legislation.*

## Revision history

| Revision | Date       | Description                  | Prepared      | Checked       | Approved     |
|----------|------------|------------------------------|---------------|---------------|--------------|
| S3       | 25/05/2022 | Draft to Client for Approval | Sophie Isaacs | Debra Griffin | Steven Brown |
| A1       | 31/05/2022 | Final                        | Sophie Isaacs |               |              |
|          |            |                              |               |               |              |
|          |            |                              |               |               |              |
|          |            |                              |               |               |              |

*Before publication or any other way of disclosing, consent needs to be obtained or this document needs to be anonymised, unless anonymisation of this document is prohibited by legislation.*

|           |                                                  |           |
|-----------|--------------------------------------------------|-----------|
| <b>1</b>  | <b>Introduction</b>                              | <b>1</b>  |
| <b>2</b>  | <b>Site Setting</b>                              | <b>4</b>  |
| <b>3</b>  | <b>Relevant Policy and Guidance</b>              | <b>8</b>  |
| <b>4</b>  | <b>Climate Change Allowances</b>                 | <b>9</b>  |
| <b>5</b>  | <b>Sequential &amp; Exception Testing</b>        | <b>13</b> |
| <b>6</b>  | <b>Development Compatibility with Flood Zone</b> | <b>15</b> |
| <b>7</b>  | <b>Stakeholder Engagement</b>                    | <b>18</b> |
| <b>8</b>  | <b>Flood Risk: Historic Records</b>              | <b>19</b> |
| <b>9</b>  | <b>Flood Risk: Tidal Flooding</b>                | <b>21</b> |
| <b>10</b> | <b>Flood Risk: Fluvial Flooding</b>              | <b>23</b> |
| <b>11</b> | <b>Flood Risk: Surface Water Flooding</b>        | <b>24</b> |
| <b>12</b> | <b>Flood Risk: Groundwater Flooding</b>          | <b>27</b> |
| <b>13</b> | <b>Flood Risk: Sewer Flooding</b>                | <b>29</b> |
| <b>14</b> | <b>Residual Flood Risk</b>                       | <b>30</b> |
| <b>15</b> | <b>Surface Water Drainage Strategy</b>           | <b>33</b> |
| <b>16</b> | <b>Recommendations</b>                           | <b>40</b> |
| <b>17</b> | <b>Conclusions</b>                               | <b>42</b> |
| <b>18</b> | <b>Glossary</b>                                  | <b>44</b> |

## Table of Tables

|                                                                                              |    |
|----------------------------------------------------------------------------------------------|----|
| Table 1: Flood Risk Overview                                                                 | ix |
| Table 2: Surface Water Drainage Strategy                                                     | xi |
| Table 3: Sea level allowances by river basin district for each epoch in mm per year.         | 9  |
| Table 4: Peak river flow climate change allowances for the Medway management catchment       | 10 |
| Table 5: Fluvial climate change allowances to be applied based on development vulnerability. | 10 |
| Table 6: Peak rainfall intensity allowance in small catchments                               | 12 |
| Table 7: Annex 3 of the NPPF, Flood risk vulnerability classification                        | 15 |
| Table 8: Flood Risk and Coastal Change, Table 1                                              | 16 |

|                                                                                                                   |    |
|-------------------------------------------------------------------------------------------------------------------|----|
| Table 9: The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF. | 17 |
| Table 10: Environment Agency Surface Water Flood Depths                                                           | 24 |
| Table 11: EA's Thames Tidal Downriver Breach Inundation Modelling data                                            | 30 |
| Table 12: CIRIA 753 Table 2, The SuDS Hierarchy (adapted) and London Plan Policy 5.13                             | 34 |
| Table 13: SuDS Selection Matrix                                                                                   | 34 |
| Table 14: Summary of Pollution hazard Indices for different Land Use.                                             | 36 |
| Table 15: Maintenance Schedule                                                                                    | 38 |

## Table of Figures

|                                                                   |    |
|-------------------------------------------------------------------|----|
| Figure 1: Proposed Block Plan                                     | 2  |
| Figure 2: Site Location Plan                                      | 4  |
| Figure 3: Site Topography                                         | 5  |
| Figure 4: IDB Map                                                 | 6  |
| Figure 5: Main Rivers                                             | 6  |
| Figure 6: Ordinary Watercourses                                   | 7  |
| Figure 7: Management Catchments (excerpt)                         | 10 |
| Figure 8: EA Flood Map for Planning                               | 16 |
| Figure 9: EA Historic Flood Map and Recorded Flood Outlines       | 19 |
| Figure 10: Thameside SWMP Historic Flooding                       | 20 |
| Figure 11: EA Modelled 1 in 30-year Surface Water Flood Depths    | 25 |
| Figure 12: EA Modelled 1 in 100-year Surface Water Flood Depths   | 25 |
| Figure 13: EA Modelled 1 in 1,000-year Surface Water Flood Depths | 26 |
| Figure 14: Environment Agency, Risk of Reservoir Flooding         | 32 |

## Appendices

- A. Development Proposals
- B. Third Party Data

## References

- [1] Ministry of Housing, Communities & Local Government, “National Planning Policy Framework,” 20 July 2021. [Online]. Available: <https://www.gov.uk/government/publications/national-planning-policy-framework--2>.
- [2] The National Archives, “The Flood Risk Regulations 2009,” 01 04 2013. [Online]. Available: <https://www.legislation.gov.uk/uksi/2009/3042/regulation/20>.
- [3] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government, “Guidance Flood risk and coastal change,” 20 August 2021. [Online]. Available: <https://www.gov.uk/guidance/flood-risk-and-coastal-change>.
- [4] Department for Environment, Food & Rural Affairs, “Sustainable drainage systems: non-statutory technical standards,” 23 March 2015. [Online]. Available: <https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards>.
- [5] HM Government, “Guidance: Preparing a flood risk assessment: standing advice,” DEFRA and Environment Agency, 01 March 2019. [Online]. Available: <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>.
- [6] Department for Environment, Food & Rural Affairs, “Reservoir flood maps published,” 16 12 2010. [Online]. Available: <https://www.gov.uk/government/news/reservoir-flood-maps-published>.
- [7] Legislation.gov.uk, “Water Industry Act 1999,” 2022. [Online]. Available: <https://www.legislation.gov.uk/ukpga/1999/9/contents>.
- [8] Legislation.gov.uk, “Directive 2000/60/EC of European Parliament and of the Council,” 2000. [Online]. Available: <https://www.legislation.gov.uk/eudr/2000/60/contents>.
- [9] European Parliament and of the Council, “Directive 2007/60/EC on the assessment and management of flood risks,” 23 11 2007. [Online]. Available: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32007L0060>.
- [10] Legislation.gov.uk, “The Flood Risk Regulations 2009,” 2009. [Online]. Available: <https://www.legislation.gov.uk/uksi/2009/3042/contents>.
- [11] Legislation.gov.uk, “Flood and Water Management Act 2010,” 2010. [Online]. Available: <https://www.legislation.gov.uk/ukpga/2010/29/contents>.
- [12] Gov.uk, “Building Regulations and Approved Documents index,” 10 08 2021. [Online]. Available: <https://www.gov.uk/guidance/building-regulations-and-approved-documents-index>.
- [13] Legislation.gov.uk, “The Town and Country Planning (Development Management Procedure) (England) Order 2015,” 2015. [Online]. Available: <https://www.legislation.gov.uk/uksi/2015/595/contents/made>.
- [14] British Standards, “BS EN 752:2017 Drain and sewer systems outside buildings - sewer system management,” 10 2019. [Online]. Available: <https://www.thenbs.com/PublicationIndex/documents/details?DocID=327686>.
- [15] Gov.uk, “Sustainable drainage systems: non-statutory technical standards,” 23 03 2015. [Online]. Available: <https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards>.
- [16] Gov.uk, “Guidance, Flood risk and coastal change,” 20 08 2021. [Online]. Available: <https://www.gov.uk/guidance/flood-risk-and-coastal-change>.
- [17] Ciria, “The SuDS Manual (C753F),” 12 2015. [Online]. Available: <https://www.ciria.org/ItemDetail?iProductCode=C753F&Category=FREEPUBS>.

- [18] Water.org.uk, "Sector Guidance in relation to the adoption of sewerage assets by sewerage companies in England," 25 10 2019. [Online]. Available: <https://www.water.org.uk/wp-content/uploads/2020/02/Sewerage-Sector-Guidance-v1-251019.pdf>.
- [19] Environment Agency & Department for Environment, Food and Rural Affairs, "Preparing a flood risk assessment: standing advice," 08 02 2022. [Online]. Available: <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>.
- [20] Environment Agency, "Guidance; Flood risk assessments: climate change allowances," 06 10 2021. [Online]. Available: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>.
- [21] Local Government Association, "Local Government Association," [Online]. Available: <https://www.local.gov.uk/topics/severe-weather/flooding/local-flood-risk-management/managing-flood-risk-roles-and>.
- [22] Association of Drainage Authorities, "Internal Drainage Boards Map," [Online]. Available: <https://www.ada.org.uk/idb-map/>.
- [23] H. Udale-Clarke, "Flood Risk Assessment Guidance for New Development Phase 2, FD2320/TR2," Department for Environment Food and Rural Affairs, London, 2005.
- [24] G. G. S. W. a. H. U.-C. Suresh Surendran, "Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose - Clarification of the Table 13.1 of FD2320/TR3 and Figure 32 of FD2321/TR1," Environment Agency & HR Wallingford, 2008.
- [25] HR Wallingford, "uksuds.com," 2022. [Online]. Available: <https://www.uksuds.com/>.

## Executive Summary

Royal HaskoningDHV has been appointed by Optimus Access Limited (OAL) to undertake a National Planning Policy Framework (NPPF) [1] compliant Flood Risk Assessment (FRA) for the proposed development located at Site E Dering Industrial Park, Dering Way, Gravesend, Kent, DA12 2FP.

A planning application (reference: 20211283 dated 13<sup>th</sup> October 2021) was submitted to Gravesham Borough Council (GBC) for the development and was later withdrawn. Gravesham Borough Council as a consultee during the planning process were consulted and raised an objection on based on the following:

*‘Unfortunately no surface water drainage strategy has been provided for the proposed development. We would therefore recommend the application is not determined until a complete surface water drainage strategy has been provided for review.’*

Email correspondence with the Client indicated that Gravesham Borough Council had also requested that a Flood Risk Assessment were completed for the development proposals.

A new retrospective planning application is in the process of being submitted and this Flood Risk Assessment and Surface Water Drainage Strategy has been produced to support it. The retrospective planning application is for the permanent retention of the existing buildings on site, which were developed without planning consent. The buildings to be retained are an office building, raised open storage platform with a timber deck, metal clad shed and open sided shed.

The following development has been constructed, as shown on Figure 1 and in Appendix A.

- Structure A – Two tier modular building in use as ancillary offices and staff welfare facilities.
- Structure B – Raised storage platform.
- Structure C – Ancillary secure storage shed.
- Structure D – Covered storage area.
- Open Yard – Storage, vehicles and staff parking.

According to the Flood Risk and Coastal Change Planning Policy Guidance, the proposed development would be classified as a Minor Development.

According to Annex 3 of the NPPF, the proposed development’s Vulnerability Classification is “Less Vulnerable”, which consists of the following uses:

*‘Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the ‘more vulnerable’ class; and assembly and leisure.’*

This report relies on information provided by third parties, either because of a direct request for information, or through reviewing their published information (usually from internet sources from Government Agencies or established institutions).

A summary of the flood risk for the site for each source requiring consideration under the NPPF is provided below and presented as Table 1, overleaf:

- Tidal: Site is defended against tidal flooding up to 1 in 1,000-year events, due to Thames Estuary 2100 defences;
- Fluvial: Site is not at risk of flooding from this source;
- Surface Water: The Site is at high risk of flooding from surface water sources. Given that the Development Proposals are for the retention of the existing buildings on site, there will be no change

to the existing impermeable surface areas, built footprint or roof areas. Thus, surface water flood risk will not change post-development;

- Groundwater: The Site is in an area which is highly susceptible to groundwater flooding. Due to the nature of the Development Proposals, there will be no excavation works and no change to the groundwater flood risk as a result of this development;
- Sewers: The Site is not located near an existing public sewer, so there should be no risk of flooding from sewers;
- Residual Risk – Flood Defence Breach: The Site would be at risk of flooding in the event of a tidal defence breach event. The likelihood of this occurring is very low;
- Residual Risk – Reservoir Failure: The Site is not at risk of flooding in the event of reservoir failure.

As discussed in Section 15 - Surface Water Drainage Strategy, surface water runoff is currently directed into ACO drains on site, before being discharged into existing drainage ditches at the edges of the site. Given that the impermeable surface areas and roof areas will remain the same as existing post-development, it is recommended that surface water runoff continues to be discharged via the ACO drains and into the nearby ditches.

To provide adequate treatment to surface water runoff, it is recommended that Proprietary Treatment Systems are retrofitted to the existing ACO drain on site, which currently takes the surface water runoff towards the existing ditch. Proprietary Treatment Systems are products used to filter specific pollutants from surface water runoff, to prevent them from polluting the ditch adjacent to the site.

The Flood Risk Assessment has been undertaken in accordance with the requirements of the NPPF, and it can be demonstrated that the development proposals are compatible with the predicted flood risk profile, including climate change allowance over the development lifetime.

It should be noted that the development proposals are not predicted to increase the risk of flooding to others over the development lifetime. Consequently, it is concluded that with regards to the Flood Risk requirements of the NPPF, the development proposals are acceptable.

Table 1: Flood Risk Overview

| Criteria                              | Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Site Setting</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Site Address                          | Site E Dering Industrial Park, Dering Way, Gravesend, Kent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Local Authority (ONS)                 | Gravesham Borough Council                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Client Name                           | Optimus Access Limited (OAL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Redline Site Boundary                 | 3427 m <sup>2</sup> (0.3 ha)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Ordnance Survey Grid Reference        | OS X (Eastings) 566552, OS Y (Northings) 173953                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Fluvial Climate Change Catchment Area | Medway                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Development Classification</b>     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Major or Minor Development?           | Minor Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Vulnerability Classification          | Less Vulnerable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Development Proposals                 | The development proposal is a retrospective application, for the permanent retention of the existing buildings on site. The buildings to be retained are an office building, raised open storage platform with timber deck, metal clad shed and open sided shed. The development proposal has received objections from the Environment Agency and Kent County Council (27/01/2022, based on correspondence from Gravesham Borough Council), based on no provision of a Surface Water Drainage Strategy, Flood Risk Assessment or Preliminary Risk Assessment. A Preliminary Risk Assessment has been provided by Royal HaskoningDHV in a separate document. |
| Sequential Test                       | If the site has not been allocated through the Local Plan process, a Sequential Test may be required. This should be confirmed with the Local Planning Authority.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Exception Test                        | An Exception Test should not be necessary, as the Development Proposal is for the retention of the existing buildings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Site Parameters</b>                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Topographic Levels (LiDAR)            | Average Topographic Level: 2.35 m AOD<br>Highest Topographic Level: 3.34 m AOD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Ordinary Watercourses (within 500m)   | According to the CEH Rivers data, there is an Ordinary Watercourse which passes through the centre of the Application Site.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Main Rivers (within 500m)             | According to the Environment Agency Statutory Main River data, there is an unnamed main river approximately 140m north of the Application Site. The River Thames is located approximately 330m north of the Application Site.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| BGS Hydrogeological Setting           | Aquifers with significant intergranular flow: Highly productive aquifer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| BGS Lithology                         | Superficial Geology: Alluvium - Clay, Silt, Sand And Peat<br>Bedrock Geology: Lewes Nodular Chalk Formation, Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| BGS Borehole Record                   | Confidential or restricted borehole records on site. Limited borehole records off site. More information provided in Land Quality Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Flood Risk</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Historic Records                      | There are no recorded instances of flooding on the Environment Agency's Historic or Recorded flood data within 500m of the site. (Figure 9)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Flood Map for Planning Classification | Flood Zone 3a and is in an area that benefits from flood defences. (Figure 8)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Tidal Flood Levels                    | 1 in 200: Defended<br>1 in 1,000: Defended                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Tidal Flood Discussion                | The Application Site is located in an area that benefits from flood defences; specifically, the 2100 Thames Tidal Defences, which offer protection against tidal flooding up to the 1 in 1,000-year standard of protection. Therefore, the Application Site is not affected by tidal flooding.                                                                                                                                                                                                                                                                                                                                                              |
| Tidal Flood Mitigation                | Mitigation measures not required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Fluvial Flood Levels                  | 1 in 20: no data<br>1 in 100: no data<br>1 in 1000: no data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Fluvial Flood Discussion              | The main source of flood risk to the Application Site is tidal, from the nearby River Thames. The Environment Agency have not provided modelled fluvial flood data or indicated that the Application Site is at risk of fluvial flooding.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Fluvial Flood Mitigation              | Mitigation measures not required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Criteria                                       | Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Surface Water Flood Risk                       | 1 in 30: Between 600mm and 900mm<br>1 in 100: Between 900mm and 1200mm<br>1 in 1,000: Over 1200mm<br>Based on the Environment Agency's risk of flooding from surface water mapping, the Application Site is classified as being at High Risk of flooding from surface water.                                                                                                                                                                                             |
| Surface Water Flood Discussion                 | The Application Site is classified as being at High Risk of flooding from surface water. The Development Proposals are for the permanent retention of the existing structures on site, so should not increase surface water flood risk.                                                                                                                                                                                                                                  |
| Surface Water Flood Mitigation                 | On the basis that the site is predicted to be at risk from pluvial flooding, it will be necessary to include pluvial flood mitigation measures within the developments design. Mitigation options are discussed in the mitigation section of this document.                                                                                                                                                                                                              |
| Groundwater Flood Risk                         | The Application Site is located in an area that is identified as being susceptible to groundwater flooding of the property below ground level (considered high risk).                                                                                                                                                                                                                                                                                                    |
| Sewer Flooding Risk                            | Where sewers exist, there is a residual risk of sewer flooding as a result of either a failure, usually a collapse or blockage, or as a result of the system's capacity being exceeded.                                                                                                                                                                                                                                                                                  |
| Sewer Flooding Mitigation                      | Adopting a precautionary approach to the potential for sewer flooding, or other events that exceed the design standard of infrastructure, appropriate mitigation measures should be included in the design of all new buildings, and where practicable in the refurbishment or change of use of existing buildings.                                                                                                                                                      |
| Residual Risk: Flood Defence Breach            | Flood Defence Breach: The Application Site is indicated to be located in an area that benefits from the presence of flood defences. Therefore, should a portion of the flood defences fail (breach), then the Application Site may be at risk as a consequence of a breach in the flood defences. The Environment Agency's Thames Tidal Downriver Breach Inundation Modelling (2018) indicates that the Application Site would be at risk of flooding in a breach event. |
| Residual Risk: Reservoir Failure               | Predicted Flood Depth: None<br>The Environment Agency risk of reservoir flooding indicates that the site is not at risk as a result of a modelled reservoir failure.                                                                                                                                                                                                                                                                                                     |
| Canal Failure                                  | According to the CEH Canals data, there are no canals within 500m of the Application Site; therefore, there is no residual risk of flooding as a result of a canal breach.                                                                                                                                                                                                                                                                                               |
| <b>Flood Emergency Response Plan (FERP)</b>    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Is a FERP required?                            | As the Application Site is defended against tidal flooding and not at risk from fluvial flooding, a Flood Emergency Response Plan is unlikely to be required. If there is already a Flood Emergency Response Plan for the existing site, this should continue to be used by staff.                                                                                                                                                                                       |
| <b>Offsite Impacts</b>                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Floodplain Displacement                        | As the Application Site is not shown to be at risk from fluvial flooding, floodplain displacement is unlikely to occur. Therefore, floodplain compensation is not anticipated to be required.                                                                                                                                                                                                                                                                            |
| <b>Future Flood Related Permits / Licences</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Access for maintenance of watercourses         | It is recommended that an 8m access route be provided to any watercourses, including culverted watercourses. Where crossings of watercourses are required to facilitate access, these should cover as small an area of the watercourse as possible and should permit the free flow of water within the channel.                                                                                                                                                          |
| Flood Risk Activity Permit                     | A Flood Risk Activity Permit is unlikely to be required.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Ordinary Watercourse Consent                   | Any works to the ditches or watercourses on site are likely to require Ordinary Watercourse Consent from the Lead Local Flood Authority, or IDB as appropriate.                                                                                                                                                                                                                                                                                                          |
| Public Sewer Licence                           | Any works within 3m of a public sewer and any new connections shall require the consent of the Public Sewer Authority. Should public sewers be found to cross the site, then discussions with the Public Sewer Authority will be necessary to determine if easements or build over agreements are required.                                                                                                                                                              |

Table 2: Surface Water Drainage Strategy

| Surface Water Drainage Strategy          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Proposed Surface Water Drainage Strategy | <p>Surface water runoff is currently directed into ACO drains on site, before being discharged into existing drainage ditches at the edges of the site. Given that the impermeable surface areas and roof areas will remain the same as existing post-development, it is recommended that surface water runoff continues to be discharged via the ACO drains and into the nearby ditches.</p> <p>To provide adequate treatment to water runoff, it is recommended that Proprietary Treatment Systems are retrofitted to the existing ACO drain on site, which currently takes the surface water runoff towards the existing ditch. Proprietary Treatment Systems are products used to filter specific pollutants from surface water runoff, to prevent them from polluting the ditch adjacent to the site.</p> |

## 1 Introduction

Royal HaskoningDHV has been appointed by Optimus Access Limited (OAL) to undertake a National Planning Policy Framework (NPPF) [1] compliant Flood Risk Assessment (FRA) for the proposed development located at Site E Dering Industrial Park, Dering Way, Gravesend, Kent DA12 2FP, hereafter referred to as the Application Site.

