



## **FLOOD RISK ASSESSMENT**

Proposed Development of East London Renewable  
Energy Facility, Dagenham

**Version 1**

**Novera Energy**

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# 1 Introduction

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- 1.1 RPS Planning Transport and Environment has been commissioned to undertake a Flood Risk Assessment for the proposed development of the East London Renewable Energy Facility in Dagenham, (JER2943-001 – Site Location Plan and Surface Water Features). This FRA accounts for the requirements of the Environment Agency, and Havering Borough Council.
- 1.2 Planning Policy and Guidance Note 25 (PPG 25) requires such an assessment to ascertain whether the proposed development will be at risk of flooding, or will have an adverse impact on flood risk elsewhere in the catchment. This assessment evaluates the potential flood risk for the proposed development, and outlines the mitigation requirements including a drainage strategy in accordance with SUDS guidance, as outlined by CIRIA, and a review of the state of the current flood defences.

## Purpose of the Report

- 1.3 This FRA has been requested by the Environment Agency and Havering Borough Council. The document will form part of the Technical Appendix to the Environmental Statement for the development and has been completed in accordance with PPG 25.
- 1.4 The majority of the site is located within Flood Zone 1, Low Risk. However, parts of the southern and south-eastern section of the site are located within Flood Zone 3, High Risk, and is shown by the Environment Agency Flood Map (JER2943-002 - EA Flood Map) to be affected by the 1:100 year and 1:1000 year return period fluvial and 1:200 year and 1:1000 year return period tidal floodplains.
- 1.5 A surface drainage assessment is required to demonstrate that any increase in surface water runoff resulting from the development would not effect the flood risk at the site or adjacent areas.
- 1.6 An assessment of the state of the existing River Thames flood defences and the level of protection afforded the site is required.

## Background Information

- 1.7 The proposed site for development is 1.11ha in area and is to be developed to provide a Renewable Energy Facility. The development site currently forms part of a much larger storage car park for vehicles produced at the Ford Motor Works (JER2943-003 – Existing Site Layout). The existing car park surface is comprised of asphalt.

## Site Situation

- 1.8 The application site is located on land included within the Ford Motor Company Complex at Dagenham in the London Borough of Havering, (NGR 550770, 181170), as shown in the Site Location Plan – JER2943-001. The Ford Motor Company Complex borders the site to the north and west, while the River Thames forms the southern boundary. The Fairview Industrial Estate is located on the eastern boundary.

## Existing Site Description

- 1.9 RPS Planning Transport and Environment visited the site in August 2005. The site visit comprised a general site walkover, during which time photographs were taken of the site layout and surface water features within and adjacent to the site and the existing River Thames flood defences; these are located in Appendix 1.
- 1.10 The site topography shows a moderate relief, with levels ranging by approximately 3.5m across the site. The highest levels (9m AOD) are located in the north of the site, reducing to a minimum (5.5m AOD) in the south. The topographical survey (JER2943-005 – Topographical Survey Plan) shows a centrally elevated section trending north-south with levels reducing to the east and west. This gives the site a cambered effect and dividing it into two contributing catchments, draining to the south-east and south-west, respectively.
- 1.11 The existing River Thames flood defences run along the southern boundary and consist of a grassed earthen embankment with a typical level of 7.52m AOD.
- 1.12 The site is currently used as a car compound for new vehicles produced by Ford, and is laid to asphalt.
- 1.13 Access to the site is currently via Frog Lane which enters the site in the north-eastern corner, and which serves the Ford Plant and several other businesses. Levels on the road increase from 9m adjacent to the site to 10m AOD at a locally elevated high point 135m north of the site. From this point the levels decrease to moving north to a minimum of 1.5m AOD at the junction approximately 560m north of the site.
- 1.14 The Flo-Gas site, where the conveyor is to be located is locally elevated, being approximately 1-2m higher than the Ford site. This site is currently laid to gravel hardstanding and is used for the storage of gas bottles. Levels decrease in a southerly direction, with surface water runoff being directed towards the Thames. The land adjacent to the Flo-Gas site to the east is approximately 2m lower.