### 1.1 Development

A planning application (reference: 20211283 dated 13<sup>th</sup> October 2021) was submitted to Gravesham Borough Council (GBC) for the development and was later withdrawn. Gravesham Borough Council as a consultee during the planning process were consulted and raised an objection on based on the following:

*‘Unfortunately no surface water drainage strategy has been provided for the proposed development. We would therefore recommend the application is not determined until a complete surface water drainage strategy has been provided for review.’*

Email correspondence with the Client indicated that Gravesham Borough Council had also requested that a Flood Risk Assessment were completed for the development proposals.

A new retrospective planning application is in the process of being submitted and this Flood Risk Assessment and Surface Water Drainage Strategy has been produced to support it. The retrospective planning application is for the permanent retention of the existing buildings on site. The buildings to be retained are an office building, raised open storage platform with a timber deck, metal clad shed and open sided shed.

The following development has been constructed, as shown on Figure 1 and in Appendix A.

- Structure A – Two tier modular building in use as ancillary offices and staff welfare facilities.
- Structure B – Raised storage platform.
- Structure C – Ancillary secure storage shed.
- Structure D – Covered storage area.
- Open Yard – Storage, vehicles and staff parking.

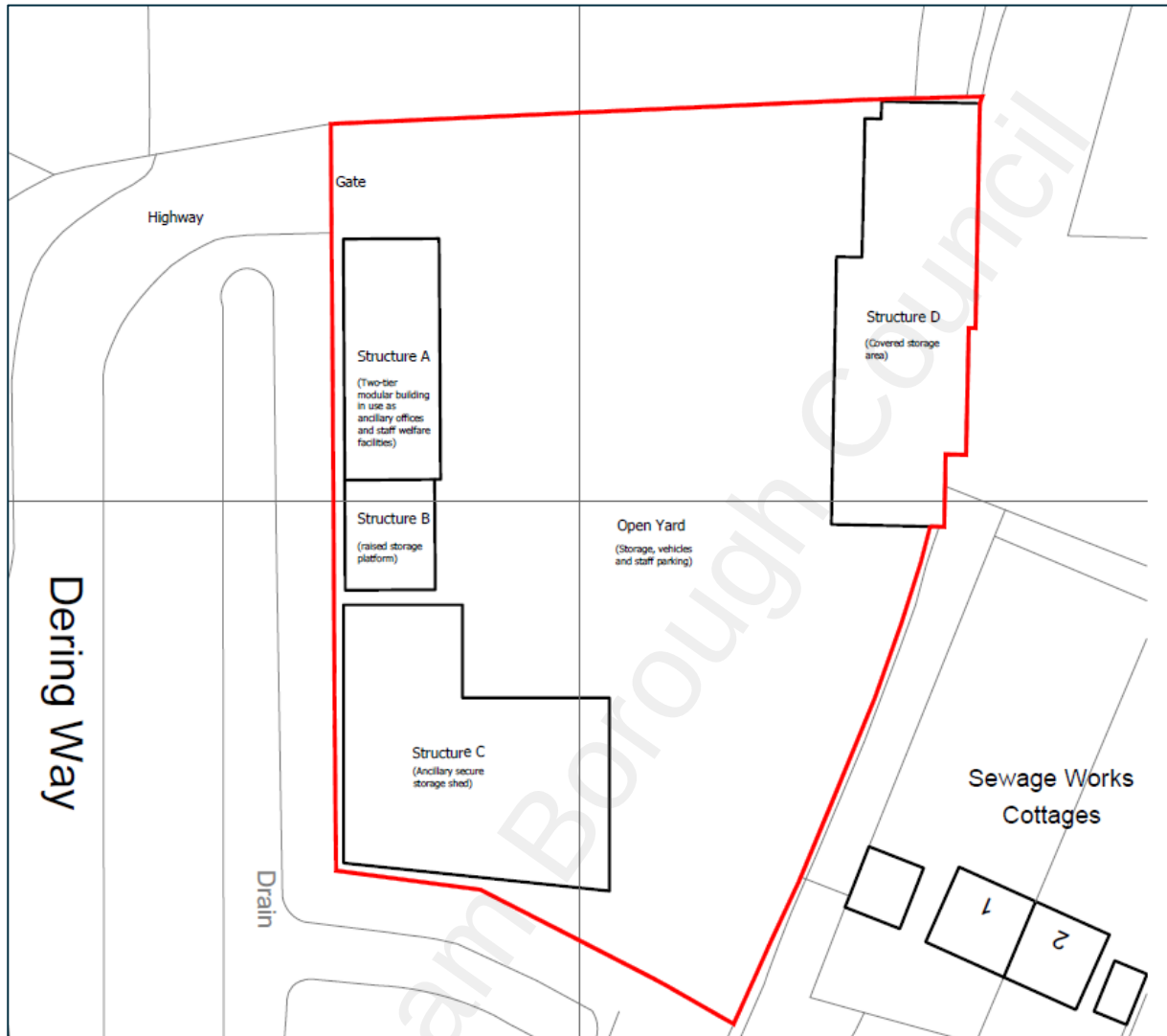


Figure 1: Proposed Block Plan

## 1.2 Objectives

The overall objectives of this assessment are as follows:

- To demonstrate that the Development Proposal can be satisfactorily accommodated without worsening flood risk for the area and without placing the development itself at risk of flooding.
- To be written in accordance with national guidance provided within the NPPF, the Planning Guidance, Flood risk and coastal change [2], DEFRA's National Standards for Sustainable Drainage [3], and Local Guidance and Policy Documents.

## 1.3 Scope of Assessment

Under Section 14 of the NPPF, a Flood Risk Assessment (FRA) is required for development proposals which meet any of the following conditions:

- i. Development in Flood Zones 2 and 3.

- ii. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more;
- iii. Land which has been identified by the Environment Agency as having critical drainage problems;
- iv. Land identified in a strategic flood risk assessment as being at increased flood risk in future; or,
- v. Land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

The NPPF states that a FRA needs consider the risk of flooding to a property or site and demonstrate that the site will be safe over its lifetime (including identification of appropriate mitigation measures). The FRA also needs to demonstrate that the proposals will not increase flood risk to others. The sources of flooding that need to be assessed are, from the following sources:

- i. **Fluvial (River) flooding.** When flows within watercourses exceed the capacity of the watercourse causing out of bank flows, resulting in flooding of adjacent areas.
- ii. **Groundwater flooding.** Usually, the result of prolonged wet weather causing groundwater levels to rise sufficiently to either emerge at surface or to cause flooding of below ground infrastructure, such as basements.
- iii. **Pluvial (Surface Water) flooding.** When rainfall causes overland flow rates and volumes which exceed the capacity of the drainage network, causing flooding to land that is normally dry.
- iv. **Tidal flooding.** When high tide events overtop the shoreline to cause flooding to land behind, this is usually the result of a combination of high tide events and storm surges.

As well as considering the risk of flooding from these primary sources, a FRA needs to consider the potential impact of a failure of flood defence, or reservoir infrastructure, however, as the likelihood of these types of flooding are much lower they are known as “residual risks”. The residual flood risks to be considered are:

- i. **Reservoir failure.** Although the likelihood of reservoir failure resulting in widespread flooding is extremely low<sup>1</sup> [5], the consequences of such an event need to be considered to inform appropriate emergency planning.
- ii. **Flood defence failure.** The consequence of a failure of part of a flood defence could result in the rapid release of water in an area that would otherwise not be at risk of flooding. If such an event was to occur, they could be very little warning time, and therefore it is unlikely that prior evacuation from an area at risk could be achieved.

<sup>1</sup> Environment Minister Richard Benyon said: “While the risk of a reservoir failure is extremely low the safety of the public must remain our top priority and where there is even a small risk we need to make sure that we are prepared.”

## 2 Site Setting

### 2.1 Site Location

The Application Site is located in Gravesend, Kent, approximately 1.70 km west of Gravesend Town Centre, with further details summarised below:

- Address: Site E Dering Industrial Park, Dering Way, Gravesend, Kent DA12 2FP
- Ordnance Survey grid reference: 566560 Eastings, 173950 Northing.
- Area: 0.35 Hectares

The Application Boundary and existing building footprint on site are shown in Figure 2.

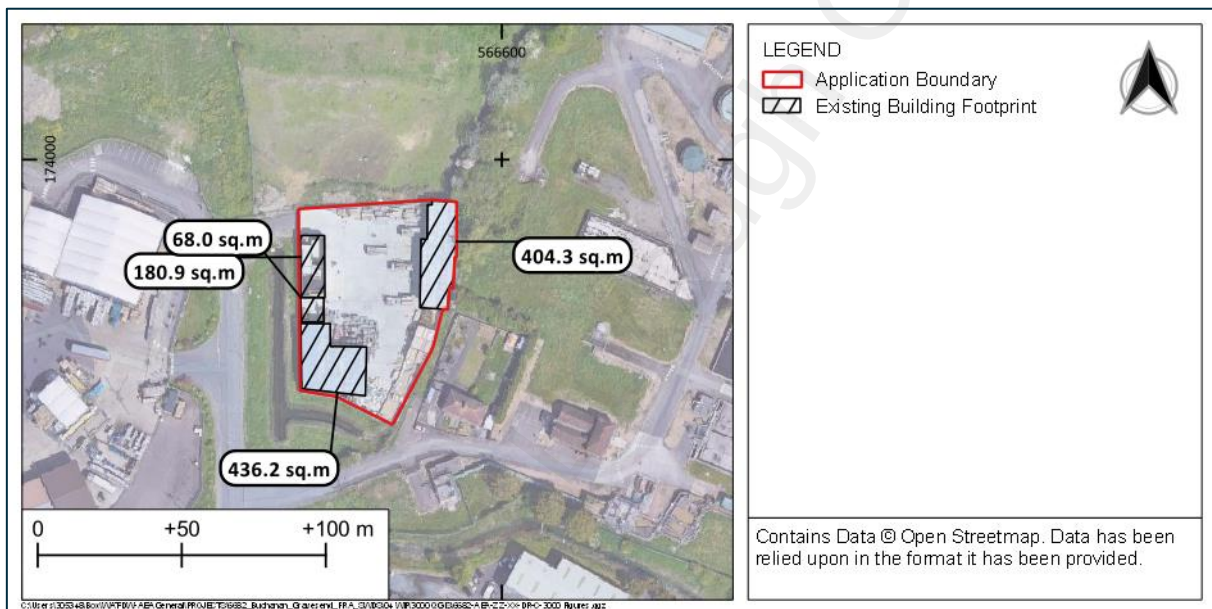


Figure 2: Site Location Plan

### 2.2 Site Details

A site inspection survey was carried out by Royal HaskoningDHV on the 18<sup>th</sup> March 2022, to inform the Land Quality Desk Top Study and Preliminary Risk Assessment. As such, information provided in the Land Quality Desk Top Study and Preliminary Risk Assessment (provided by RoyalHaskoning DHV Ltd) has been summarised below, where relevant.

#### 2.2.1 Current Site

The Application Site is presently used for the storage of scaffolding equipment and temporary office space. The Application Site is accessed via a courtyard through a metal gate off Dering Way and is bound by metal fencing (2.00 to 2.50 m in height).

#### 2.2.2 Ground Cover and Vegetation

The Application Site is covered in reinforced concrete, generally in good condition. Anecdotal evidence from the current site operator indicated the site was cleared of all vegetation and an unspecified liner was installed at the base of rubble fill at a depth of 0.50 to 0.75 metres below ground level (m bgl) prior to the installation of 0.20 m thick reinforced concrete.

### 2.2.3 On-Site Structures and Fuel Tanks

Staff welfare facilities are located on the western boundary (referenced as Structure A on Figure 1). A storage shed is present in the south-western corner (referenced as Structure C on Figure 1). A covered storage area is present in the north-eastern corner (referenced as Structure D Figure 1).

Gas oil drums (not banded) (photographic plate No. 10), a fuel additive tank (banded) (photographic plate No. 03), COSHH storage boxes (containing paint tins) (photographic plate No. 13) and a 1000 litre above ground gas oil tank (banded) (photographic plate No. 09) were observed along the western boundary during the site walkover. The photographs referred to here are included in the Preliminary Risk Assessment provided by Royal HaskoningDHV for the Application Site.

### 2.2.4 Electricity Substations

A high voltage electricity cabinet was identified in the north-western corner (photographic plate No. 04). The photograph referred to can be found in the Preliminary Risk Assessment provided by Royal HaskoningDHV for the Application Site.

## 2.3 Topography

The Site Walkover Survey completed for the Preliminary Risk Assessment indicated that the Application Site is generally flat and gently slopes to the north and south from the centre of the site.

Further review of the Environment Agency's 2m resolution DTM LiDAR data indicates that the ground levels are on average 2.35 m AOD, with a highest topographic level of 3.34 m AOD (see Figure 3).

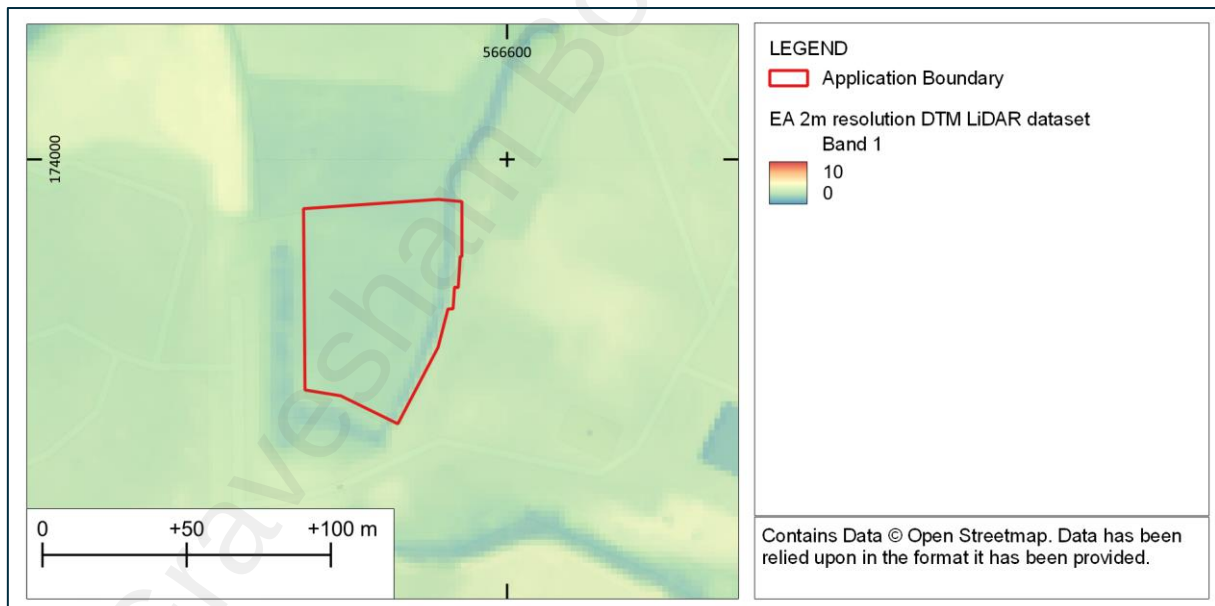


Figure 3: Site Topography

## 2.4 Site Hydrology

### 2.4.1 Internal Drainage Board

According to mapping available from the Association of Drainage Authorities internal drainage boards map [22], the Application Site is located in the North Ken Marshes Internal Drainage Board, as indicated on Figure 4.



Figure 4: IDB Map

## 2.4.2 Main Rivers

According to the Environment Agency Statutory Main River data, there is an unnamed main river approximately 140m north of the Application Site. The River Thames is located approximately 330m north and the Thames and Medway Canal is located approximately 110m north of the Application Site (Figure 5).

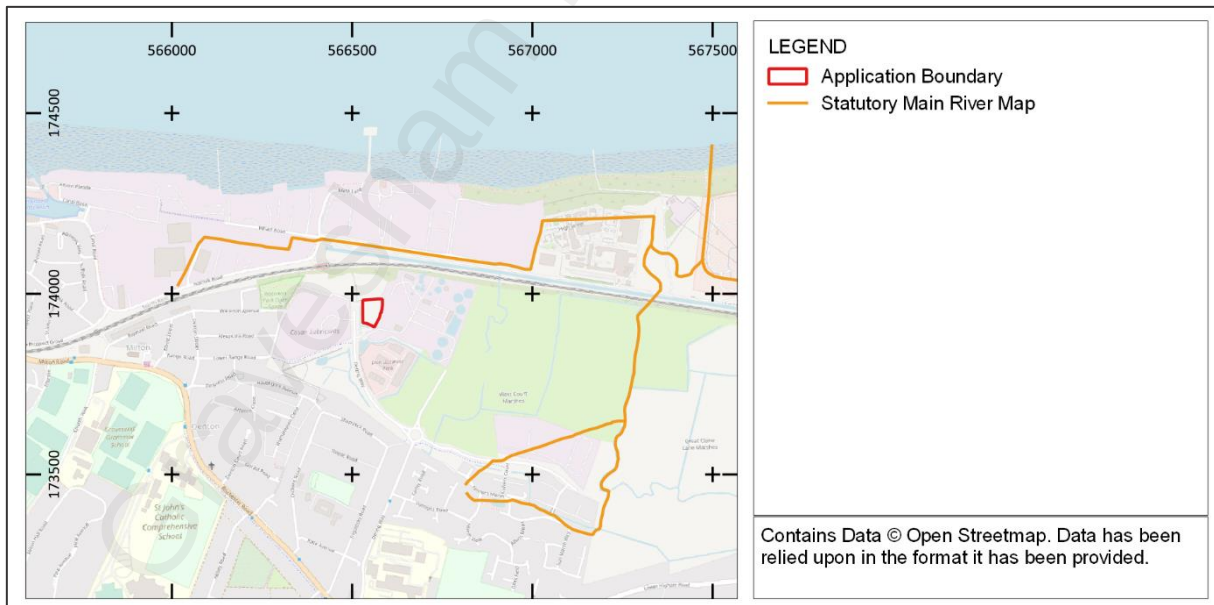


Figure 5: Main Rivers

### 2.4.3 Ordinary Watercourses

According to the CEH Rivers data, there is an Ordinary Watercourse which passes through the centre of the Application Site (Figure 6). It is considered that the watercourse passing through the Application Site may be under the jurisdiction of the North Kent Marshes IDB.

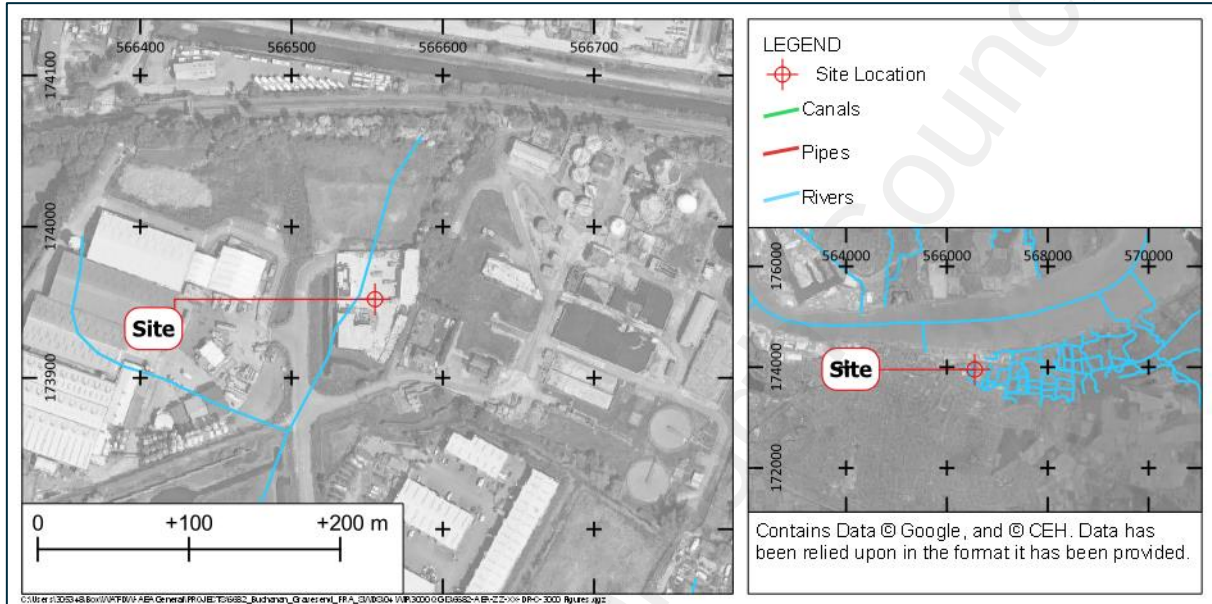


Figure 6: Ordinary Watercourses

## 2.5 Ground Conditions

RoyalHaskoning DHV Ltd have produced a Preliminary Risk Assessment for the Application Site, for the purposes of the Development Proposals discussed in this report. As such, further information on the ground conditions is detailed with the Land Quality Desk Top Study and Preliminary Risk Assessment.