**River Thames**

- 1.15 The site is located on the north bank of the River Thames, which forms the southern boundary of the application site and represents the principle source of flood risk at the site. This section of the river is tidally affected and the site is shown to be located partially within the fluvial and tidal floodplains for the River Thames. The river follows a north-west to south-east alignment along the southern boundary, turning south just downstream of the site.
- 1.16 The current River Thames predicted flood levels and flood levels to 2052 have been provided by the EA. Flood levels to the year 2110 have been predicted using a 5mm/year allowance for sea rise as recommended in general guidance by the EA. *Table JER2943-001* summarises the predicted flood levels for the River Thames for a number of recurrence interval events.

*Table JER2943-001 Summary of River Thames Maximum Water Levels*

<b>Recurrence Interval</b>	<b>Flood Level 2005</b>	<b>Flood Level 2110</b>	<b>Data Source</b>
Maximum Spring Tide	4.02	-	Admiralty Tide Charts
10	5.19	5.71	2005 EA Provided, 2110 RPS Estimate
20	5.28	5.86	2005 EA Provided, 2110 RPS Estimate
50	5.42	5.96	2005 EA Provided, 2110 RPS Estimate
100	5.53	6.05	2005 EA Provided, 2110 RPS Estimate
200	5.72	6.26	A linear interpolation has been used to estimate the approximate 200-year return period event.
1000	5.90	6.50	2005 EA Provided, 2110 RPS Estimate

- 1.17 The Ingrebourne (also known as the Rainham Creek) is located approximately 300m to the east of the application site. This watercourse drains a catchment area of approximately 62km<sup>2</sup>, convening with the River Thames east of the site. An Environment Agency gauging station is located on this watercourse at Upminster (37018), 6km upstream of the site. The baseflow in this river is reported to be 0.62 cumecs (Envirocheck, 2005). Discharge to the River Thames appears to be controlled through a system of sluices beneath Frog Island, through which the Ingrebourne is culverted before discharging into the Thames. The watercourse is designated as Main River.

- 1.18 The EA were unable to supply fluvial flood levels for this watercourse although they have indicated that flood levels similar to the Beam River are to be expected.
- 1.19 The Beam River is located 800m to the west of the site. This watercourse drains a catchment area of 63km<sup>2</sup>, discharging into the River Thames at this location. An Environment Agency gauging station, the Beam at Elm Park (37019), is located on this watercourse 3.5km upstream of the confluence with the Thames. The baseflow in this river is reported to be 0.31 cumecs, (Envirocheck, 2005). Discharge to the River Thames is controlled through a system of sluices. The site visit revealed the sluice at the downstream extent to be in good operational order, and to be maintained by the Environment Agency. The watercourse is designated as Main River.
- 1.20 The EA have provided flood levels at the Beam River (NGR 549911 181586) as follows:
- 1 in 100 year event – 1.88m AOD
  - 1 in 200 year event – 1.92m AOD
- 1.21 The Havering drainage ditch is located 250m to the west of the site. Discharge to the River Thames is by a flap gated and sluiced culverted outlet which is maintained by the EA and appeared to be in good working order at the time of the site visit. A second sluice is located in this drainage ditch approximately 480m upstream of the River Thames discharge point and is likely to be used to control water levels. The Havering drainage ditch provides the main surface drainage for a portion of the Ford Motor Works and adjacent industrial areas. The drainage ditch trends in a north-easterly direction beyond the site and is culverted beneath the Docks access road 770m upstream of the confluence with the River Thames. A further unnamed drainage ditch trending east-west, to the north of Marsh Way convenes with the main Havering drainage ditch on the north-eastern side upstream of the Dock access road culvert. The Havering drainage ditch is classified as Main River by the EA.
- 1.22 The EA have provided flood levels at the Havering Drainage Ditch (NGR 550416 181384) as follows:
- 1 in 100 year event – 1.53m AOD
  - 1 in 200 year event – 1.77m AOD
- The EA have qualified these levels indicating that other private studies for this area were predicting higher levels by about 300mm and similar to those predicted for the River Beam.

#### **Site Surface Drainage**

- 1.23 The Ford carpark formal drainage system outfalls to the surrounding watercourses with runoff following the surface topography, resulting in a south-west / south-east flow split. Surface

water runoff will either pond in the south-eastern and/or south-western corners of the site, or discharge to the Ingrebourne and/or Havering drainage ditch respectively under natural gravitational flows or sheet flow during periods of heavy rainfall. It is likely that the storage pond in the south-eastern corner of the site accepts some surface water runoff. It is unlikely that much infiltration of surface water occurs, as the site is laid to asphalt.

- 1.24 The Flo-Gas site appeared to have a formal drainage system, with water draining to the southern part of the site under natural gravitational flows, whence it passes into a sump from where it is discharged into the Thames via a pumped outfall. It is likely that a proportion of the surface water infiltrates through the gravel hardstanding.
- 1.25 The site walkover revealed the presence of a storage pond within the south-eastern section of the application area, which is currently used to store a proportion of the surface water runoff. No outfall could be found for this pond, although it was high tide in the Thames and any outfall may have been obscured. This pond may previously have been used for the storage of a proportion of the surface water runoff from the site.

#### **Flood Defences**

- 1.26 The proposed development site is generally located above the topography of the surrounding area with a typical site level range of 5.50 to 9.00m AOD as compared to the Hornchurch Marshes with levels ranging between 2.00 to 4.50m AOD.
- 1.27 The site is protected by the River Thames flood defences, which include grassed earth embankments and floodwalls constructed from reinforced concrete. Flood flapped and sluiced outfall arrangements to the River Thames are located on the Ingrebourne, Beam River and the unnamed drainage ditch to the west of the site. These arrangements can be used to control flows in the watercourses and to prevent inflow from the River Thames during high water levels. The location of the flood defence elements are shown on the Site Location Plan JER 2943-001.
- 1.28 The site is located downstream of the Thames Flood Barrier and is therefore not afforded the additional protection from tide levels and storm surges that other areas of greater London benefit from.
- 1.29 The River Thames flood defences in the vicinity of the site consist of an earth embankment of approximately 600m length that is located immediately adjacent and to the south of the existing site, parallel with the River Thames. The elevation of the flood defence embankment is generally 7.54m AOD with an approximate base width of 15m. This embankment is formed from compacted earth and has stone pitching at the base on the River Thames face. In addition significant lengths of similar flood defences at a similar levels are located to the east

and west of the site providing a continuous line of flood protection for other areas of greater Barking. In some instances a portion of the flood defences in the vicinity of the site consist of a lower embankment topped with a low-level concrete flood defence wall.

- 1.30 Visual inspections of the existing flood defences adjacent the site was undertaken as part of the site walkover. This included an inspection of the culverted and sluiced outfall arrangements for the Ingrebourne and Havering drainage ditch to the west of the site. The existing flood defences were found to be in generally good condition. Full details of the visual inspection and a photographic record are contained in Appendix 1.

### **Proposed Site Description**

- 1.31 It is proposed to construct a Renewable Energy Facility on the application site. The total area of the development is 1.11ha and no significant reprofiling of the surface topography is proposed. A conveyor may be utilised to provide fuel with its route located adjacent and parallel to the existing River Thames flood defences for a length.

## 2 Flood Risk Assessment

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### Summary of Method

2.1 The assessment has been undertaken in accordance with the principals of PPG25 and aims to minimise any impacts of the development on flood risk via appropriate mitigation. The scope of the assessment has been agreed in principal with the EA. A copy of the relevant correspondence is contained in Appendix 3. The scope includes:

- A review of the provided EA 200-year and 1000-year tidal flood levels for the River Thames in the vicinity of the site;
- Assessment of the current level of defence provided by the flood defences along the River Thames and in the future. The 200-year event has been assessed as the guideline standard for purposes of development, while the 1000-year event has been used to assess the consequences of a significant flood event. A development design life of 100-years has been assumed;
- An assessment of the impact of the potential development on the existing defences and/or future maintenance or upgrades.
- Consideration of the consequences of an overtopping or breach scenario for the flood defences in the vicinity of the site;
- Estimation of the 100-year fluvial flows for the Ingrebourne, Beam River and Havering drainage ditch;
- Assessment of the 100-year fluvial flooding for the site. This has been undertaken using modelled flood level data provided by the EA and a quantitative approach which considers flow volumes in the adjacent watercourses and storage volume in the Hornchurch Marshes floodplain;
- An outline surface water drainage strategy that demonstrates no detrimental impact on the existing watercourses or property;
- Consideration of other flood management issues (i.e. access/egress)
- Assessment of the 200-year and 1000-year tidal floodplain envelopes for the existing and proposed development