### 2.5.1 BGS Hydrogeological Setting

According to the BGS Hydrogeological Setting data, the Application Site is classified as:

*Aquifers with significant intergranular flow: Highly productive aquifer*

### 2.5.2 BGS Lithology

According to the BGS Lithology the ground beneath the site has the following attributes:

*Superficial Geology: Alluvium - Clay, Silt, Sand And Peat*

*Bedrock Geology: Lewes Nodular Chalk Formation, Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk*

### 2.5.3 BGS Borehole

According to the BGS historic borehole records data, there are numerous BGS Borehole logs both on and off site; however, these are identified as confidential or restricted. TQ67SE39 is located approximately 150m east of the Application Site. More information is provided in the Land Quality Desk Top Study and Preliminary Risk Assessment completed for the Application Site.

### 3 Relevant Policy and Guidance

This Flood Risk Assessment has been developed in accordance with the guidance, and legislation set out in the below documents:

#### 3.1 National Policy

- Water Industry Act (1999) [5]
- EU Water Framework Directive (2000) [6]
- EU Floods Directive (2007) [7]
- The Flood Risk Regulations (2009) [8]
- Flood and Water Management Act (2010) [9]
- The Building Regulations, Part H (2015) [10]
- Town and Country Planning, Development Management Procedure, (England) Order (2015) [11]
- British Standards, Drain and sewer systems outside buildings (BS EN 752:2017) [12]
- National Planning Policy Framework (NPPF, 2021) [1]

#### 3.2 National Guidance

- Non-statutory Sustainable Drainage Technical Standards (2015) [13]
- Flood Risk and Coastal Change Planning Practice Guidance (PPG, 2014) [14]
- CiRIA SuDS Manual (C753, 2015) [15]
- Sector Guidance in relation to the adoption of sewerage assets by sewerage companies in England (October 2019) [16]
- Preparing a Flood Risk Assessment: Standing Advice, Environment Agency, and DEFRA (2022) [17]
- Flood Risk Assessments: Climate Change Allowances, Environment Agency (2020) [18]

#### 3.3 Local Policy and Guidance

- Kent Local Flood Risk Management Strategy 2017-2023 [19]
- Kent County Council Land Drainage Policy 2019 [20]
- Preliminary Flood Risk Assessment 2011 [21]
- Water. People. Places. A guide for master planning sustainable drainage into developments. [22]

## 4 Climate Change Allowances

The Environment Agency published guidance on climate change allowances for Flood Risk Assessments in February 2016, with the latest update in October 2021 [18].

The current Environment Agency climate change allowances are classified on how likely that scenario is predicted to occur, based on percentile of the scenario.

*An allowance based on the 70th percentile is exceeded by 30% of the projections in the range. At the 95th percentile it is exceeded by 5% of the projections in the range.*

*For these allowances it is important you do not use a single percentile out of context. For example, while the 70th percentile is the higher central estimate, it does not represent the full range of likely futures. Using this percentile on its own may cause you to under-adapt to climate change.*

### 4.1 Tidal Climate Change Allowances

Tidal Climate Change Allowances are determined by the predicted increase in sea levels. These are determined by regional variations, which are based on the River Basin District under consideration.

**The Application Site is located in the Thames area of England. National guidance for climate change allowances indicates that, for area in the Thames area, the South east climate change allowances should be used. As such, the 2125 Higher Central Climate Change allowance for sea level rise total until 2125 is 1.2m and the Upper End allowance is 1.6m compared to the 1981 to 2000 baseline. The sea level rise allowances are reproduced as Table 3 below.**

Table 3: Sea level allowances by river basin district for each epoch in mm per year.

| Area of England | Allowance      | 2000 to 2035 (mm) | 2036 to 2065 (mm) | 2066 to 2095 (mm) | 2096 to 2125 (mm) | Cumulative rise 2000 to 2125 (metres) |
|-----------------|----------------|-------------------|-------------------|-------------------|-------------------|---------------------------------------|
| South east      | Higher central | 5.7 (200)         | 8.7 (261)         | 11.6 (348)        | 13.1 (393)        | 1.20                                  |
| South east      | Upper end      | 6.9 (242)         | 11.3 (339)        | 15.8 (474)        | 18.2 (546)        | 1.60                                  |

Based on a 1981 to 2000 baseline, the total sea level rise for each epoch is in brackets

### 4.2 Fluvial Climate Change Allowances

Fluvial Climate Change Allowances are determined by the predicted increase in peak river flows. These are determined by on regional variations, which are based on the management catchments. Management catchments are sub-catchments of river basin districts. An excerpt of the management catchment map is provided below (Figure 7), indicating which sub-catchment the Application Site is in. Table 4 presents the Peak River flow climate change allowance for this management catchment.

The guidance also sets out which climate change allowance should be used for different development Vulnerability Classifications, and these are summarised in Table 5.

It should be noted that the epochs are based on the change from the baseline of 1981 to 2000. The climate change allowances are as follows:

- 2020 epoch, is 2015 to 2039
- 2040 epoch, is 2040 to 2069
- 2080 epoch, is 2070 to 2125

**The Application Site is located in the Medway management catchment. The 2080 Central Climate Change allowance for peak river flows is 27%, compared to the 1981 to 2000 baseline.**

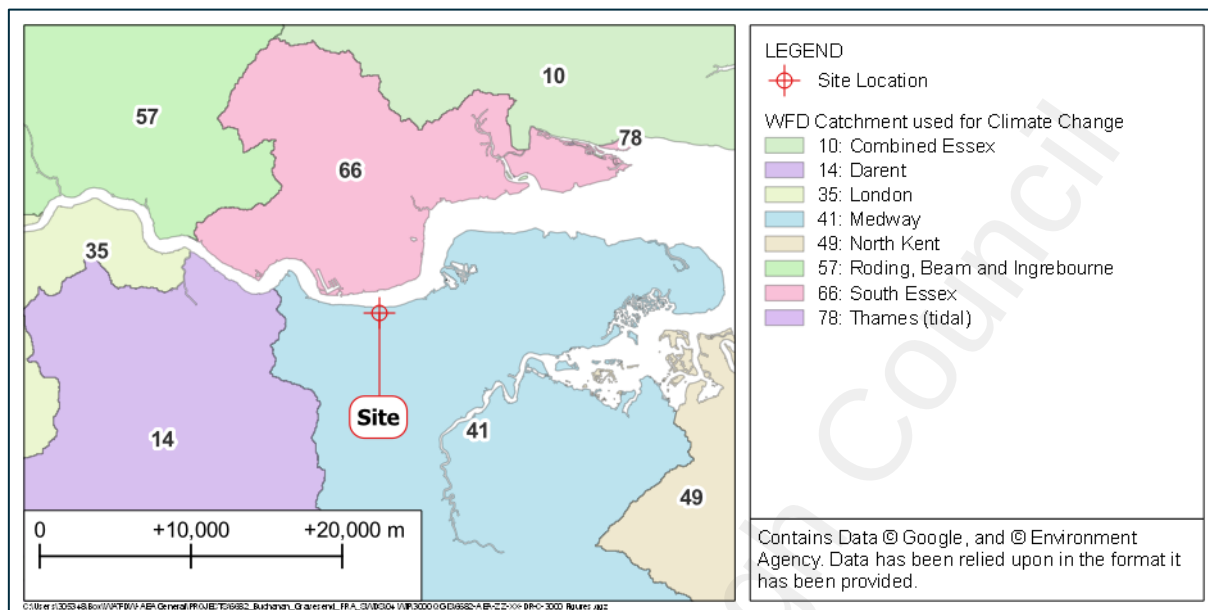


Figure 7: Management Catchments (excerpt)

Table 4: Peak river flow climate change allowances for the Medway management catchment

| Management catchment name | 2020s central | 2020s higher central | 2020s upper end | 2050s central | 2050s higher central | 2050s upper end | 2080s central | 2080s higher central | 2080s upper end |
|---------------------------|---------------|----------------------|-----------------|---------------|----------------------|-----------------|---------------|----------------------|-----------------|
| Medway                    | 14%           | 19%                  | 29%             | 15%           | 21%                  | 37%             | 27%           | 37%                  | 62%             |

Table 5: Fluvial climate change allowances to be applied based on development vulnerability.

| Vulnerability Classification | Flood Zone 1, 2, or 3a                                                   | Flood Zone 3b                                                                             |
|------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Essential Infrastructure     | Higher central allowance                                                 | Higher Central Allowance                                                                  |
| Highly Vulnerable            | Central allowance (development should not be permitted in Flood Zone 3a) | Development should not be permitted, but where exceptions are appropriate, Higher Central |
| More Vulnerable              | Central allowance                                                        |                                                                                           |
| Less Vulnerable              | Central allowance                                                        |                                                                                           |
| Water Compatible             | Central allowance                                                        | Central allowance                                                                         |

### 4.3 Pluvial Climate Change Allowances

Pluvial Climate Change Allowances are determined by the predicted increase in peak rainfall intensity. These are reproduced as

Table 6 below.

|                                                                                                                |
|----------------------------------------------------------------------------------------------------------------|
| <b>The Climate Change allowance for peak rainfall intensity is 40%, compared to the 1961 to 1990 baseline.</b> |
|----------------------------------------------------------------------------------------------------------------|

Gravesham Borough Council

Table 6: Peak rainfall intensity allowance in small catchments

| Applies across all of England | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|-------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|
| Upper end                     | 10%                                                               | 20%                                                               | 40%                                                               |
| Central                       | 5%                                                                | 10%                                                               | 20%                                                               |

Small catchments are less than 5km<sup>2</sup>, or urban drainage catchments (based on a 1961 to 1990 baseline)

The Guidance [18] states:

*Design your drainage system to make sure there is no increase in the rate of runoff discharged from the site for the upper end allowance.*

*Where on-site flooding for the upper end allowance presents a significant flood hazard (for example, where depths and velocities of surface water runoff cause a significant danger to people), you will need to take measures to protect people and property. This could include, for example, raising floor levels. As a minimum, there should be no significant flood hazard to people from on-site flooding for the central allowance.*

## 5 Sequential & Exception Testing

### 5.1 Sequential Test Definition

The NPPF Flood Risk Sequential Test is used to establish whether there are any other sites at a lower flood risk that would be available for the proposed development.

Wherever possible, development must be directed to a site in the lowest flood risk zone. If the development is planned in a higher risk zone, flood management and mitigation measures may be required to reduce risks to an acceptable level, for the specific use in question.

The Sequential Test requires a demonstration that the residual risk, with respect to flood management and mitigation measures, is acceptable. The potential for climate change over the life of the development must also be considered.

With specific reference to the Planning Practice Guide, Flood Risk and coastal change <sup>2</sup> (March 2014), Paragraph: 033 Reference ID: 7-033-20140306, which provides guidance for ‘applying the Sequential Test to individual planning applications.’ The guidance states:

*The Sequential Test does not need to be applied for individual developments on sites which have been allocated in development plans through the Sequential Test, or for applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).*

*Nor should it normally be necessary to apply the Sequential Test to development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea), unless the Strategic Flood Risk Assessment for the area, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of climate change).*

*For individual planning applications where there has been no sequential testing of the allocations in the development plan, or where the use of the site being proposed is not in accordance with the development plan, the area to apply the Sequential Test across will be defined by local circumstances relating to the catchment area for the type of development proposed. For some developments this may be clear, for example, the catchment area for a school. In other cases it may be identified from other Local Plan policies, such as the need for affordable housing within a town centre, or a specific area identified for regeneration. For example, where there are large areas in Flood Zones 2 and 3 (medium to high probability of flooding) and development is needed in those areas to sustain the existing community, sites outside them are unlikely to provide reasonable alternatives.*

*When applying the Sequential Test, a pragmatic approach on the availability of alternatives should be taken. For example, in considering planning applications for extensions to existing business premises it might be impractical to suggest that there are more suitable alternative locations for that development elsewhere. For nationally or regionally important infrastructure the area of search to which the Sequential Test could be applied will be wider than the local planning authority boundary.*

*Any development proposal should take into account the likelihood of flooding from other sources, as well as from rivers and the sea. The sequential approach to locating development in areas at lower flood risk should be applied to all sources of flooding, including development in an area which has critical drainage problems, as notified to the local planning authority by the Environment Agency, and where the proposed location of the development would increase flood risk elsewhere.*

*See also advice on who is responsible for deciding whether an application passes the Sequential Test and further advice on the Sequential Test process available from the Environment Agency (flood risk standing advice).*

<sup>2</sup> <https://www.gov.uk/guidance/flood-risk-and-coastal-change#Sequential-Test-to-Local-Plan>

## 5.2 Exception Test Definition

The NPPF sets out the two criteria for the Exception Test at paragraph 164 to 165, and it makes it clear that both elements need to be satisfied, for a development to pass the Exception Test. The criteria are as follows:

- “a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*
- b) 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.”*

## 6 Development Compatibility with Flood Zone

### 6.1 Development Vulnerability Classification

The vulnerability classifications are summarised in Table 7 (below), which identifies that the Development Proposals are '**Less Vulnerable**', as highlighted below.

Table 7: Annex 3 of the NPPF, Flood risk vulnerability classification

| Classification               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Essential infrastructure     | Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Highly vulnerable            | Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure')                                                      |
| More vulnerable              | Hospitals. Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non-residential uses for health services, nurseries and educational establishments. Landfill* and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.                                                                                                                                                                                                                                                                                      |
| Less vulnerable              | Police, ambulance and fire stations which are not required to be operational during flooding. <b>Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution;</b> non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill* and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.                           |
| Water-compatible development | Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. Ministry of Defence defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan. |

### 6.2 Flood Zone Classification

The EA Flood Map for Planning (Figure 8) demonstrates that the Application Site is located within an area defined as Flood Zone 3a. It also indicates that the Application Site is in an area which benefits from flood defences.

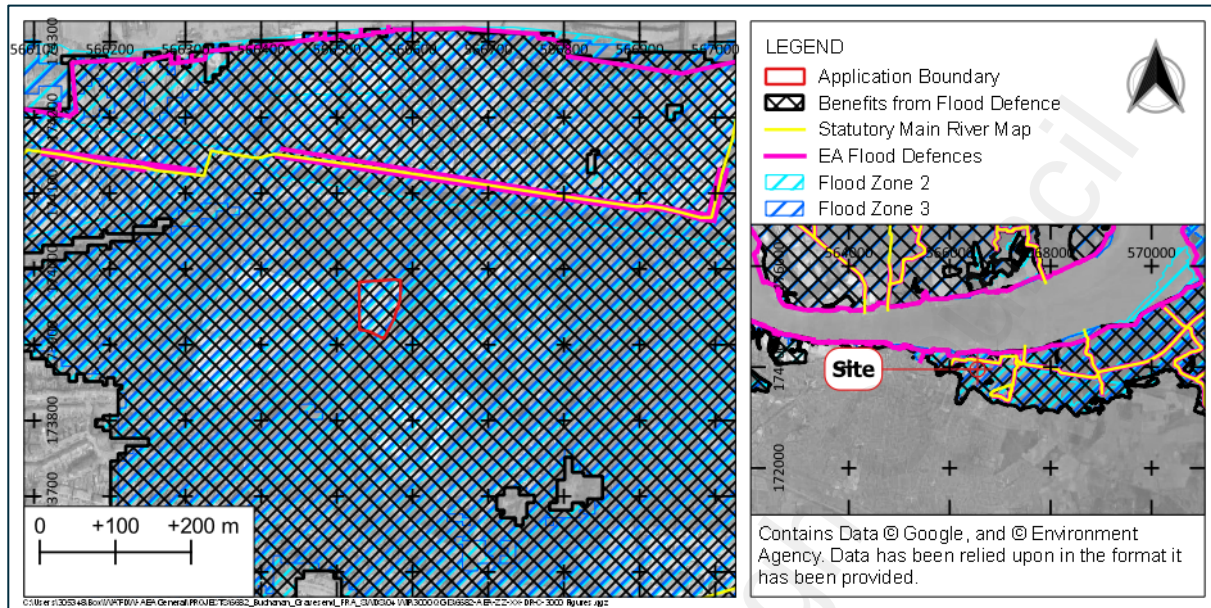


Figure 8: EA Flood Map for Planning

Table 2 of the Flood Risk and Coastal Change Guidance [2], reproduced in Table 8, presents the flood zone definitions.

Table 8: Flood Risk and Coastal Change, Table 1

| Flood Zone | Description                                                                                                                                                                                                                                                                                                                                                                                             |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | Low Probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).                                                                                                                                                                                                                                                     |
| 2          | Medium Probability. This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% to 0.1%) in any year.                                                                                                                                                   |
| 3a         | High Probability. This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.                                                                                                                                                                                |
| 3b         | The Functional Floodplain. This zone comprises land where water has to flow or be stored in times of flood. SFRA's should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the EA, including water conveyance routes). |

The Flood Risk and Coastal Change Guidance (Paragraph 015, Reference 7-015-20140306) describes exceptions to the functional floodplain (Flood Zone 3b) as follows;

*“areas which would naturally flood, but which are prevented from doing so by existing defences and infrastructure or solid buildings, will not normally be identified as functional floodplain.”*

As such, given that the Application Site is in Flood Zone 3 and benefits from flood defences, it is not considered as being part of the functional floodplain (Flood Zone 3b).

## 6.3 Flood Zone & Vulnerability Compatibility

The NPPF Sequential Test: Flood Risk Vulnerability and Flood Zone ‘Compatibility’ Table 3 is summarised below as Table 9.

Table 9: The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF.

|                                       | Essential Infrastructure | Highly Vulnerable       | More Vulnerable         | Less Vulnerable | Water Compatible |
|---------------------------------------|--------------------------|-------------------------|-------------------------|-----------------|------------------|
| Flood Zone 1                          | Appropriate              | Appropriate             | Appropriate             | Appropriate     | Appropriate      |
| Flood Zone 2                          | Appropriate              | Exception Test Required | Appropriate             | Appropriate     | Appropriate      |
| Flood Zone 3a                         | Exception Test Required  | Not Appropriate         | Exception Test Required | Appropriate     | Appropriate      |
| Flood Zone 3b (Functional Floodplain) | Exception Test Required  | Not Appropriate         | Not Appropriate         | Not Appropriate | Appropriate      |

**Given the Application Site is located within Flood Zone 3a and the Development Proposals are for a Less Vulnerable development, under the NPPF the Development Proposals are considered appropriate and should not require Exception Testing or application of a Sequential Test.**

## 7 Stakeholder Engagement

Copies of the correspondence with stakeholders is provided in Appendix B.

### 7.1 Environment Agency

“The Environment Agency has a strategic overview of all sources of flooding and coastal erosion (as defined in the Flood and Water Management Act 2010 [9]). It is also responsible for flood and coastal erosion risk management activities on main rivers and the coast, regulating reservoir safety, and working in partnership with the Met Office to provide flood forecasts and warnings. It must also look for opportunities to maintain and improve the environment for people and wildlife while carrying out all of its duties.” [23]

An enquiry email was sent to the Environment Agency on 28<sup>th</sup> February 2022. In the Environment Agency’s response email on 13<sup>th</sup> April 2022, they indicated that the appropriate flood model for this area is the Thames Tidal Downriver Breach Inundation Modelling (2018).

## 8 Flood Risk: Historic Records

### 8.1 Assessment Methodology

To assess if the Application Site has previously been affected by flooding, the following data sources have been inspected:

- Environment Agency Historic Flood Maps
- Environment Agency Recorded Flood Outlines
- Strategic Flood Risk Assessment.

If these sources of data do not return any records of flooding, it is concluded that the Application Site has not been recorded as having flooded.

### 8.2 Environment Agency Recorded Flooding

The Environment Agency publishes records of historic flooding<sup>3</sup>, and this data has been reviewed. The Historic mapping (Figure 9) indicates that the Application Site has not been affected by historical flooding.

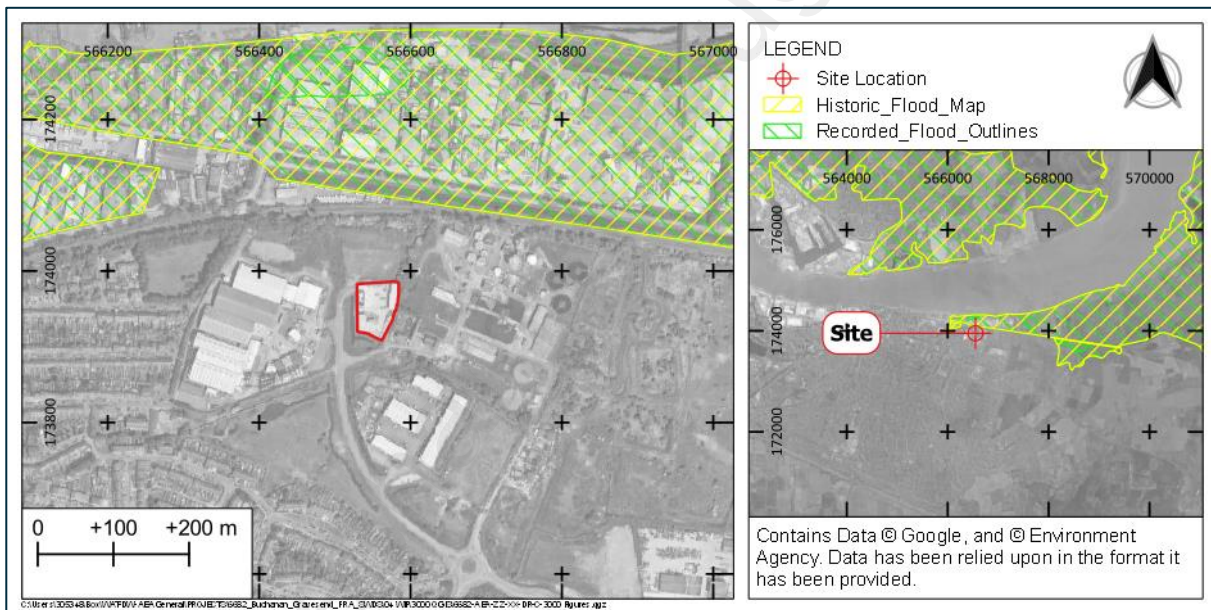


Figure 9: EA Historic Flood Map and Recorded Flood Outlines

### 8.3 Lead Local Flood Authority Recorded Flooding

The Thameside Surface Water Management Plan (SWMP, 2013) provides information on historic flooding within Gravesend Borough. An extract of the historic flooding map from the SWMP is shown in Figure 10 below, with an approximate location of the site. It indicates that the Application Site is located in an area with limited historic records of flooding. There is evidence of a tidal flood event to the north of the train line, and evidence of sewer flooding to the south.