- Evaluation of the flood storage area available within the vicinity of the site for flooding from the Thames tributaries
- Outline for a flood mitigation strategy and flood management plan

## **Flood Concerns**

### **Tidal Flooding**

- 2.2 The application site is shown to be partially located within the defended floodplain envelope for the River Thames (see JER2943-002). This report will review the standard of protection offered by the flood defences at the application site through a comparison of the flood levels for the River Thames with the defence and site levels (as applicable). The River Thames flood levels are provided in *Table JER2943-001*.
- 2.3 In addition it should be highlighted that the existing River Thames flood defences adjacent the site are built to a very high standard that equates to greater than the current 1000 year flood event recurrence interval (i.e. there is a 0.1% chance of this event occurring in any one year) however events in excess of this (rarer or into the future) could occur and overtopping of the flood defences could result. In addition a structural failure of the flood defences resulting in a breach is possible, as is a failure of the flapped gate and sluiced culverted outfall arrangements. Any such events could have a minor to significant impact on the site or future development subject principally to the nature and location of the failure. The consequences of such an unlikely event are to be considered.

### **Fluvial Flooding**

- 2.4 During high tidal events and/or extreme flooding in the River Thames, the discharge of surface water from the Ingrebourne, Beam River and the Havering drainage ditch may become restricted resulting in backwater effects. The resultant surface water stored within these channels and adjacent floodplain can lead to a significant rise in water levels, which cannot be alleviated until water levels in the Thames fall. The resultant flood levels in the adjacent watercourses and floodplain could impact on the site.

### **Flood Defences**

- 2.5 The construction of the development built forms including the conveyor option and/or surface water outfall structures could impact on the integrity of the existing defences or the ability of the EA to undertake future maintenance and/or upgrades.

## Flood Risk

### Tidal Flood Risk

- 2.6 An existing 200-year recurrence interval tidal flood level of 5.72m AOD has been determined for the River Thames at this location. The topographic survey data shows the tidal defences to be at a level of 7.20- 7.54m AOD. The existing site and proposed development are therefore considered to be defended from a 200-year recurrence interval tidal event with a minimum 600mm freeboard allowance.
- 2.7 A 200-year recurrence interval tidal flood level of 6.26m AOD has been determined for the River Thames at this location to the year 2110. The proposed development is therefore considered to be defended from a 200-year recurrence interval tidal event with a minimum 600mm freeboard allowance.
- 2.8 An existing 1000-year recurrence interval tidal flood level of 5.90m AOD has been determined for the River Thames at this location. The site and proposed development are therefore considered to be defended from a 1000-year recurrence interval tidal event with a minimum 600mm freeboard allowance.
- 2.9 A 1000-year recurrence interval flood defence level of 6.50m AOD has been determined for the River Thames at this location to the year 2110. The proposed development is therefore considered to be defended from a 1000-year recurrence interval tidal event with a minimum 600mm freeboard allowance.
- 2.10 In the unlikely event of overtopping of the existing flood defences or a breach during an extreme River Thames flood event, inundation of the Hornchurch Marshes floodplain and potentially the development may occur. The extent of this overtopping and the consequences for the development would be dependent upon a number of factors including the magnitude of the event (River Thames water level), location, extent and the emergency response. The failure event could occur over several tide cycles and access to implement temporary protection (i.e. sandbags) may be impeded. The velocity of floodwater would be expected to be high given the developments location directly adjacent the flood defences. Flood depths of several 100 millimetres could be expected across the site for an overtopping event while depths exceeding 1.5m could occur should the breach form adjacent to the site (extremely unlikely). In any event a failure of the flood defences would result in the rapid inundation of the development with a high associated flood hazard.
- 2.11 The development site is located at a level significantly higher than the surrounding floodplain, which provides a preferential flow path and significant flood storage potential. Therefore flood

depths exceeding several hundred millimetres would be unlikely with surface flow to the lower areas adjacent the development. Figure JER2943-006 demonstrates this.