<sup>3</sup> [Historic Flood Map - data.gov.uk](https://data.gov.uk)

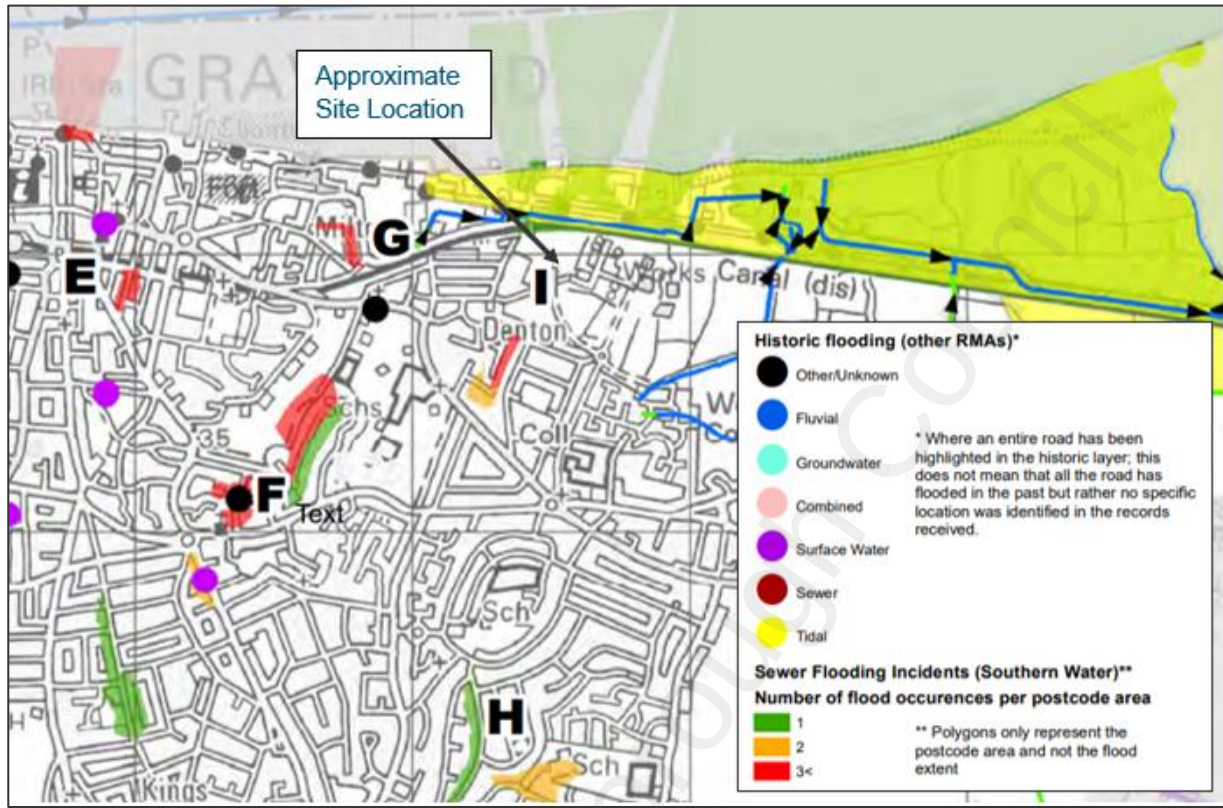


Figure 10: Thameside SWMP Historic Flooding

## 9 Flood Risk: Tidal Flooding

### 9.1 Tidal Flooding Definition

Tidal flooding results from a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may happen which can cause serious flooding.

### 9.2 Assessment Methodology

In order to determine the flood risk from tidal sources, the Environment Agency's Flood Map for Planning has been used, as an initial assessment of flooding. If this assessment demonstrates that the Application Site is at risk of tidal flooding, a further assessment is provided, whereby the ground levels at the site are compared with site-specific modelled flood data or the Environment Agency's Coastal Design Sea Levels<sup>4</sup>. It should be noted that the baseline year for the Coastal Design Sea Levels data set is 2018.

### 9.3 Baseline Tidal Flood Risk

The Application Site is identified by the Environment Agency's Flood Map for Planning as being within an area that benefits from flood defences. Given the location of the Application Site and based on the information provided by the Environment Agency, it is considered that the site benefits from the TE2100 Tidal Flood Defence Scheme, which offers protection up to the 1 in 1,000-year tidal flood event. There could, however, be a residual risk of tidal flooding at the Application Site, in the unlikely event of a breach in the flood defences. This is discussed in Section 18 of this Flood Risk Assessment.

### 9.4 Post Development Tidal Flood Risk

The Application Site is defended up to the 1 in 1,000-year tidal flood event. Furthermore, the built footprint on site and the impermeable surface areas will remain the same as existing post-development, due to the nature of the Development Proposals. Therefore, it is considered that the Development Proposals will not alter the tidal flood risk to the Application Site or the surrounding areas.

### 9.5 With Climate Change Tidal Flood Risk

The Application Site is defended up to the 1 in 1,000-year tidal flood event, due to the Thames Estuary 2100 flood defences. It is understood that these flood defences have been built to take account of the increases in sea and tidal levels, as a result of climate change. Therefore, it is considered that the Application Site should not be at risk of tidal flooding in the climate change scenario. This is also based on the assumption that the flood defences are maintained in the future.

### 9.6 Mitigation Measures

As the Application Site is defended up to the 1 in 1,000-year tidal flood event and therefore not identified as being at risk of tidal flooding, no specific mitigation measures are considered necessary.

### 9.7 Residual Risk of Tidal Flooding

As the Application Site is not identified as being at risk of tidal flooding, the residual flood risk is Very Low. However, there could be a residual risk of tidal flooding in the event of a breach in the defences. This is discussed in Section 18 of the Flood Risk Assessment.

<sup>4</sup> <https://data.gov.uk/dataset/73834283-7dc4-488a-9583-a920072d9a9d/coastal-design-sea-levels-coastal-flood-boundary-extreme-sea-levels-2018>

## 9.8 Assessed Tidal Flood Risk

Considering the impacts of climate change, and the other factors discussed above, the assessed tidal flood risk over the development lifespan is Very Low.

Gravesham Borough Council

## **10 Flood Risk: Fluvial Flooding**

### **10.1 Fluvial Flooding Definition**

River flooding occurs when a watercourse cannot cope with the water draining into it from the surrounding land. This can happen, for example, when heavy rain falls on an already waterlogged catchment.

### **10.2 Assessment Methodology**

To determine the flood risk from fluvial sources, the Environment Agency's Flood Map for Planning has been used, as an initial assessment of flooding. If this assessment demonstrates that the Application Site is at risk of fluvial flooding, a further assessment is provided, whereby the ground levels at the site are compared to the Environment Agency's modelled flood levels. Where flood levels are not provided by the Environment Agency, the extent of the floodplain is compared to the ground level from LiDAR to provide an indicative flood level for the site.

### **10.3 Baseline Fluvial Flood Risk**

The main source of flood risk to the Application Site is tidal, from the nearby River Thames. The Environment Agency have not provided modelled fluvial flood data or indicated that the Application Site is at risk of fluvial flooding.

It should be noted, however, that there is an ordinary watercourse located within the Application Site boundary, which could pose a risk of fluvial flooding. Modelled flood information was not provided by the Environment Agency for this watercourse.

### **10.4 Post Development Fluvial Flood Risk**

The Application Site is not identified as being at risk of fluvial flooding. Therefore, the Development Proposals will have no impact on fluvial flood risk to the Application Site and surrounding area.

### **10.5 With Climate Change Fluvial Flood Risk**

The Application Site is not at risk of fluvial flooding in the baseline scenarios and no modelled flood data has been provided for this source of flooding by the Environment Agency. Therefore, it is considered that the Application Site will continue to be at low risk of fluvial flooding in the future.

### **10.6 Mitigation Measures**

As the Application Site is not identified as being at risk of fluvial flooding, no specific mitigation measures are considered necessary.

### **10.7 Residual Risk of Fluvial Flooding**

As the Application Site is not identified as being at risk of fluvial flooding, the residual flood risk is Very Low.

### **10.8 Assessed Fluvial Flood Risk**

Considering the impacts of climate change, and the other factors discussed above, the assessed fluvial flood risk over the development lifespan is Very Low.

## 11 Flood Risk: Surface Water Flooding

### 11.1 Surface Water Flooding Definition

Surface water flooding occurs when heavy rainfall overwhelms the drainage capacity of the local area. It is difficult to predict and pinpoint.

### 11.2 Assessment Methodology

To determine the flood risk from Pluvial sources, the Environment Agency surface water flood map has been inspected. The greatest flood depth has been compared to the ground level (from LiDAR) to determine the predicted pluvial flood level. It should be noted that the surface water flood map is presented in large bandings of depth, in all cases the upper value of the band has been used to determine the flood depth. It should be acknowledged that this may result in an over-estimate of flood levels, as it is unlikely that in all cases the peak of the band is reached.

### 11.3 Baseline Surface Water Flood Risk

Comparison of the Environment Agency's surface water flood maps with the average ground level is presented in Table 10. Most of the Application Site is shown to be affected by surface water flooding in the assessed scenarios. The following return period events have been assessed:

- 1 in 30-year (High Risk): Figure 11;
- 1 in 100-year (Medium Risk): Figure 12;
- 1 in 1,000-year (Low Risk): Figure 13.

It should also be noted that the maximum surface water flood depths experienced on site in the 1 in 30-year and 1 in 100-year events are at the eastern part of the site, where the existing watercourse is located. The existing watercourse is topographically lower than the rest of the site, with the greatest surface water flood depths. To obtain a representative view of surface water flood risk at the site, the average ground levels have been used, with the most appropriate surface water flood depth.

Table 10: Environment Agency Surface Water Flood Depths

| Baseline Surface Water Flood Risk       | 1 in 30 RP (High Risk) | 1 in 100 (Medium Risk) | 1 in 1,000 RP (Low Risk) |
|-----------------------------------------|------------------------|------------------------|--------------------------|
| Predicted Flood Depth Band, upper value | 0.9 m                  | 1.2 m                  | >1.2 m                   |
| Average Ground Level                    | 2.35 mAOD              |                        |                          |
| Predicted Flood Level (no mitigation)   | 3.25 mAOD              | 3.55 mAOD              | >3.55 mAOD               |
| At risk of surface water flooding?      | Yes                    | Yes                    | Yes                      |

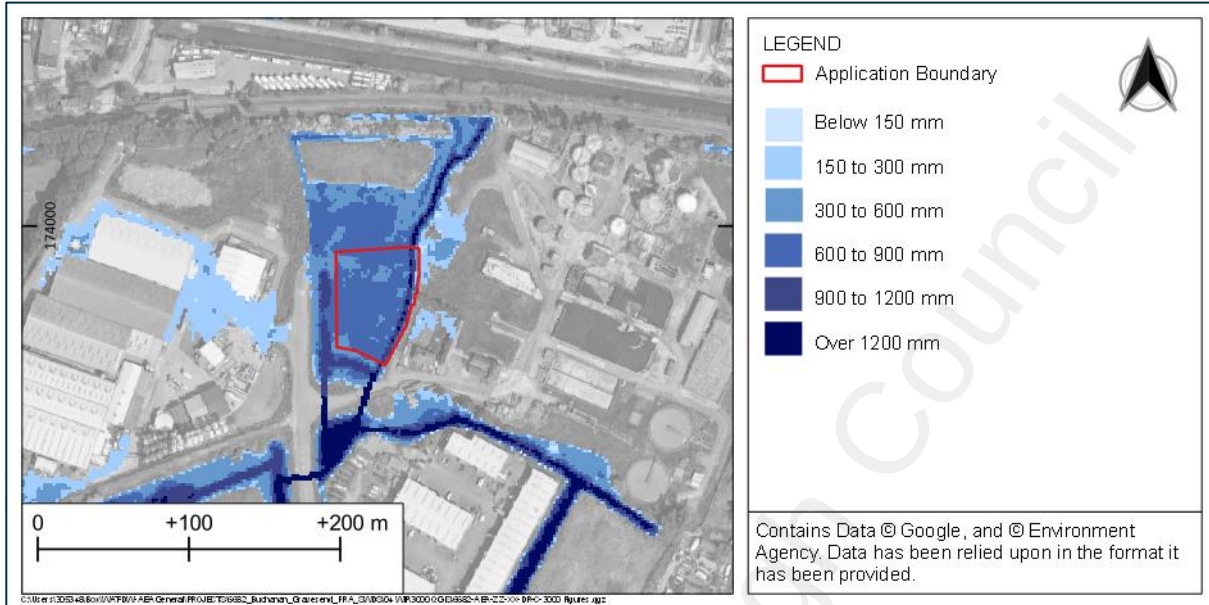


Figure 11: EA Modelled 1 in 30-year Surface Water Flood Depths

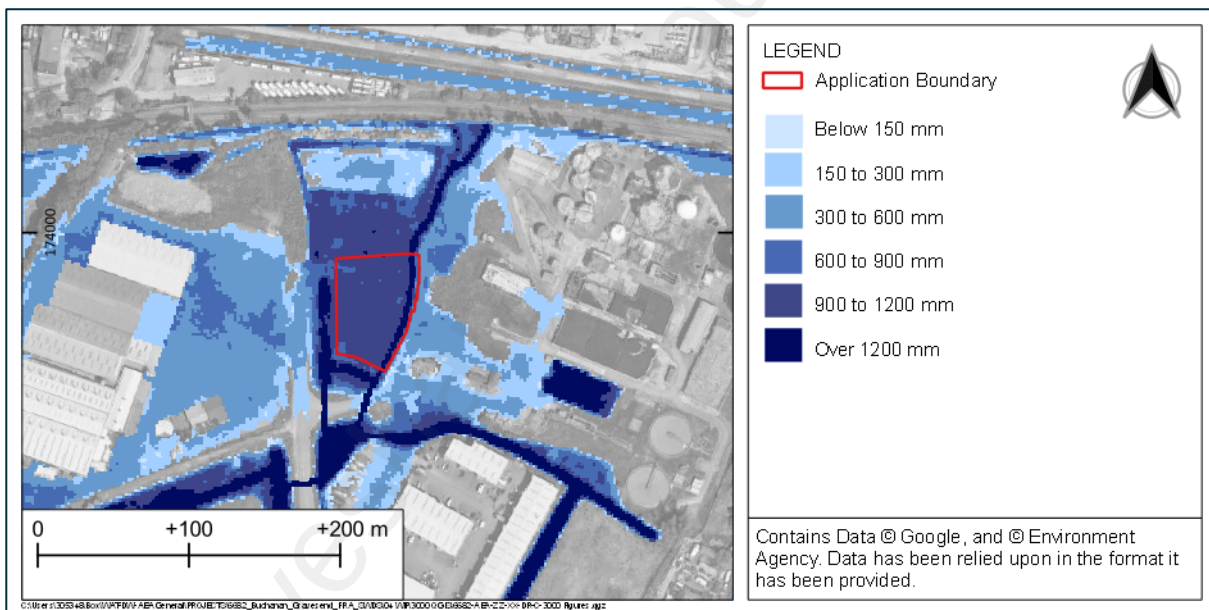


Figure 12: EA Modelled 1 in 100-year Surface Water Flood Depths

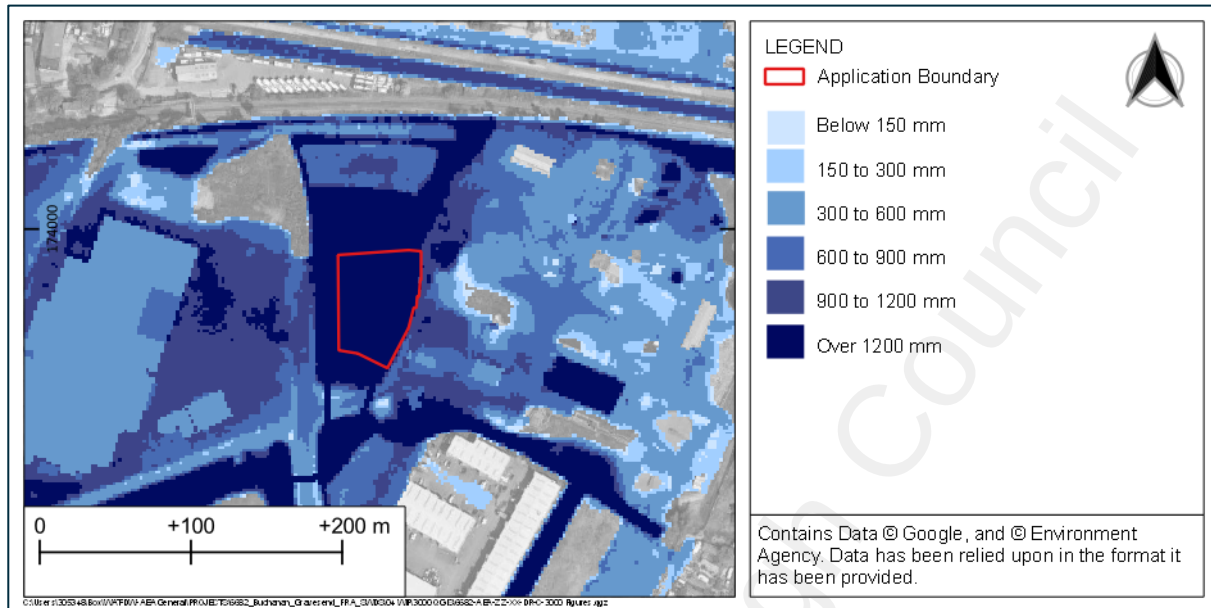


Figure 13: EA Modelled 1 in 1,000-year Surface Water Flood Depths

This analysis demonstrates that the Application Site is at high risk of surface water flooding.

#### 11.4 Post Development Surface Water Flood Risk

The Development Proposals are for the permanent retention of the existing buildings on site, so there will be no change in built footprint post-development. Furthermore, the Application Site is wholly impermeable, due to the existing buildings and car parking areas. Therefore, the impermeable surface areas will remain as existing post-development. It is considered that the Development Proposals will not impact the surface water flood risk to the site.

#### 11.5 With Climate Change Surface Water Flood Risk

It is expected that rainfall storm events will increase in frequency and intensity as a direct result of climate change. Therefore, the surface water flood risk at the Application Site will likely increase in the future.

#### 11.6 Mitigation Measures

As the Application Site is identified as being at risk of surface water flooding, specific mitigation measures are considered necessary. Given that the Development Proposals are for the permanent retention of existing buildings on site, the mitigation measures recommended centre on the provision of an appropriate flood warning and alert systems. It is recommended that site management keep informed on weather forecasts for the area. If a weather warning is implemented, it would be advised that site management consider closing the facility and only re-open when it is considered safe to do so.

#### 11.7 Residual Risk of Pluvial Flooding

Taking into consideration the mitigation measures, the residual flood risk is Very Low.

#### 11.8 Assessed Pluvial Flood Risk

Considering the impacts of climate change and the other factors discussed above, the assessed pluvial flood risk over the development lifespan is Very Low.

## 12 Flood Risk: Groundwater Flooding

### 12.1 Groundwater Flooding Definition

Groundwater flooding is the emergence of groundwater at the ground surface or into subsurface voids or structures, arising as a result of:

- abnormally high groundwater heads or flows;
- the introduction of an obstruction to groundwater flow; or
- the rebound of previously depressed groundwater levels.

Groundwater flooding most commonly occurs in unconfined aquifers; either major aquifers from which considerable amounts of water can be discharged or in shallow permeable sediments. Flooding locations are typically near areas of natural groundwater discharge such as river valleys and spring lines.

### 12.2 Assessment Methodology

Groundwater at the Application Site has been assessed in the Land Quality Desk Top Study and Preliminary Risk Assessment, using information provided in an Envirocheck Report and the DEFRA MAGIC map application. This information has been used to inform this assessment.

### 12.3 Baseline Groundwater Flood Risk

As stated in the Land Quality Desk Top Study and Preliminary Risk Assessment (page 12), *'the Envirocheck Report indicates that the site is located within an area of high groundwater vulnerability'*.

It also indicates that the Application Site is located in an area designated as potential for groundwater flooding of property below ground level. This is considered as the highest category for susceptibility to groundwater flooding.

### 12.4 Post Development Groundwater Flood Risk

Based on the nature of the Development Proposals, it is anticipated that the minimal groundworks will need to be undertaken. It is understood from correspondence with the client that an attenuation tank will be installed beneath the ground, to manage surface water runoff on site. If groundwater is encountered during these construction works, it is recommended that works are halted and professional advice from a Hydrogeologist, or Geo-technical Engineer is sought. Works should only continue when it is considered safe to do so.

### 12.5 With Climate Change Groundwater Flood Risk

According to the UK Groundwater Forum<sup>5</sup>, the effects of the predicted impacts of climate change may include:

- a long term decline in groundwater storage
- increased frequency and severity of groundwater droughts
- increased frequency and severity of groundwater-related floods

<sup>5</sup> Groundwater Resources and Climate Change, [http://www.groundwateruk.org/Groundwater\\_resources\\_climate\\_change.aspx#:~:text=The%20effects%20of%20climate%20change,the%20UK%20therefore%20may%20include%3A&text=increased%20frequency%20and%20severity%20of,to%20seasonally%20high%20water%20tables](http://www.groundwateruk.org/Groundwater_resources_climate_change.aspx#:~:text=The%20effects%20of%20climate%20change,the%20UK%20therefore%20may%20include%3A&text=increased%20frequency%20and%20severity%20of,to%20seasonally%20high%20water%20tables)

- mobilisation of pollutants due to seasonally high water tables
- saline intrusion in coastal aquifers, due to sea level rise and resource reduction

These impacts cannot be locally managed and would need a catchment wide resource management plan to mitigate the risks.

## **12.6 Mitigation Measures**

Perched groundwater may be present below areas of the Application Site and could be encountered during the below ground civil engineering works. The perched groundwater, if encountered, would need to be mitigated for by appropriate construction techniques and in accordance with an appropriate method statement to ensure Health and Safety and Environmental permitting requirements are satisfied.

## **12.7 Residual Risk of Groundwater Flooding**

Taking into consideration the mitigation measures, the residual flood risk is Very Low.

## **12.8 Assessed Groundwater Flood Risk**

Considering the impacts of climate change, and the other factors discussed above, the assessed groundwater flood risk over the development lifespan is Very Low.

## **13 Flood Risk: Sewer Flooding**

### **13.1 Sewer Flooding Definition**

Sewer flooding occurs when sewers are overwhelmed by heavy rainfall or when they become blocked, or fail. The likelihood of flooding depends on the capacity of the local sewerage system. Land and property can be flooded with water contaminated with raw sewage as a result. Rivers can also become polluted by sewer overflows.

### **13.2 Assessment Methodology**

Records of sewer flooding from the Lead Local Flood Authority and Public Sewer Authority should be used to assess the likelihood of sewer flooding.

### **13.3 Baseline Sewer Flood Risk**

Due to the absence of sewer flooding records for this area, it is not possible to discern the likelihood of sewer flooding at the Application Site.

### **13.4 Post Development Sewer Flood Risk**

The Development Proposals should not have an impact on the sewer flood risk at the Application Site.

### **13.5 With Climate Change Sewer Flood Risk**

Risk of flooding from sewers is likely to increase as a direct result of climate change, due to the increased frequency and intensity of storms and thus the increased potential for sewers to reach their full capacity.

### **13.6 Mitigation Measures**

Due to the nature of the Development Proposals, mitigation measures are limited, as the buildings are already constructed on site.

If not already installed, non-return valves or similar protection measures should be installed to prevent the public sewers from surcharging into the lateral drains serving buildings.

### **13.7 Residual Risk of Sewer Flooding**

Taking into consideration the mitigation measures, the residual flood risk is Very Low.

### **13.8 Assessed Sewer Flood Risk**

Considering the impacts of climate change, and the other factors discussed above, the assessed sewer flood risk over the development lifespan is Very Low.

## 14 Residual Flood Risk

Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;
- failure of a reservoir, or;
- a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.

### 14.1 Flood Defence Breach

#### 14.1.1 Flood Defence Breach Definition

The consequence of a failure of part of a flood defence could result in the rapid release of water in an area that would otherwise not be at risk of flooding. If such an event was to occur, they could be very little warning time, and therefore it is unlikely that prior evacuation from an area at risk could be achieved.

#### 14.1.2 Assessment Methodology

In some areas, the Environment Agency or other Risk Management Agency have undertaken specific flood defence breach modelling. In such instances, this data is used to assess the residual risk of flooding.

#### 14.1.3 Flood Defence Breach Analysis

The Application Site is in an area that benefits from flood defences according to the EA Flood Map for Planning. Consequently, the Application Site may be at residual risk of a flood defence breach.

The Environment Agency's Thames Tidal Downriver Breach Inundation Modelling data (2018) has been used to assess whether the Application Site is at residual risk of flooding from a breach in the tidal flood defences. The analysis is shown in Table 11 below.

Table 11: EA's Thames Tidal Downriver Breach Inundation Modelling data

| Breach Flood Risk                                     | 1 in 200 (2115) | 1 in 1,000 RP (Low Risk) |
|-------------------------------------------------------|-----------------|--------------------------|
| Modelled Flood Level                                  | 5.04 mAOD       | 5.12 mAOD                |
| Average Ground Level                                  | 2.35 mAOD       |                          |
| Modelled Flood Depth (no mitigation)                  | 2.69 m          | 2.77 m                   |
| At residual risk of flooding in flood defence breach? | Yes             | Yes                      |

This analysis demonstrates that the Application Site would be at risk of flooding in the unlikely event of a breach in the Thames Tidal flood defences. It should be noted that the TE2100 tidal defences are maintained and checked regularly, so the likelihood of a breach or failure of these defences is considered to be very low.

## 14.2 Reservoir Failure

### 14.2.1 Reservoir Flooding Definition

The emergency response of a partial structural failure of the Toddbrook Reservoir (2019) indicates the level of significance attached to the potential consequences of a dam failure. The response to the Toddbrook Reservoir incident and evacuation of residents within the potential hazard area demonstrates that reasonable and co-ordinated steps can be taken to manage the residual risk of reservoir flooding.

In the unlikely event that a reservoir dam fails, a large volume of water would escape at once with little or no warning. According to the EA, there has been no loss of life in the UK from reservoir flooding since 1925.

All large reservoirs must be inspected and supervised by reservoir panel engineers, as detailed by the enforcement authority for the Reservoirs Act 1975 in England. The EA are responsible to ensure that reservoirs are inspected regularly and to ensure that essential safety work is carried out.

As reservoir flooding is unlikely and the modelled flood depths are based on the worst-case scenario, flooding from this source may be considered as a relatively low risk. Through the management of the risks via the reservoir act and the work of the Environment Agency, the risk of reservoir flooding can be considered to have been reduced to as low a level as practical.

### 14.2.2 Assessment Methodology

The Environment Agency Publishes mapping that indicates if an area is at risk of reservoir flooding under two conditions:

- 1 When river levels are normal
- 2 When there is also flooding from the rivers.

### 14.2.3 Reservoir Flood Risk Analysis

The EA Risk from Reservoir Map (Figure 14) demonstrates that the Application Site is outside of the predicted flood extents in the event of reservoir flooding. Therefore, the Site is not at risk of reservoir flooding and no specific mitigation measures are required.

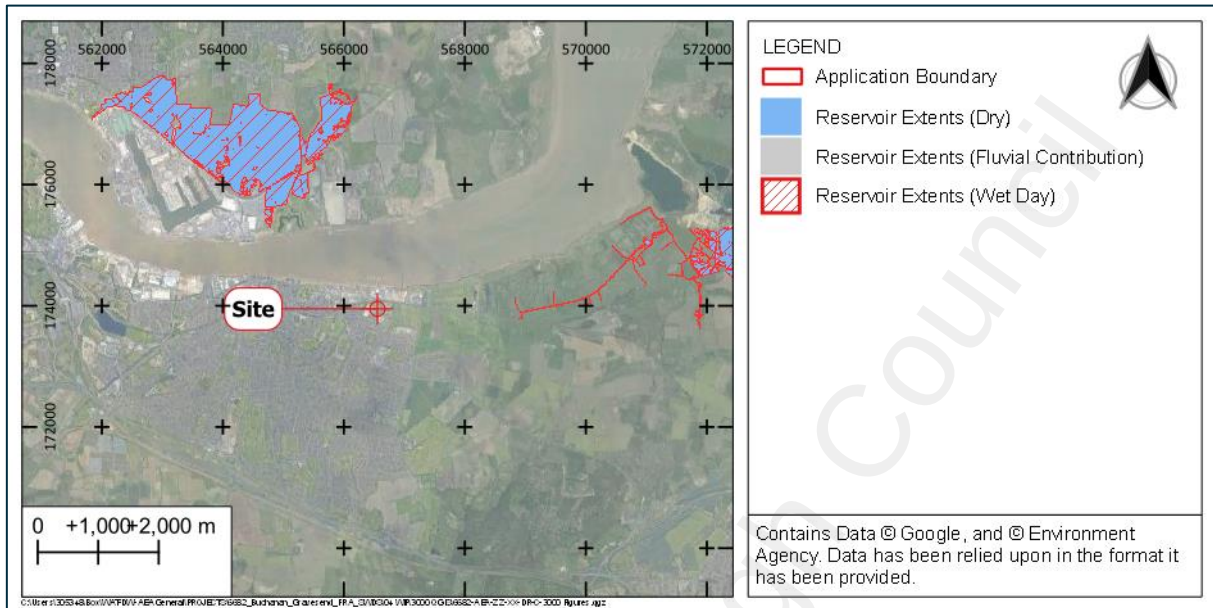


Figure 14: Environment Agency, Risk of Reservoir Flooding

### 14.3 Canal Failure

Canal Failure could result in flooding if a section of raised canal, either on an embankment or on a viaduct, was to fail.

As the Application Site is not within 1km of a raised canal, it is considered that the residual risk of canal flooding is low.

## 15 Surface Water Drainage Strategy

### 15.1 Introduction

A key component of the Flood Risk provisions of the NPPF are the requirements that proposals do not increase the risk of flooding to others. Where development proposals increase the amount of hardstanding (roofs, roads, car parks, service yards, etc.), the amount of rainfall that is converted to surface water flow is greater than that which would have been generated as a result of the rain falling on an area of open land. The cumulative impact of creating more hardstanding areas within a catchment can therefore result in more surface water within the drainage system, which can contribute to local flooding. In this case, the focus will be to provide mitigation (surface water storage) to offset the predicted increases in rainfall as a result of climate change and to reduce the risk of surface water flooding to the site and the surrounding area.

The Surface Water Drainage Strategy (SWDS) will demonstrate the following:

- How the increases in impermeable surfaces, and the associated increases in surface water run-off will be mitigated. Fundamentally, it needs to demonstrate that:
  - The total rate of surface water discharged from the site will not be greater post development than it was predevelopment; and,
  - The water quality discharged from the site, will not be polluted, by particles and other material mobilised from the ground surfaces as a result of rainfall events.

The above objectives are achieved through the provision of surface water storage (attenuation) and the provision of Sustainable Drainage Systems (SuDS). Surface water run-off generated by development sites, where impermeable surface areas are increased, have the potential to exacerbate flood risk to others by increasing the peak rate of surface water discharged from the Site.

SuDS components should be designed to accommodate and dispose of runoff from storms, without causing flooding to properties up to and including the 1:100 year, including an allowance for the current predicted impacts of climate change which increase peak rainfall intensities by 40%.

Under the requirements of the non-statutory technical standards for sustainable drainage systems (SuDS), where practicable peak surface water discharge rates should be limited to as close to the pre-development (greenfield) surface water run-off rate as possible.

The Development should utilise sustainable drainage systems (SUDS) unless there are practical reasons for not doing so and should aim to provide betterment and ensure that surface water run-off is managed as close to its source as possible. Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

As DEFRA Report 'Rainfall runoff management for Developments' recommends, the design principle is to limit the runoff for events of similar frequency of occurrence to the same peak rate of run off as that which takes place from greenfield sites. However, there are two situations where the greenfield flow rate is not actually applied to define the limiting discharge rates:

- a) The limit of discharges based on QBAR that are less than 1 l/s/ha for permeable sites as this is seen as being an unreasonable requirement (producing very large storage volumes). QBAR is then set to 1 l/s/ha;
- b) Small sites would require impractically small controls to achieve the required flow rates where these are calculated to be less than 5 l/s.

In order to limit flows to as close as possible to the respective Greenfield runoff rates, the use of orifice plates is recommended. Sub-chapter 20.5 section c) of The SuDS Manual specifies that the minimum diameter outflow control for orifice plates for permeable pavements can be 20mm – due to the runoff flowing

through a 6-20mm clean crushed stone aggregate (CCA) trapping all objects greater than 20mm in diameter. The orifice plates should also be provided with a filter mesh and the manhole access cover sealed.

The non-statutory technical guidance for SuDS identifies that an allowance for urban creep (10% increase in area), should be allowed for, to accommodate future increases in hardstanding over the developments lifetime.

## 15.2 Assessment of surface water disposal point

The management of surface water has been considered in respect to the SuDS hierarchy in Table 12, as detailed in Building Regulations Part H and within the CIRIA 753 'The SUDS Manual', Section 3.2.3.

It is understood that surface water runoff is currently directed into ACO drains on site, before being discharged into existing drainage ditches at the edges of the site. Given that the impermeable surface areas and roof areas will remain the same as existing post-development, it is recommended that surface water runoff continues to be discharged via the ACO drains and into the nearby ditches.

Table 12: CIRIA 753 Table 2, The SuDS Hierarchy (adapted) and London Plan Policy 5.13

| Hierarchy (most preferred first)                                              | Suitable? | Comment                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Store rainwater for later use                                              | No        | Given the use of the development, it is considered that rainwater storage may not be feasible on site.                                                                                                                                  |
| 2. Discharge to the Ground (Infiltration)                                     | No        | The existing site is brownfield and wholly impermeable, so infiltration is not considered a viable solution.                                                                                                                            |
| 3. Discharge to Surface Water (lake, watercourse, canal, etc.)                | Yes       | Discharge to existing ditches                                                                                                                                                                                                           |
| 4. Discharge to Surface Water Sewer, Highway Drain or another Drainage System | No        | It is unlikely that connections to the public sewer system will be required for surface water run-off, due to the nearby ditches.                                                                                                       |
| 5. Discharge to Combined Sewer                                                | No        |                                                                                                                                                                                                                                         |
| 6. Discharge to Foul Sewer                                                    | No        | Surface water drainage connections to foul drainage should be avoided. However, the Water Industry Act, 1991, 106.2.b.ii, identifies that surface water can be discharged into the foul sewer with the consent of the sewer undertaker. |

## 15.3 SuDS Selection

The suitability of SuDS components has been assessed (based on Table 13 below) to determine which methods are appropriate to be used within the proposed development.

Table 13: SuDS Selection Matrix

| SuDS Component                     | Description                                                                                                                                                                                                                                                                                                                                                                                | Constraints and Opportunities                                                                                | Suitable? |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-----------|
| 1. Infiltrating SuDS               | Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The suitability and infiltration rate depends on the permeability of the surrounding soils.                                                                                                                                                                 | The existing site is brownfield and wholly impermeable, so infiltration is not considered a viable solution. | No        |
| 2. Filter Drains and Filter Strips | Filter drains are shallow trenches filled with stone, gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter strips are uniformly graded and gently sloping strips of grass or dense vegetation, designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration. | The existing site is brownfield and wholly impermeable, so infiltration is not considered a viable solution. | No        |

| SuDS Component                  | Description                                                                                                                                                                                                                                                                                                                                        | Constraints and Opportunities                                                                                                                                                                                                    | Suitable? |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 3. Permeable Pavement           | Pervious surfaces can be used in combination with aggregate sub-base and/or geocellular/modular storage to attenuate and/or infiltrate runoff from surrounding surfaces and roofs. Liners can be used where ground conditions are not suitable for infiltration.                                                                                   | Hardstanding areas on site will remain the same as existing post-development, so permeable pavements would not be achievable. Furthermore, there will be heavy load vehicles moving on site which would damage permeable paving. | No        |
| 4. Green & Blue Roofs           | Green Roofs provide areas of visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They are generally more costly to install and maintain than conventional roofs but can provide many long-term benefits and reduce the on-site storage volumes.                                             | The volume of surface water attenuation achieved by green roofs is limited. Furthermore, the structure of the existing buildings on site may not be strong enough to hold green and blue roofs.                                  | No        |
| 5. Rainwater Harvesting         | Rainwater Harvesting is the collection of rainwater runoff for use. It can be collected from roofs or other impermeable area, stored, treated (where required) and then used as a supply of water for domestic, commercial and industrial properties.                                                                                              | As the volume within a Rain Water Harvesting system does not contribute to the overall attenuation, these systems have not been considered further here.                                                                         | No        |
| 6. Swales                       | Swales are designed to convey, treat and attenuate surface water runoff and provide aesthetic and biodiversity benefits. They can replace conventional pipework as a means of conveying runoff, however space constraints of some sites can make it difficult incorporating them into the design.                                                  | Due to the size and nature of the site, it is unlikely that these features will be needed.                                                                                                                                       | No        |
| 7. Rills and Channels           | Rills and Channels keep runoff on the surface and convey runoff along the surface to downstream SuDS components. They can be incorporated into the design to provide a visually appealing method of conveyance, they also provide effectiveness in pre-treatment removal of silts.                                                                 |                                                                                                                                                                                                                                  | No        |
| 8. Bioretention Systems         | Bioretention systems can reduce runoff rates and volumes and treat pollution through the use of engineer soils and vegetation. They are particularly effective in delivering interception, but can also be an attractive landscape feature whilst providing habitat and biodiversity.                                                              |                                                                                                                                                                                                                                  | No        |
| 9. Retention Ponds and Wetlands | Ponds and Wetlands are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. They enhance treatment processes and have great amenity and biodiversity benefits. Often a flow control system at the outfall controls the rates of discharge for a range of water levels during storm events. |                                                                                                                                                                                                                                  | No        |
| 10. Detention Basins            | Detention Basins are landscaped depressions that are usually dry except                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                  | No        |

| SuDS Component                    | Description                                                                                                                                                                                                                                                                                                | Constraints and Opportunities                                                                                                                                                                        | Suitable? |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                   | during and immediately following storm events and can be used as a recreational or other amenity facility. They generally appropriate to manage high volumes of surface water from larger sites such as a neighbourhoods.                                                                                  |                                                                                                                                                                                                      |           |
| 11. Geocellular Systems           | Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The inherent flexibility in size and shape means they can be tailored to suit the specific characteristics and requirements of any site. | The Application Site is wholly impermeable, and it is not within the means of this development to provide underground geocellular storage. Thus, this option is not viable.                          | No        |
| 12. Proprietary Treatment Systems | Proprietary treatment systems are manufactured products that remove specific pollutants from surface water runoff. They are especially useful where site constraints preclude the use of other methods and can be useful in reducing the maintenance requirements of downstream SuDS.                      | Proprietary Treatment Systems will be required, to treat surface water runoff from the HGV turning and loading area on site, and prevent pollutants from entering the nearby ditch and watercourses. | Yes       |

(Numbered with lowest number representing the most sustainable approach)

## 15.4 Water Quality

In order to protect the downstream receiving water body, a key element of SuDS is that they have the potential to improve the quality of surface water discharged from a site. In order to assess this, the "Pollution hazard indices for different land use classifications" provided in the CIRIA SuDS Manual (C753) as table 26.2 has been reviewed. The indices use four different methods of assessing pollution potential based on the hazard level, total suspended solids (TSS), metals, and Hydro-Carbons.

Adequate treatment must be delivered to the water runoff to remove pollutants through SuDS devices, which are able to provide pollution mitigation. Pollution Hazards and the SuDS Mitigation have been indexed in the CIRIA 753 'The SUDS Manual'.

The Pollution Hazard Indices are summarised in Table 14 (reference: Table 26.3.CIRIA SuDS Manual 2015).

Table 14: Summary of Pollution hazard Indices for different Land Use.

| Land Use                           | Pollution Hazard Level | Total suspended Solids (TSS) | Metals      | Hydrocarbons |
|------------------------------------|------------------------|------------------------------|-------------|--------------|
| Commercial Yard and delivery areas | Medium                 | 0.70                         | 0.60        | 0.70         |
| <u>Standard to be achieved</u>     | <u>Medium</u>          | <u>0.70</u>                  | <u>0.60</u> | <u>0.70</u>  |

To provide adequate treatment to surface water runoff, it is recommended that Proprietary Treatment Systems are retrofitted to the existing ACO drain on site, which currently takes the surface water runoff towards the existing ditch. Proprietary Treatment Systems are products used to filter specific pollutants from surface water runoff, to prevent them from polluting the ditch adjacent to the site.

## 15.5 Proposed Surface Water Drainage Strategy

Surface water runoff is currently directed into ACO drains on site, before being discharged into existing drainage ditches at the edges of the site. Given that the impermeable surface areas and roof areas will remain the same as existing post-development, it is recommended that surface water runoff continues to be discharged via the ACO drains and into the nearby ditches.

To provide adequate treatment to water runoff, it is recommended that Proprietary Treatment Systems are retrofitted to the existing ACO drain on site, which currently takes the surface water runoff towards the existing ditch. Proprietary Treatment Systems are products used to filter specific pollutants from surface water runoff, to prevent them from polluting the ditch adjacent to the site.