- 2.12 The impact associated with a failure of the flood defences would be considered as minor to severe adverse.
- 2.13 The existing flapped gate and sluiced culverted outfall arrangements prevent backwater effects from the River Thames affecting levels in the Ingrebourne, River Beam and the Havering drainage ditch. In the event of failure of the existing flapped gate and sluiced culverted outfall arrangements, reverse flow into the watercourses would occur from the River Thames during periods of high water levels. This would cause progressive flooding of the watercourses and adjacent floodplain areas. Flooding from such a source is extremely unlikely to affect the existing site. The existing site is located at a level significantly higher than the surrounding floodplain, which provides a preferential flowpath and significant flood storage potential. Figure JER2943-006 demonstrates this.

#### **Fluvial Flood Risk**

- 2.14 The fluvial flood risk assessment has been undertaken using watercourse flood level data provided by the EA. A qualitative approach to fluvial flooding has also been undertaken to demonstrate the significant flood storage volumes available in the Hornchurch Marsh floodplain for extreme fluvial events or river-locking scenarios.

#### EA Provided Flood Levels

- 2.15 An existing 100-year recurrence interval fluvial flood level of 1.88m AOD has been adopted for assessment of the impact on the watercourses in the vicinity of the site. The topographic survey data shows the existing site to be at a level of 5.50 to 9.00m AOD. The existing site and proposed development are therefore considered to be unaffected by fluvial flooding for a 100-year recurrence interval fluvial event with a minimum 300mm freeboard allowance.
- 2.16 A predicted 100-year recurrence interval fluvial flood level of 2.26m AOD has been determined for the watercourses in the vicinity of the site to the year 2110. This estimate has conservatively assumed a +20% increase in flood level as a result of global warming. The proposed development is therefore considered to be unaffected by fluvial flooding for a 100-year recurrence interval fluvial event to the year 2110 with a minimum 300mm freeboard allowance.

#### Qualitative Approach

A qualitative approach has been undertaken to assess the fluvial flood risk to the existing site and development. This approach involves establishing the maximum potential volume of surface water that could be trapped in the watercourses during river-locking by the River

Thames. A conservative assumption that assumes no outflow from the watercourses to the River Thames during the 100-year recurrence interval event has been utilised.

- 2.15 A rainfall event duration of 12 hours was used in the flow estimate and represents the event that would generate the greatest volume of runoff to the subject watercourses over a period of two-tide cycles.
- 2.16 An approximate stage/storage (level/volume) relationship was developed for the Hornchurch Marsh floodplain area located upstream of the site using 1:50000 Ordnance Survey mapping. The assumed flood cell bounded by the Ingrebourne and Beam River is shown on Figure JER2943-006 as is the preferential flow paths for larger flood events. It has been assumed that all flows in the three subject watercourses are directed into this flood cell (conservative).
- 2.17 Flows have been generated for the Ingrebourne, the Beam River and the Havering drainage ditch using WINFAP-FEH with the production of hydrographs scaled to the FEH flow estimates using MIKE11.
- 2.18 The flow estimates for the watercourses were derived using the Flood Estimation Handbook Statistical Method and catchment descriptors. No gauging information was used and only stations with an inadequate record length were removed from the default pooling group. This minimal approach was considered sufficient for a qualitative assessment.

The predicted flows are as follows:

*Table JER2943-002 Return Period Flows for the Watercourses*

Return Period (years)	Ingrebourne	Beam River	Havering Drainage Ditch
	Statistically Derived Flow (m <sup>3</sup> /s)		
QMED	12.354	13.332	0.277
5	17.077	18.095	0.400
10	19.697	20.602	0.480
25	22.731	23.382	0.586
50	24.855	25.254	0.672
100	26.884	26.987	0.764

- 2.19 The volume of water contained in the flood cell watercourses for a 100-year, 12-hour duration recurrence interval storm event, with river-locking is detailed in *Table JER2943-003*. The hydrographs are contained in Appendix 2 – Calculations.

Table JER2943-003 – Watercourse Volume Summary

Return Period (Years)	Ingrebourne (m <sup>3</sup> )	Beam River (m <sup>3</sup> )	Havering Drainage Ditch (m <sup>3</sup> )	Total Volume (m <sup>3</sup> )
100	1161339	1165838	33005	2360232
100 + 20 % **	1393667	1399006	39606	2832278

2.20 The storage volume available in the assumed flood cell and approximate depth of inundation given the total volumetric inputs from Table JER2943-003 is detailed in Table JER2943-004, below. An assumed typical watercourse invert of 0.00m AOD and a typical minimum floodplain level of 2.50m AOD have been assumed for the floodcell (conservative).