## 15.6 Maintenance

### 15.6.1 During Construction

The surface water runoff generated during construction has the potential to have higher concentrations of oils and sediments from heavy machinery and earthworks respectively. As such, it is necessary to devise appropriate surface water management plans tailored to specific construction activities and receptors of runoff. Specific considerations are:

- Provision of appropriate bunding / containment for potentially hazardous materials / chemicals;
- Re-fuelling of plant and equipment to take place only within designated areas, with suitable pollution containment;
- Good house-keeping on site to prevent accidental spillages, and spill kits to be provided as appropriate;
- Vehicle wash down areas / wheel cleaning to be located in areas with appropriate pollution control measures;
- If water/spray dust suppression is needed, the run-off should be directed to a temporary containment area, and should not be allowed to discharge to the borehole soakaways;
- The installed surface water drainage network should be routinely inspected during construction, especially the borehole soakaways; and,
- Suitable protection measures should be in place during construction to protect the watercourse and groundwater resources.

### 15.6.2 Spillage: Emergency Action

**Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system. In the event of a serious spillage, either by volume or of unknown or toxic compounds, then this should be isolated with soil, turf, or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or close woven fabric.) Contact the Environment Agency (0800 80 70 60) immediately.**

### 15.6.3 Commissioning the Drainage System

A pre-occupation commissioning survey to confirm all elements of the surface water drainage system operate as per the design, should be undertaken. This survey should include a CCTV survey of all below ground drainage assets, if any defects are identified these should be rectified prior to use of the development.

### 15.6.4 Maintenance Schedule

A maintenance and adoption strategy for the site will need to be developed in conjunction with the site management, the Highway Authority, Public Sewer Authority and the LLFA.

A detailed adoption and maintenance strategy will need to be developed that details the ownership and responsibility of the proposed SuDS devices. As a minimum the guidance provided in the CIRIA SuDS Manual should be considered in conjunction with the Local SuDS Guidance, and the requirements of the LLFA and the Highway Authority. A summary long-term maintenance schedule is presented as Table 15. This should be updated and expanded as part of the site wide maintenance documentation.

Table 15: Maintenance Schedule

| Item                                  | Visual Inspection                                            | Cleanse / De-sludge | CCTV Survey | Comments                                  |
|---------------------------------------|--------------------------------------------------------------|---------------------|-------------|-------------------------------------------|
| Pipework, chambers etc.               | 5 years                                                      | 10 years            | 10 years    | Cleansing to be carried out as necessary. |
| Gullies/Channels                      | 1 year                                                       | 1 year              | N/A         |                                           |
| Catchpits                             | 1 year                                                       | As required         | N/A         |                                           |
| Proprietary Treatment Systems / Pumps | In accordance with manufacturer's warranty / recommendations |                     |             |                                           |

### 15.6.5 Replacement of elements

Should replacement of any element be required this should be undertaken in accordance with the manufacturers specifications, and in a planned and controlled manor. **Working on live drainage systems can pose a health and safety hazard, and should only be undertaken by a competent contractor.**

## **15.7 Adoption & Ownership**

As the SuDS infrastructure will be provided on private land, it is anticipated that a private maintenance contractor would be appointed to maintain the SuDS features. This will be subject to detailed design and further consultation with the LLFA and Public Sewer Authority as appropriate.

## **15.8 Drainage Exceedance**

In the event of extreme rainfall events, flooding may occur within the site, the surface water runoff flows would be dictated by the local topography on site. Design of external ground levels need to be undertaken at detailed design stage to finalise overland conveyance routes.

## 16 Recommendations

### 16.1 Impact to Flood Risk Elsewhere

The Application Site is only at residual risk of flooding as a result of a breach in the River Thames Tidal Flood Defences, coinciding with a peak tidal flood event. Consequently, the proposed development would not increase flood risk to others.

### 16.2 Flood Resilient Construction Techniques

Based on the findings of this assessment it is recommended that the client should incorporate the following mitigation measures:

#### 16.2.1 Construction

- Incorporation of surface water drainage strategy measures.

#### 16.2.2 Drainage

- Maintenance responsibilities should clearly identify which assets would be private assets and which would be public assets.
- Manhole / Inspection chamber covers to be secured;
- Anti-syphon fitted to all toilets; and,
- Non-return valves on sewers to prevent back-flow, to be installed separately on the foul and surface water systems to prevent “self-flooding”.

#### 16.2.3 Flood Warning & Emergency Plan

The Application Site is in Flood Zone 3a and defended by tidal flooding up to the 1 in 1,000-year standard of protection, due to the Thames Tidal 2100 flood defences. Consequently, the dominant flood risk is residual resulting from a breach or failure of the Thames flood defences.

The Application Site is located within an Environment Agency Flood Warning Area. Thus, if the site management and staff have not done so already, they should sign up to receive Flood Warnings. In the event of a Flood Warning being received, site management should close the site temporarily, until it is safe to open again,

#### 16.2.4 Surface Water Management Strategy

For details of the surface water management strategy for this site, please see Section 15 of this report.

### 16.3 Post Planning Consents

Following Planning Consent a number of Post Planning Consents can be required, which are likely to be informed by the findings of this document.

#### 16.3.1 Ordinary Watercourse Consent

Any works within 8m of an Ordinary Watercourse will require Ordinary Watercourse Consent from either the LLFA or the IDB. These are usually obtained post planning once the detailed design of the proposed activities has been developed to a substantially complete status.

### 16.3.2 Development within 3m of a Public Sewer

Based on the current information, the Proposed Development is not within 3m of a Public Sewer, and therefore easements are unlikely to be required. However, this should be confirmed with the Public Sewer Authority. The sewer asset plan is included in Appendix B.

## 17 Conclusions

Royal HaskoningDHV has been appointed by Optimus Access Limited (OAL) to undertake a National Planning Policy Framework (NPPF) [1] compliant Flood Risk Assessment (FRA) for the proposed development located at Site E Dering Industrial Park, Dering Way, Gravesend, Kent, DA12 2FP.

A planning application (reference: 20211283 dated 13<sup>th</sup> October 2021) was submitted to Gravesham Borough Council (GBC) for the development and was later withdrawn. Gravesham Borough Council as a consultee during the planning process were consulted and raised an objection on based on the following:

*‘Unfortunately no surface water drainage strategy has been provided for the proposed development. We would therefore recommend the application is not determined until a complete surface water drainage strategy has been provided for review.’*

Email correspondence with the Client indicated that Gravesham Borough Council had also requested that a Flood Risk Assessment were completed for the development proposals.

A new retrospective planning application is in the process of being submitted and this Flood Risk Assessment and Surface Water Drainage Strategy has been produced to support it. The retrospective planning application is for the permanent retention of the existing buildings on site. The buildings to be retained are an office building, raised open storage platform with a timber deck, metal clad shed and open sided shed.

The following development has been constructed, as shown on Figure 1 and in Appendix A.

- Structure A – Two tier modular building in use as ancillary offices and staff welfare facilities.
- Structure B – Raised storage platform.
- Structure C – Ancillary secure storage shed.
- Structure D – Covered storage area.
- Open Yard – Storage, vehicles and staff parking.

According to the Flood Risk and Coastal Change Planning Policy Guidance, the proposed development would be classified as a Minor Development.

According to Annex 3 of the NPPF, the proposed development’s Vulnerability Classification is “Less Vulnerable”, which consists of the following uses:

*“Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the ‘more vulnerable’ class; and assembly and leisure.”*

This report relies on information provided by third parties, either because of a direct request for information, or through reviewing their published information (usually from internet sources from Government Agencies or established institutions).

A summary of the flood risk for the site for each source requiring consideration under the NPPF is provided below and presented as Table 1, overleaf:

- Tidal: Site is defended against tidal flooding up to 1 in 1,000-year events, due to Thames Estuary 2100 defences;
- Fluvial: Site is not at risk of flooding from this source;
- Surface Water: The Site is at high risk of flooding from surface water sources. Given that the Development Proposals are for the retention of the existing buildings on site, there will be no change

to the existing impermeable surface areas, built footprint or roof areas. Thus, surface water flood risk will not change post-development;

- Groundwater: The Site is in an area which is highly susceptible to groundwater flooding. Due to the nature of the Development Proposals, there will be no excavation works and no change to the groundwater flood risk as a result of this development;
- Sewers: The Site is not located near an existing public sewer, so there should be no risk of flooding from sewers;
- Residual Risk – Flood Defence Breach: The Site would be at risk of flooding in the event of a tidal defence breach event. The likelihood of this occurring is very low;
- Residual Risk – Reservoir Failure: The Site is not at risk of flooding in the event of reservoir failure.

As discussed in Section 15 - Surface Water Drainage Strategy, surface water runoff is currently directed into ACO drains on site, before being discharged into existing drainage ditches at the edges of the site. Given that the impermeable surface areas and roof areas will remain the same as existing post-development, it is recommended that surface water runoff continues to be discharged via the ACO drains and into the nearby ditches.

To provide adequate treatment to surface water runoff, it is recommended that Proprietary Treatment Systems are retrofitted to the existing ACO drain on site, which currently takes the surface water runoff towards the existing ditch. Proprietary Treatment Systems are products used to filter specific pollutants from surface water runoff, to prevent them from polluting the ditch adjacent to the site.

The Flood Risk Assessment has been undertaken in accordance with the requirements of the NPPF, and it can be demonstrated that the development proposals are compatible with the predicted flood risk profile, including climate change allowance over the development lifetime.

It should be noted that the development proposals are not predicted to increase the risk of flooding to others over the development lifetime. Consequently, it is concluded that with regards to the Flood Risk requirements of the NPPF, the development proposals are acceptable.

## 18 Glossary

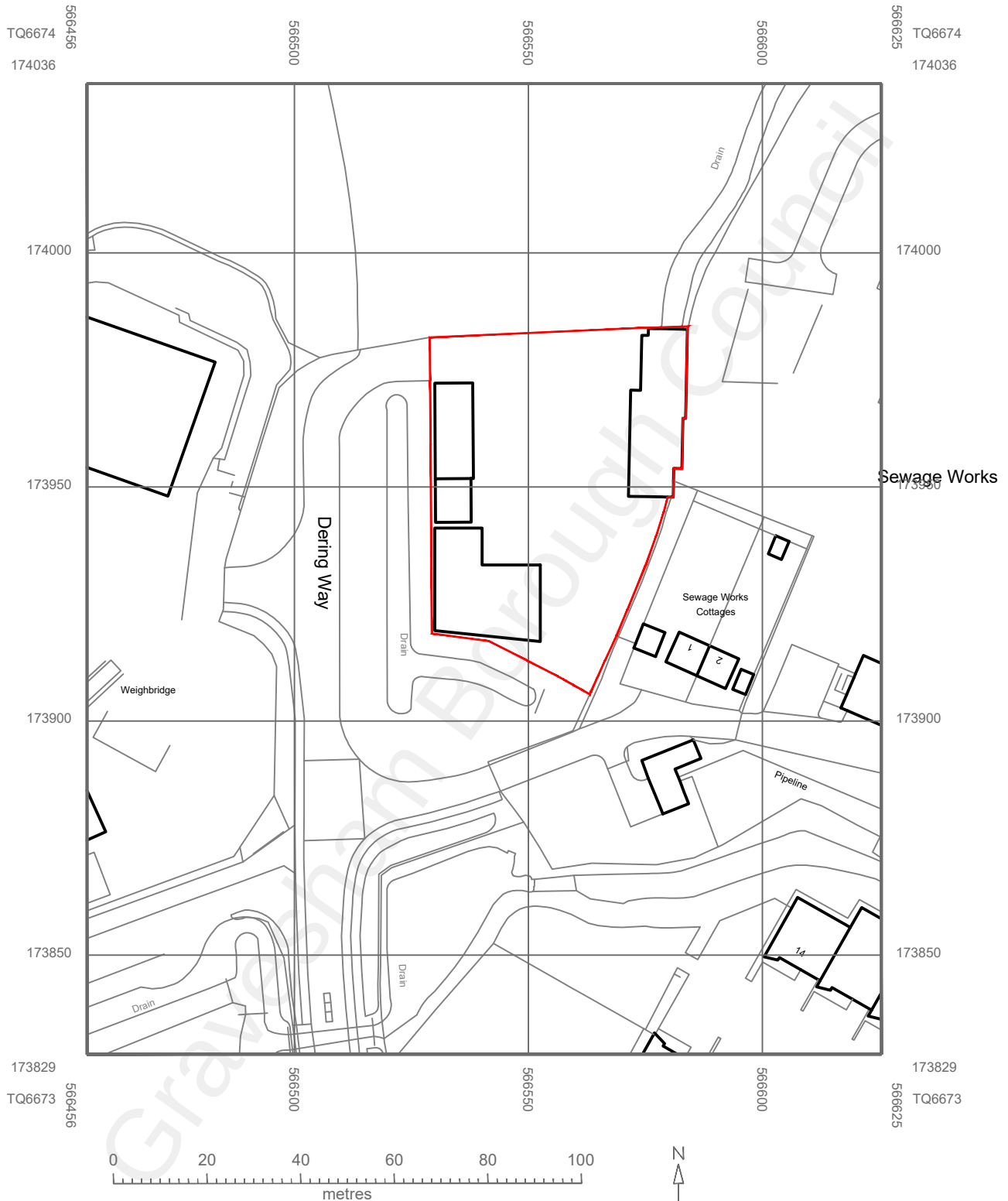
| Term                          | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AEP                           | Annual Exceedance Probability is the probability of a rainfall or tidal event occurring within any one year. For example, an event of a 100 year return period has an AEP of 1:100 or 1%.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Flood Defences                | Artificial structures maintained to a set operational level designed to protect land people and property from Tidal and Fluvial flood sources to an established chance of happening in any year threshold.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Flood Source: Fluvial (River) | When flows within watercourses exceed the capacity of the watercourse causing out of bank flows.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Flood Source: Groundwater     | Groundwater flooding is usually the result of prolonged wet weather causing groundwater levels to rise sufficiently to either emerge at surface or to cause flooding of below ground infrastructure, such as basements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Flood Source: Pluvial         | When rainfall causes overland flows which exceed the capacity of the drainage network, causing flooding to land that is normally dry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Flood Source: Tidal           | When high tide events overtop the shoreline to cause flooding to land behind.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Flood Zone 1                  | Low Probability. Land defined as having a less than 1:1000 annual probability of flooding from tidal and fluvial sources.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Flood Zone 2                  | Medium Probability. Land defined as having a risk of fluvial flooding between 1:100 annual probability and 1:1000 annual probability. Or Land defined as having a risk of tidal flooding between 1:200 annual probability and 1:1000 annual probability.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Flood Zone 3 (A)              | High Probability. Land defined as having a fluvial risk of 1:100 annual probability or greater. Or a tidal risk of 1:200 annual probability or greater.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Flood Zone 3 (B)              | Functional Floodplain. Defined by SFRA's as areas where floodwater is stored during lower AEP events, typically the 1:20 annual probability.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Flood Zone Map                | The Environment Agency has produced a mapping data set which covers England and provides the general extents of Flood Zones 1, 2, and 3. However the national data set available online does not differentiate between Flood Zone 3 (A) and 3 (B).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| LiDAR                         | "Light Detection and Ranging (LiDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Up to 500,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at spatial resolutions of between 25cm and 2 metres." EA LiDAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Main River                    | Defined on the Main River map and relate to rivers on which the Environment Agency have powers to carry out flood defence works.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Minor Development             | Minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metres.<br>Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.<br>Householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.<br>Paragraph: 046 Reference ID: 7-046-20140306, Revision date: 06 03 2014<br><a href="https://www.gov.uk/guidance/flood-risk-and-coastal-change#minor-development-to-flood-risk">https://www.gov.uk/guidance/flood-risk-and-coastal-change#minor-development-to-flood-risk</a> |
| m AOD                         | Metres Above Ordnance Datum.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| OS                            | Ordnance Survey                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| Term                 | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ordinary Watercourse | A watercourse which does not form part of a Main River, works on Ordinary Watercourses usually require consent from either the Lead Local Flood Authority, or the Internal Drainage Board (where one exists).                                                                                                                                                                                                                                                                                                                                 |
| Qbar                 | Qbar is the mean annual maximum flow rate, for a catchment which has an equivalent return period of 1 in 2.3 years                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Return Period        | The return period of a flood might be 100 years; otherwise expressed as its probability of occurring being 1 in 100, or 1% in any one year. If a flood with such a return period occurs, then this does not mean the next will occur in about one hundred years' time - instead, it means that, in any given year, there is a 1% chance that it will happen, regardless of when the last similar event was. Or, put differently, it is 10 times less likely to occur than a flood with a return period of 10 years (or a probability of 10%). |
| SuDS                 | Sustainable Drainage Systems, which are designed to manage surface water flows in order to mimic the Greenfield run-off from an undeveloped site.                                                                                                                                                                                                                                                                                                                                                                                             |
| Urban Creep          | Urban creep is the conversion of permeable surfaces to impermeable over time e.g. surfacing of front gardens to provide additional parking spaces, extensions to existing buildings, creation of large patio areas.                                                                                                                                                                                                                                                                                                                           |