Table JER2943-004 – Hornchurch Marsh Floodcell Volume Summary

Contour Level	Flood Cell Storage Area	Total Inflow Volume	Approximate Depth	Approximate Flood Level Range
100 – Year				
2.50	0	N/A	N/A	N/A
5.00	2250000	2360231	2.10	2.10 - 4.60
7.50	4000000	2360231	N/A	N/A
10.00	5750000	2360231	N/A	N/A
100 – Year + 20%				
2.50	0	N/A	N/A	N/A
5.00	2250000	2832276	2.52	2.52 - 5.02
7.50	2250000	2832276	N/A	N/A
10.00	5750000	2832276	N/A	N/A

2.21 Therefore using a simple but conservative volumetric check it can be clearly demonstrated that the existing site and development with surface levels ranging between 5.50-9.00m AOD are well elevated above the surrounding Hornchurch Marsh floodplain with the preferential flow paths along the existing watercourses. The site and proposed development is therefore considered at negligible risk from fluvial flooding.

## **Mitigation of Flood Risk**

### **Tidal Flood Risk**

- 2.22 No tidal flood mitigation is proposed for the site. The site is protected from tidal flooding from the River Thames by the existing flood defences consisting of grassed earthen embankments with flapped gate and sluiced culverted outfall arrangements protecting the watercourses discharging to the River Thames.
- 2.23 A flood management strategy should be developed for the site to include designated dry access routes and evacuation plans. It should incorporate as appropriate the guidance provided on flood management that is available at a local, regional and national level.
- 2.24 A flood management strategy should be developed for the site to include designated dry access routes and evacuation plans. Additionally it may prove beneficial to subscribe to the EA Flood Warning programme, which would provide warning and/or predictions for high flows resulting from fluvial and tidal events.
- 2.25 Dry access for the site would be provided via Frog Lane, which exits the site to the north and is locally elevated (all levels adjacent to the site being 9.10m AOD). However, this links into the main arterial roads of Rainham, which are at a lower level in areas.

### **Fluvial Flood Risk**

- 2.26 No fluvial flood mitigation is proposed for the site.
- 2.27 The surface water drainage strategy for the site will incorporate measures to ensure no detrimental impact on the existing watercourses. This is further detailed in the surface water assessment.

### **Flood Defences**

- 2.28 The development built form should be setback from the existing flood defences to minimise construction impacts on the stability of the defences and to allow for future maintenance or improvements as part of the EA's ongoing flood protection program.

## 3 Surface Water Runoff Assessment

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### Summary of Method

- 3.1 Based on guidance in PPG 25, the Environment Agency request that developments greater than 1ha in size should include an appropriate drainage strategy to ensure that surface water runoff discharge does not have a detrimental impact on the surrounding watercourses and property. In many instances this involves the attenuation of flows with controlled release typically at greenfield runoff rates. Analysis of the following has therefore been undertaken:
- Establishment of the existing runoff rate for the site
  - Assessment of the runoff from the proposed development
  - Determination of appropriate discharge rates from the development using guidance from local authorities including the Environment Agency and Development Control
  - Assessment of the mitigation requirements to ensure that appropriate discharge rates are maintained
  - Conceptual outline for a drainage strategy to provide the mitigation including attenuation of surface water runoff
- 3.2 For the assessment of the runoff from the existing site and the proposed development, three key land uses are considered: built area, hardstanding, and soft landscaping.
- 3.3 The proposed development will be built within the footprint of the existing Ford Motorworks carpark, which is impervious. Therefore an increase in runoff from the development is unlikely and infact the addition of soft landscape within the development could potentially reduce surface runoff to the adjacent watercourses. The EA have confirmed that they would be seeking to gain a reduction in the potential runoff from the site in the interest of providing a benefit to the greater catchment area. The improvement could be provided by a number of SUDS solutions including pervious pavers and storage ponds.
- 3.4 For purposes of this FRA the maximum storage requirement assuming discharge at the greenfield runoff rate has been evaluated, however the potential to reduce this storage volume may be possible as part of the detailed design.
- 3.5 The greenfield runoff rate has been assessed for the existing sites consider for various recurrence intervals up to 100 years, for a range of durations.

### Available Data

- 3.6 The following sources of data have been used to complete this assessment:

- Topographical data for the existing site
- Land-use data for the existing and proposed sites
- Catchment descriptors and rainfall data for the site for storm durations up to 48 hours, as determined from the FEH CD-ROM
- Flow information for the local watercourses determined using WINFAP-FEH analysis
- Information and photography gathered from the site walkover

## Rainfall Conditions

3.7 Using the FEH CD-ROM DDF modelling, the depth of rainfall at the site for a range of durations spanning from 15 minutes to 48 hours has been calculated. A brief synopsis of the rainfall depths and intensities for the 100-year event for this range of durations is provided in Appendix 2 – Catchment Rainfall.

## Land Use

3.8 The existing site area is 1.11ha, predominantly asphalt surfaced and used as a new car carpark by Ford. The proposed development layout is shown in Figure JER2943-004 and would also be predominantly of an impervious nature. Table *JER2943-005* below, lists the area coverage of each land use type across the existing site and also shows the revised land use for the proposed development.

*Table JER2943-005 Land Use Types for the Existing Site and Proposed Development*

Land Use Type	Total Land use Area			
	Existing Site		Proposed Development	
	m <sup>2</sup>	%	m <sup>2</sup>	%
Built area	0	0	5543	50
Hard standing	11120	100	5577	50
Soft landscaping	0	0	0	0
TOTAL	11120	100	11120	100

## Estimation of Greenfield Runoff Rates

3.9 The 'greenfield' runoff rate estimates have been derived using the FEH statistical procedure. Estimates of flows within each of the three watercourse catchments surrounding the site have been made for various recurrence interval events using a time to peak of 3.0 hours.

- 3.10 The 'greenfield' runoff rate relevant to a particular recurrence interval has been simply determined by dividing the predicted flow by the relevant watercourse catchment area (catchment wide approach). The adopted 'greenfield' runoff rates are the average of those derived for the individual catchments. Calculations are provided in Appendix 2.
- 3.11 The site is located adjacent the River Thames (receiving water) and no significant change to the existing imperviousness of the site or catchment break-up is proposed (i.e. maintain status quo). In many similar scenarios there would be no requirement for attenuation storage however given the potential river-locking scenario, attenuation storage has been considered for the site.
- 3.12 A 'greenfield' runoff rate of 4.1 l/s/ha and an approximate attenuation storage requirement of 450m<sup>3</sup> per hectare of impervious area has been adopted. A storage requirement of 500m<sup>3</sup> would be required for the development.

### **Surface Water Runoff Mitigation**

- 3.13 The required attenuation storage for the development can be achieved through the incorporation of appropriate SUDS (Sustainable Urban Drainage Systems) measures and/or the use of more traditional methods for the storage of runoff. Attenuation methods possible for the application site include:
- Permeable Paving
  - Attenuation Pond
  - Infiltration trenches
  - Swale
- 3.14 The predominant surface water drainage regime within the site is split with flow being directed to the south-east and south-west. It may therefore be prudent to locate any attenuation measures in one (or both) of the topographically low areas in the south-east and south west of the site, to allow natural gravitational flow towards the storage area.
- 3.15 Figure JER2943 – 004A and OO4B shows the conceptual surface water drainage and attenuation storage. The exact layout and form of the attenuation storage would be finalised as part of the detailed design.

## 4 Conclusions and Recommendations

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- 4.1 This assessment has been completed in accordance with PPG 25 as advised by Havering Borough Council and the Environment Agency, Development Control. It can be demonstrated that the proposed development site would not be at risk from fluvial or tidal flooding.
- 4.2 An outline strategy is to be agreed with the Environment Agency and key stakeholders as part of the planning application, to ensure the continued protection of the development from flood risk throughout its design life.
- 4.3 A drainage assessment has been completed to establish the existing surface water discharge rate for the site and the impacts on runoff resulting from the proposed development. It can be demonstrated that with the adoption of an appropriate drainage strategy, the development will have no adverse impacts on the flood risk elsewhere in the catchment.

## References

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CIRIA C523, (2001). Sustainable urban drainage systems: *best practice manual for England, Scotland, Wales and Northern Ireland*. 129

# Figures

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# Appendices

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## **Appendix 1**

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### **Photography**

## Appendix 2

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### Calculations

## **Appendix 3**

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### **Correspondence**