## **Appendix**

### **A. Development Proposals**

# MapServe



© Crown copyright 2021 Ordnance Survey 100053143



Buccanartley Architects Limited  
architecture interiors environment

248 Gray's Inn Road WC1X 8JR  
E mail@buccanartley.co.uk

Title

OAL Dering Way Depot DA12 2FP  
Site Location Plan

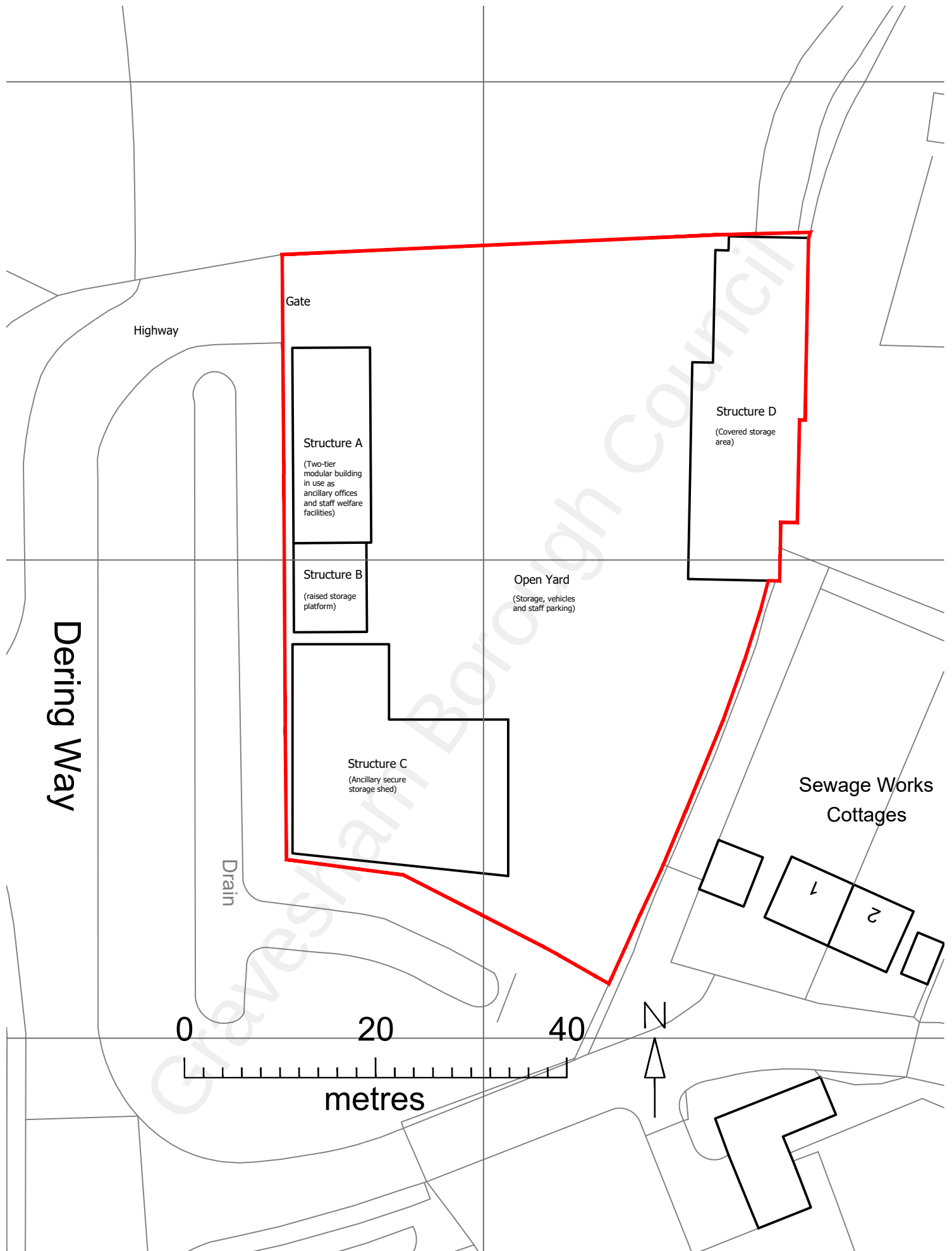
DATE  
210920

PROJECT NO  
0945

SCALE  
1/1250@A4

DRAWING NO  
L(EX)001

REV  
-



Buchanan Hartley Architects Limited  
architecture interiors environment

248 Gray's Inn Road WC1X 8JR  
E mail@buchananhartley.co.uk

Title

OAL Dering Way Depot DA12 2FP  
Block Plan

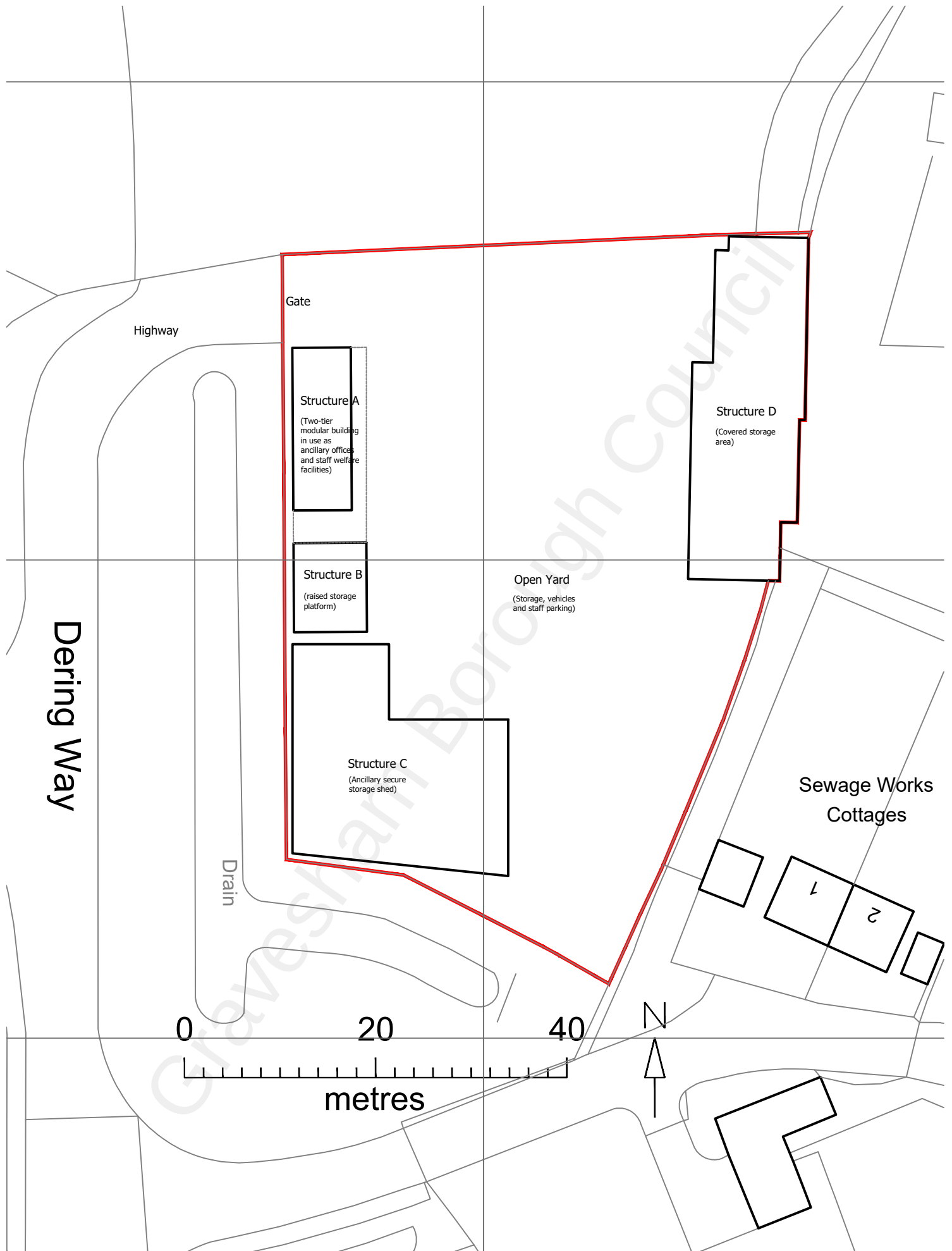
DATE  
210920

PROJECT NO  
0945

SCALE  
1/500@A4

DRAWING NO  
L(EX)002

REV  
-



Buchanan Hartley Architects Limited  
architecture interiors environment

248 Gray's Inn Road WC1X 8JR  
E mail@buchananhartley.co.uk

Title

OAL Dering Way Depot DA12 2FP  
Block Plan

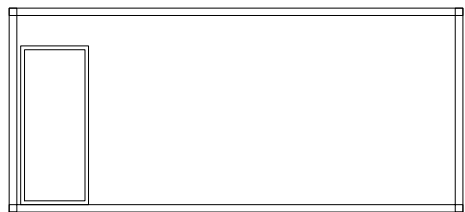
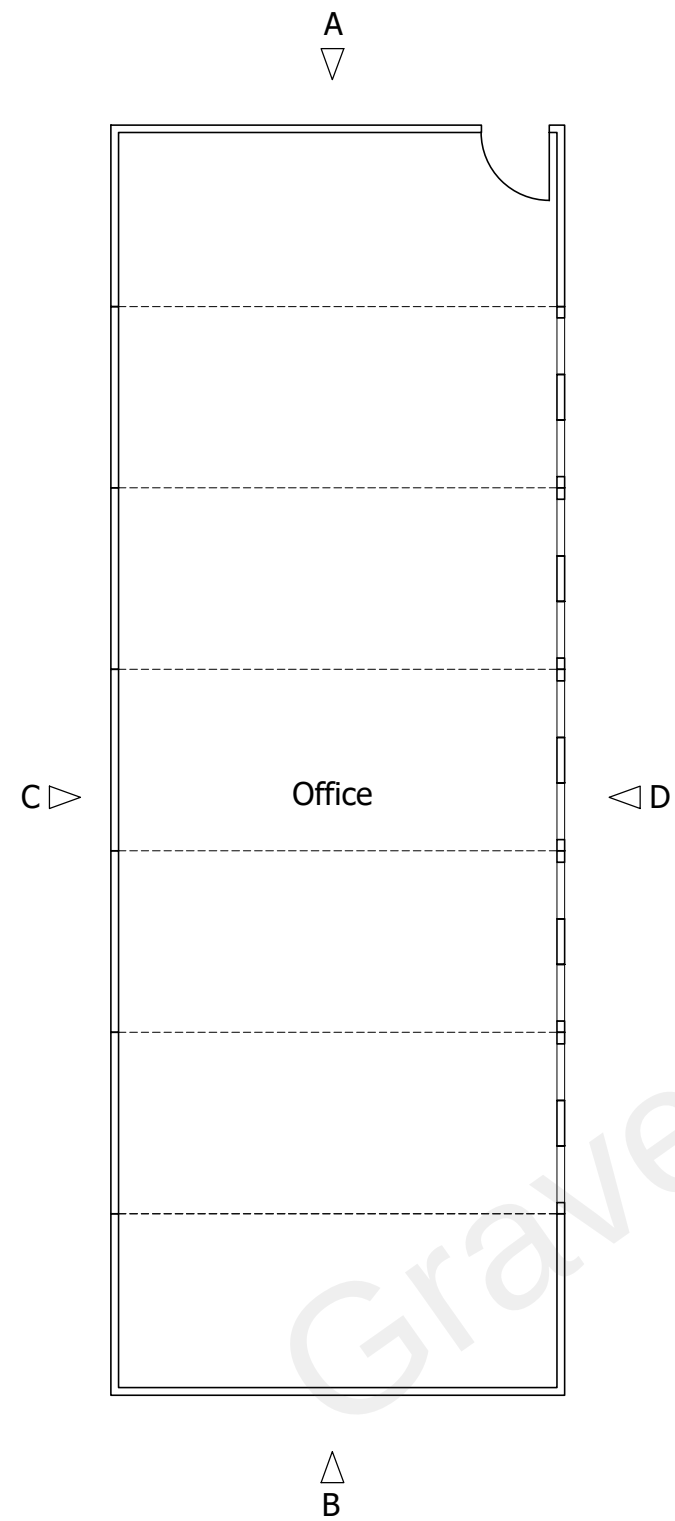
DATE  
210920

PROJECT NO  
0945

SCALE  
1/500@A4

DRAWING NO  
L(EX)002

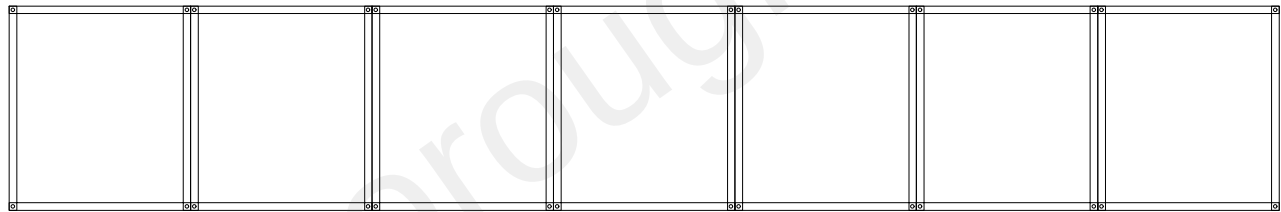
REV  
A



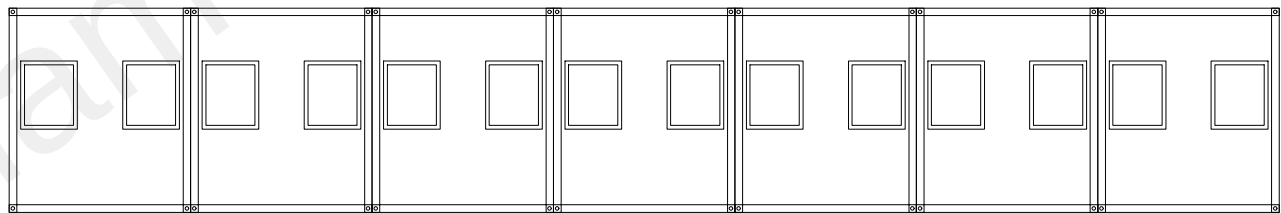
Elevation A



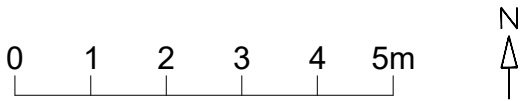
Elevation B



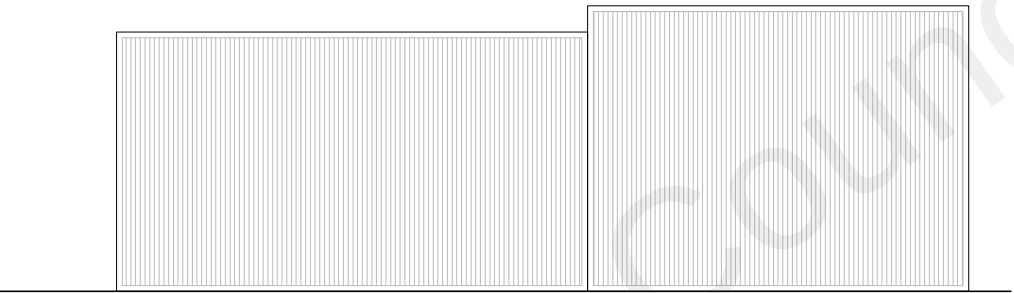
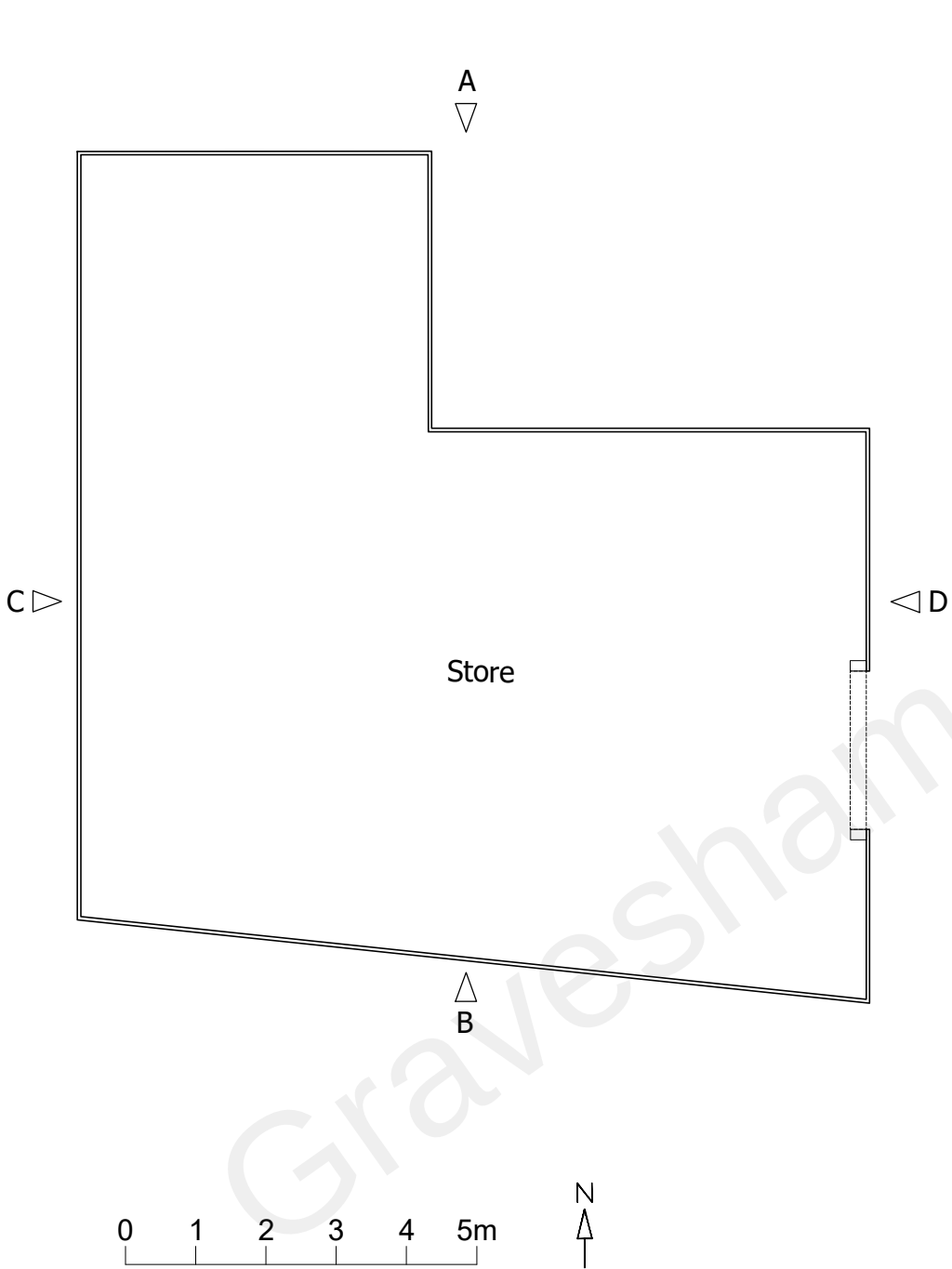
Elevation C



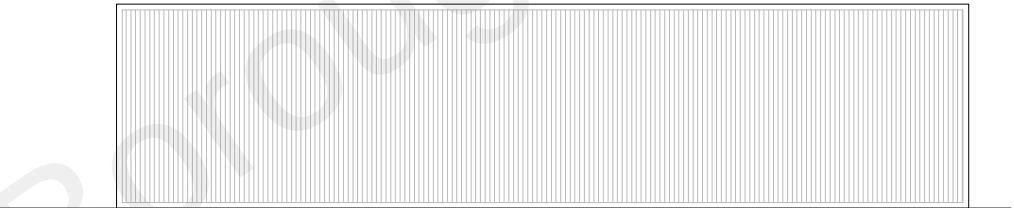
Elevation D



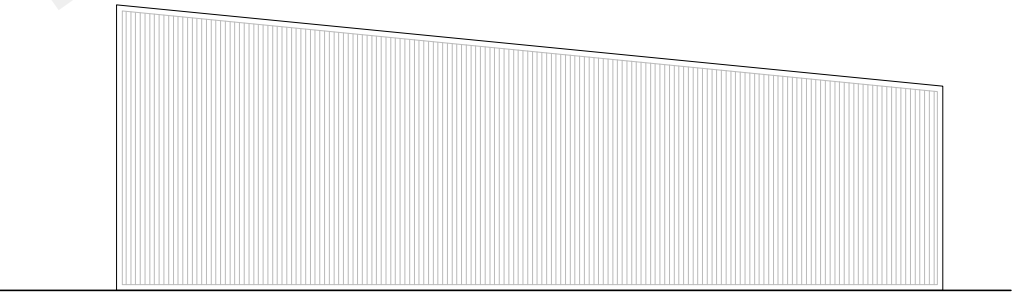
| -                                                                                                                                                                                                                                                                                           | -                      |          | -    | -  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------|------|----|--|
| Rev                                                                                                                                                                                                                                                                                         | Description            |          | Date | By |  |
| <div><div></div><div><div>Buchanan Hartley Architects Limited</div><div>architecture interiors environment</div></div></div> <div>248 Gray's Inn Road WC1X 8JR<br/>E: mail@buchananhartley.co.uk</div> |                        |          |      |    |  |
| Client<br>OAL                                                                                                                                                                                                                                                                               |                        |          |      |    |  |
| Project<br>Dering Way Depot DA12 2FP<br>-                                                                                                                                                                                                                                                   |                        |          |      |    |  |
| Title<br>Structure A<br>Plan and elevations                                                                                                                                                                                                                                                 |                        |          |      |    |  |
| Scale<br>1/100@A3                                                                                                                                                                                                                                                                           |                        |          |      |    |  |
| Date<br>211102                                                                                                                                                                                                                                                                              |                        |          |      |    |  |
| Project No<br>0945                                                                                                                                                                                                                                                                          | Drawing No<br>L(EX)003 | REV<br>- |      |    |  |



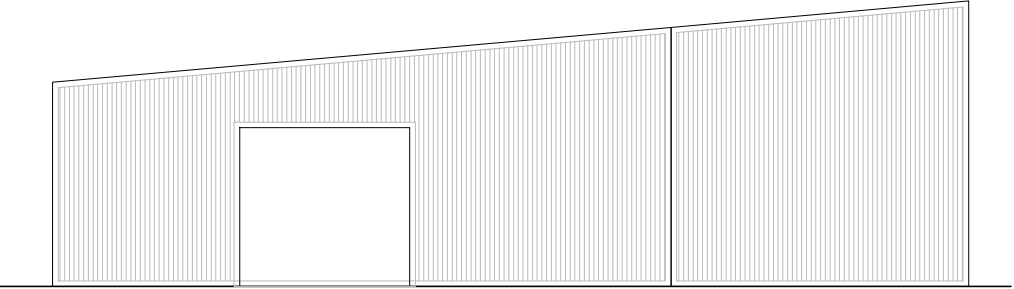
Elevation A



Elevation B

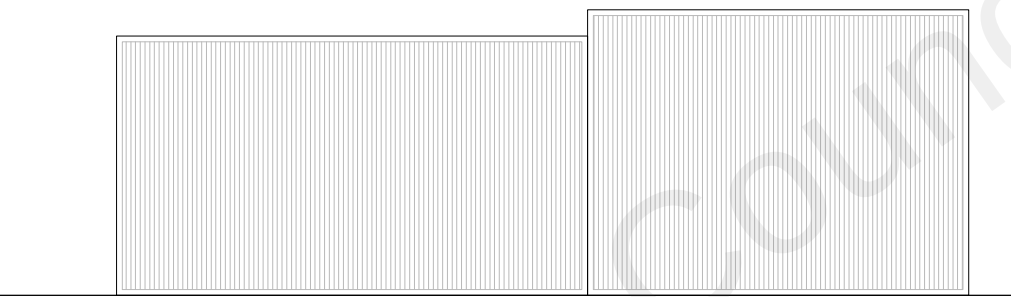
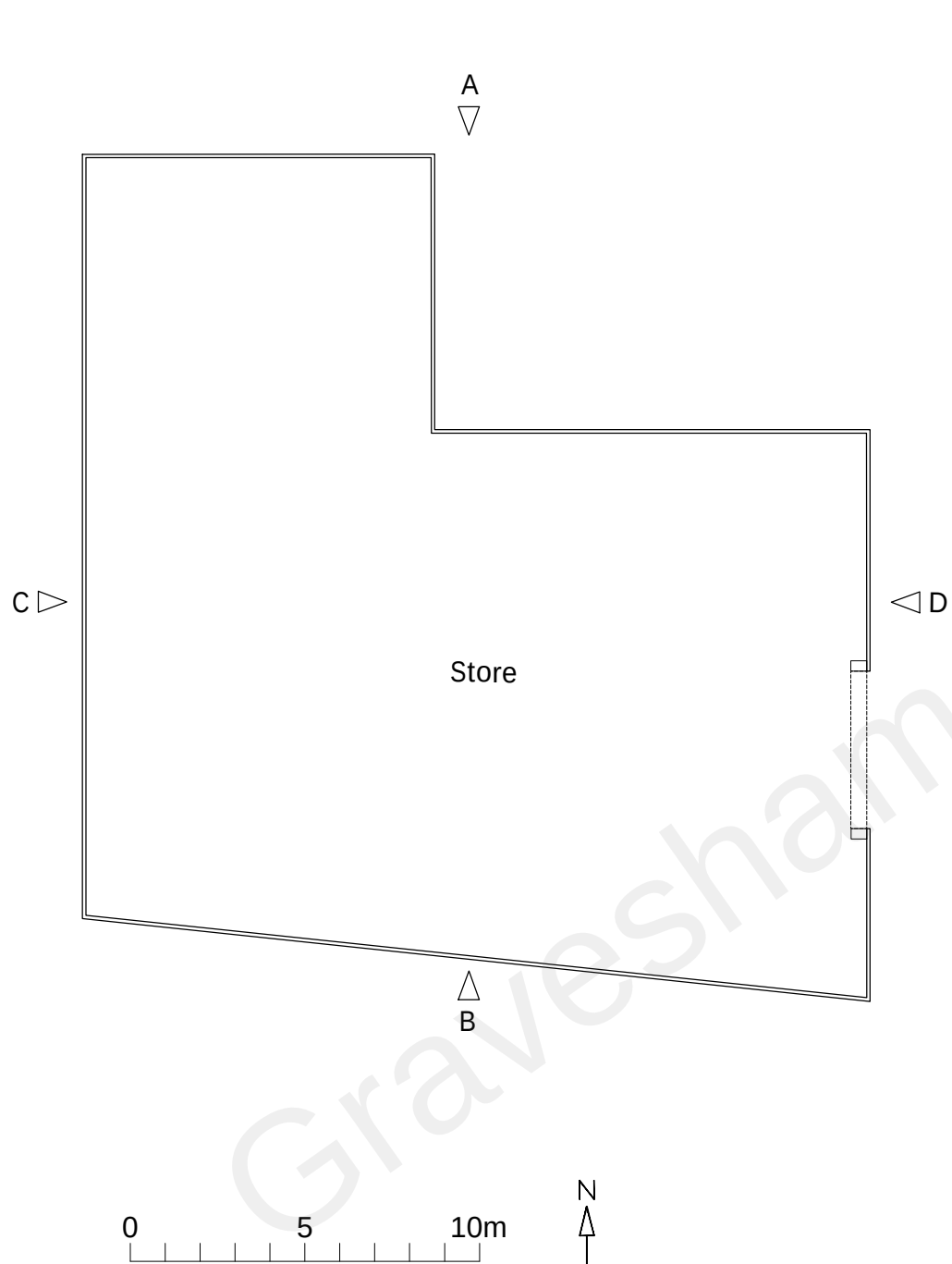


Elevation C

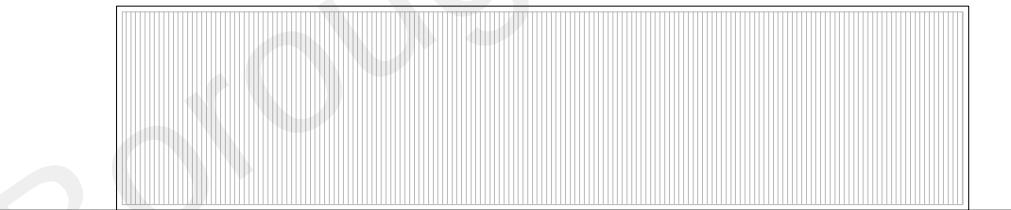


Elevation D

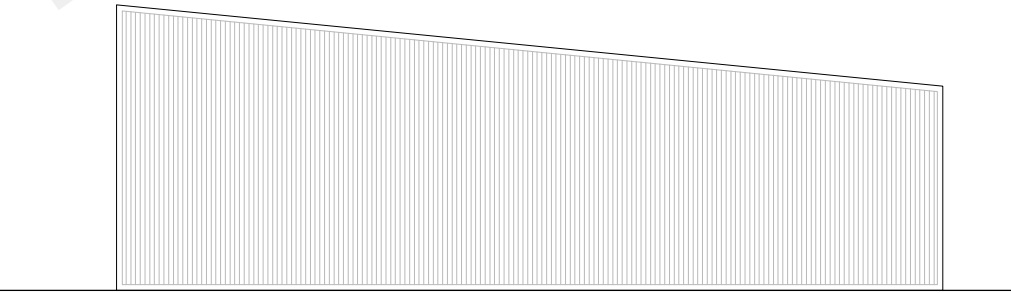
|                                                                                                                                                                                                                                                                                                 |                           |      |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|----|
|                                                                                                                                                                                                                                                                                                 |                           |      |    |
|                                                                                                                                                                                                                                                                                                 |                           |      |    |
|                                                                                                                                                                                                                                                                                                 |                           |      |    |
|                                                                                                                                                                                                                                                                                                 |                           |      |    |
|                                                                                                                                                                                                                                                                                                 |                           |      |    |
| -                                                                                                                                                                                                                                                                                               | -                         | -    | -  |
| Rev                                                                                                                                                                                                                                                                                             | Description               | Date | By |
| <div><div></div><div><div>Buchanan Hartley Architects Limited</div><div>architecture interiors environment</div><div>248 Gray's Inn Road WC1X 8JR</div><div>E mail@buchananhartley.co.uk</div></div></div> |                           |      |    |
| Client                                                                                                                                                                                                                                                                                          | OAL                       |      |    |
| Project                                                                                                                                                                                                                                                                                         | Dering Way Depot DA12 2FP |      |    |
|                                                                                                                                                                                                                                                                                                 | -                         |      |    |
| Title                                                                                                                                                                                                                                                                                           | Structure C               |      |    |
|                                                                                                                                                                                                                                                                                                 | Plan and elevations       |      |    |
| Scale                                                                                                                                                                                                                                                                                           | 1/200@A3                  |      |    |
| Date                                                                                                                                                                                                                                                                                            | 211102                    |      |    |
| Project No                                                                                                                                                                                                                                                                                      | Drawing No                | REV  |    |
| 0945                                                                                                                                                                                                                                                                                            | L(EX)004                  | -    |    |



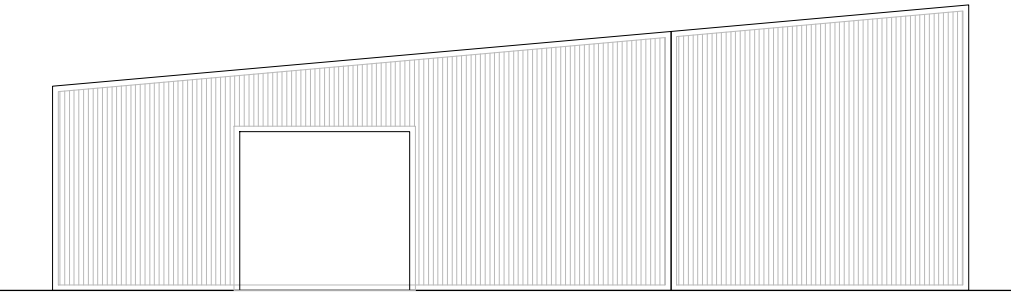
Elevation A



Elevation B



Elevation C



Elevation D

|                                                                                                                                                                                                                                                                                                 |                         |        |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------|-----|
|                                                                                                                                                                                                                                                                                                 |                         |        |     |
|                                                                                                                                                                                                                                                                                                 |                         |        |     |
|                                                                                                                                                                                                                                                                                                 |                         |        |     |
|                                                                                                                                                                                                                                                                                                 |                         |        |     |
|                                                                                                                                                                                                                                                                                                 |                         |        |     |
|                                                                                                                                                                                                                                                                                                 |                         |        |     |
| A                                                                                                                                                                                                                                                                                               | Graphical scale revised | 211103 | MFH |
| Rev                                                                                                                                                                                                                                                                                             | Description             | Date   | By  |
| <div><div></div><div><div>Buchanan Hartley Architects Limited</div><div>architecture interiors environment</div><div>248 Gray's Inn Road WC1X 8JR</div><div>E mail@buchananhartley.co.uk</div></div></div> |                         |        |     |
| Client                                                                                                                                                                                                                                                                                          |                         |        |     |
| OAL                                                                                                                                                                                                                                                                                             |                         |        |     |
| Project                                                                                                                                                                                                                                                                                         |                         |        |     |
| Dering Way Depot DA12 2FP                                                                                                                                                                                                                                                                       |                         |        |     |
| -                                                                                                                                                                                                                                                                                               |                         |        |     |
| Title                                                                                                                                                                                                                                                                                           |                         |        |     |
| Structure C                                                                                                                                                                                                                                                                                     |                         |        |     |
| Plan and elevations                                                                                                                                                                                                                                                                             |                         |        |     |
| Scale                                                                                                                                                                                                                                                                                           |                         |        |     |
| 1/200@A3                                                                                                                                                                                                                                                                                        |                         |        |     |
| Date                                                                                                                                                                                                                                                                                            |                         |        |     |
| 211102                                                                                                                                                                                                                                                                                          |                         |        |     |
| Project No                                                                                                                                                                                                                                                                                      | Drawing No              | REV    |     |
| 0945                                                                                                                                                                                                                                                                                            | L(EX)004                | A      |     |

## **Appendix**

### **B. Third Party Data**

**From:** [KSL PSO SE London & North Kent](#)  
**To:** [Sophie Isaacs](#)  
**Cc:** [KSL Enquiries](#)  
**Subject:** RE: KSL 257739 AC - Site E Dering Industrial Park, Dering Way, Gravesend, Kent  
**Date:** 13 April 2022 13:14:23  
**Attachments:** [image001.png](#)  
[KSLES FRA Checklist v3.0 June 2020.docx](#)

You don't often get email from [ps0.selondonandnkent@environment-agency.gov.uk](mailto:ps0.selondonandnkent@environment-agency.gov.uk). [Learn why this is important](#)

Dear Sophie,

**Re: KSL 257739 AC - Site E Dering Industrial Park, Dering Way, Gravesend, Kent, DA12 2DN**

Thank you for your enquiry which was received on 28<sup>th</sup> February 2022.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

Please note that we have changed our process for responding to modelled data requests, please read the information within this email for further details.

You have requested a Product 4, 5 and 6. Please see below table detailing each product:

|           |                                                                                                                                                                                                                                                                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product 4 | Detailed Flood Risk Assessment Map, including flood zones, defences and storage areas, areas benefiting from defences, statutory main river designations, historic flood event outlines and more detailed information from hydraulic models (including model extents and 2D flood level data for specific points)                                      |
| Product 5 | Reports, including flood modelling reports, model user logs and guides, hydrology reports, etc                                                                                                                                                                                                                                                         |
| Product 6 | Model Output Data, including product 5. <ul style="list-style-type: none"><li>• flood outlines usually provided in shapefile format</li><li>• 2D grids (level (h), depth (d) velocity (v) and hazard ZKU0) usually provided in ASCII format</li><li>• 1D flow and level data</li></ul> Requires GIS software such as ArcGIS, MapInfo, QGIS or similar. |
| Product 7 | Calibrated and Verified Model Input Data (CaVMID), including product 5. Enables customer to re-run and/or make changes to a hydraulic model. Requires specific hydraulic modelling software such as Flood Modeller, TUFLOW, or ICM InfoWorks.                                                                                                          |
| Product 8 | Breach Hazard Map<br>Provides a hazard map of breaches in PDF format including, maximum flood depth, maximum flood velocity and maximum flood hazard.<br>Please note product 8 is not available for fluvial models.                                                                                                                                    |

Your request for a Product 4 falls under the exemption in provision 6(1)(a) and (b) of the Environmental Information Regulations 2004 (EIR) which states that

*'.....6.—(1) Where an applicant requests that the information be made available in a particular form or format, a public authority shall make it so available, unless—  
(a) it is reasonable for it to make the information available in another form or format; or  
(b) the information is already publicly available and easily accessible to the applicant in another form or format.....'*

On this occasion we are not providing the information in the Product 4 format for the following reasons:

- Complying with the preference would incur a significant cost, which the public authority [The Environment Agency] cannot pass on to the requester;
- Using a Product 5/6/7 allows us to make the information available at a lower cost; and
- The impact on the available resources of the public authority [The Environment Agency], of supplying a Product 5/6/7, is therefore much less.

Please find below the link containing the Product 5 and 6:

**Thames Tidal Downriver Breach Inundation Modelling 2018** <https://defra.sharefile.com/d-s7fa7e1d01734d5a9>

The ShareFile link also contains Thames Estuary 2100 information.

We are licensing the supplied data to you under the [Environment Agency Conditional Licence](#), details of which are included in the ShareFile link. You must first check this supporting information, to determine if the conditions of use are suitable for your purposes. If the conditions for use are not suitable for your purposes, this information is not provided with a licence for use, and the data is provided for the right to read only.

Product 4 data is derived from the product 6 supplied above and the following open data sources;

Flood Zone 3 <https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-3>

Flood Zone 2 <https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-2>

Historic Flood Map <https://data.gov.uk/dataset/historic-flood-map1>

Product 8 data can be derived using the depth (d) velocity (v) and hazard (ZKU0) 2D grids which are provided in the Product 6 dataset.

Please note, that the Flood Map for Planning is available to view and export maps for your site at: <https://flood-map-for-planning.service.gov.uk/>

Please note that our historic flood event maps may not be comprehensive. We would therefore advise that you make further enquiries locally with specific reference to flooding at your location. You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

Please be aware that flooding can come from different sources. Examples of these are:

- from rivers or the sea
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system)
- overflowing or backing up of sewer or drainage systems which have been overwhelmed
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea.

#### **Areas Benefiting from Flood Defences**

Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year, or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

#### **Flood Risk Assessment Checklist**

If you are planning on using this data within a Flood Risk Assessment, we recommend that you take the time to fill in the attached FRA checklist, and to read the attachments which contain information relevant to the area that interests you.

We would like to stress the importance of filling in the Flood Risk Assessment check list, and providing up-to-date and correct data. The data will be checked against our records when we review the Flood Risk Assessment in our role as statutory consultee.

It is important that you provide a map in section 2 of the FRA checklist (See Appendix A), including the highest and most representative flood levels for your site. We recommend using a number of nodes that provide a fair representation of the modelled data across your site. For example, if it is a small extension (< 250 square metres) then approximately 5-10 nodes would be sufficient. For larger sites, approximately 10 to 20 nodes would be appropriate.

Please contact our Sustainable Places team at [KSLPLANNING@environment-agency.gov.uk](mailto:KSLPLANNING@environment-agency.gov.uk) if you have any further enquiries regarding the planning process and Flood Risk Assessments.

**If you have any further queries regarding how to use the above data please contact the Partnership and Strategic Overview (PSO) team directly by reply email.**

If you have a new enquiry or would like us to review the information we have provided under the Freedom of Information Act 2000 and Environmental Information Regulations 2004 please contact us within two months by email at [KSLE@environment-agency.gov.uk](mailto:KSLE@environment-agency.gov.uk)

Kind Regards,

Tim Wrenn  
Partnership & Strategic Overview - South East London & North Kent  
Kent, South London and East Sussex Area  
Environment Agency

---

**From:** Sophie Isaacs [<mailto:sophie.isaacs@rhdhv.com>]

**Sent:** 28 February 2022 16:31

**To:** Enquiries, Unit <[enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk)>

**Subject:** 220302/CMC09 - EA data request #6682

Good afternoon,

I'd like to request EA data for a site. Please see the information attached.

Kind regards,

**Sophie Isaacs**

Flood Risk Consultant

*She/Her*

AMBIENTAL-EA-RHDHV\_RGB



**Ambiental**, Science Park Square, Brighton, BN1 9SB

**Direct Dial** +44 (0) 1273 006918

**Consultancy Team** + 44 (0) 1273 006900

**W** [www.ambiental.co.uk](http://www.ambiental.co.uk) | **E** [sophie.isaacs@rhdhv.com](mailto:sophie.isaacs@rhdhv.com)

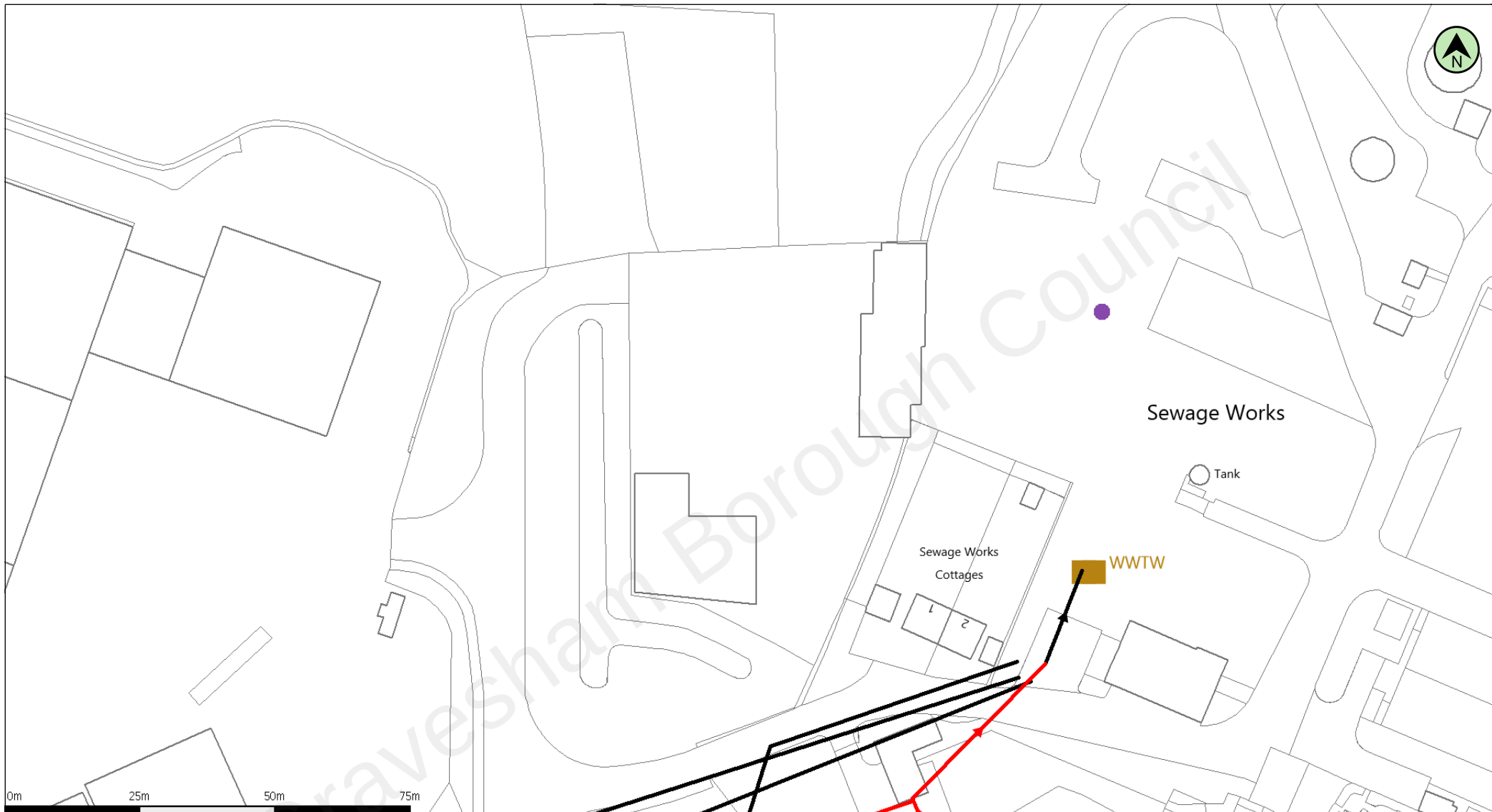
**Twitter** | **LinkedIn**

**Like many businesses, we're now following government guidance to work remotely due to the Coronavirus (COVID-19). We appreciate our customers patience at this time and we want to assure you that we remain open and working towards your projects with minimal disruption. If you have any questions, feel free to contact us via our direct emails as this will remain the fastest method of contacting our team at this time.**

Ambiental Environmental Assessment Ltd qualify to ISO 14001 (Environmental Management System) and ISO 9001 (Quality Management System). Company registered in England & Wales; Company Number 10238346; Registered Address, Sussex Innovation Centre, Science Park Square, Brighton, BN1 9SB, UK. This email and any attachments are confidential and intended exclusively for the use of the intended recipient(s). Any views or opinions presented are solely those of the author and do not necessarily represent those of Ambiental Environmental Assessment Ltd. If you are not the intended recipient(s) please note that any form of distribution, copying or use of this email or the information in it is strictly prohibited and may be unlawful. If you have received this communication in error, please notify the sender and then delete the message and any attachments from your system. Please note that no responsibility for viruses is taken and it is your responsibility to scan this message and any attachments. Please consider the environment before printing out this email.

This email and any attachments are intended solely for the use of the addressee(s); disclosure or copying by others than the intended person(s) is strictly prohibited. If you have received this email in error, please treat this email as confidential, notify the sender and delete all copies of the email immediately

Information in this message may be confidential and may be legally privileged. If you have received this message by mistake, please notify the sender immediately, delete it and do not copy it to anyone else. We have checked this email and its attachments for viruses. But you should still check any attachment before opening it. We may have to make this message and any reply to it public if asked to under the Freedom of Information Act, Data Protection Act or for litigation. Email messages and attachments sent to or from any Environment Agency address may also be accessed by someone other than the sender or recipient, for business purposes.

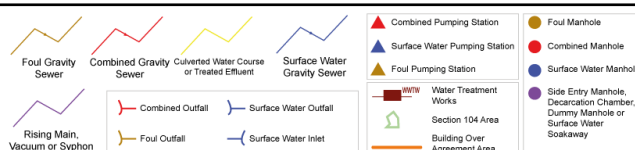


(c) Crown copyright and database rights 2022 Ordnance Survey 100031673      Date: 16/05/22      Scale: 1:1000      Map Centre: 566552,173953      Data updated: 27/04/22      Our Ref: 856139 - 1      Wastewater Plan A4

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2022 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



[ambiental.consultancy@rhdhv.com](mailto:ambiental.consultancy@rhdhv.com)

6682 Dering Way



