NORTH LONDON WASTE AUTHORITY

NORTH LONDON HEAT AND POWER PROJECT

FLOOD RISK ASSESSMENT

The Planning Act 2008 The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5 (2) (e)

AD05.14

Amec Foster Wheeler

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north london waste authority

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Executive summary

i.i.i This Flood Risk Assessment (FRA) has been prepared for the North London Heat and Power Project (the Project) at Advent Way, Enfield in North London. This report supports an application for a Development Consent Order (DCO).

i.i.ii This FRA has been prepared in line with the National Planning Policy Framework (NPPF)[1] and other relevant national, regional and local policy and guidance. The Environment Agency (EA) and London Borough Enfield (LB Enfield) have been consulted on the approach.

i.i.iii Current EA flood risk mapping shows that most of the Application Site is located in Flood Zone 1, with the central section of Edmonton EcoPark within Flood Zone 2, i.e. there is a low probability of flooding across the majority of the Edmonton EcoPark, but some areas are at risk during an extreme fluvial flood (the 0.1 per cent Annual Exceedance Probability (AEP) event). The Temporary Laydown Area is entirely located within Flood Zone 2. Watercourses which are close to the Application Site are Enfield Ditch and Salmon's Brook which are adjacent to Edmonton EcoPark, and the River Lee Navigation. The River Lee itself is located approximately 25m to the east of the Temporary Laydown Area.

i.i.iv The Project is appropriate for Flood Zone 2. As such, the Exception Test does not need to be passed. The Sequential Test is deemed to be passed because the Application Site has been allocated for the current (and the proposed) use by LB Enfield in their development planning documents; the Edmonton EcoPark is already in use for waste processing and power generation and will continue to be used as such. There is, however, a remaining requirement to apply a sequential approach to the development within the red line boundary.

i.i.v Once an allowance for climate change has been taken into account, three small areas of the Edmonton EcoPark are within the defended 1 per cent AEP flood extent. The first of these is on the wharf adjacent to the River Lee Navigation where EcoPark House is proposed. 11.0m^3 flood storage compensation would be provided for loss of floodplain volume under the climate change scenario. Level for level storage would be provided on-site upstream of the wharf on the west bank of Enfield Ditch. Finished floor levels be set at or above 10.97m AOD, which incorporates a 300mm freeboard above the design flood level. The second area relates to a small existing car park in the southern section of the Application Site. Part of this is to be developed to provide an improved southern access road from Advent Way to the Edmonton EcoPark, and floodplain compensation is also proposed here. Approximately 107m^3 of compensation would be provided on the northern bank of Enfield Ditch. The cross section of the new crossing over Enfield Ditch for the improved southern access would remain unchanged compared to that for the existing crossing, to ensure no impact elsewhere as a result of constriction of flows. The third area is located on

[1] Department for Communities and Local Government (2012) National Planning Policy Framework, March 2012.

the western edge of Edmonton Eco Park, associated with the flood extent of Salmon's Brook.

i.i.vi Upgrades are proposed to one crossing of Enfield Ditch at the main entrance at the south of the Application Site and a new crossing of the Ditch would be built on the east boundary of the Application Site, to access the Edmonton EcoPark from Lee Park Way. Flood defence consent would be required by the EA for works within 8m of the river banks. The design for the eastern crossing would ensure that the design fluvial flood (1 per cent AEP with climate change) is not impacted. As discussed above, compensation would be provided for floodplain lost associated with the improvement to the southern crossing.

i.i.vii There is a residual risk of flooding in the event of flood defence failure in the upstream Lee catchment. To mitigate this residual risk, an Emergency Flood Plan would be included as part of the overall site Emergency Plan. It would include procedures for receiving Flood Warnings from the EA, evacuating the Application Site (during construction) and the Edmonton EcoPark (once redeveloped) when Flood Warnings are received, and moving vehicles and equipment to areas at lowest risk. This is a conservative and precautionary response to residual flood risk; in future, detailed multi-scenario breach modelling in the catchment could be used to refine the residual risk and actions to be taken as set out in the Emergency Flood Plan.

i.i.viii The FRA has concluded that groundwater is not a flood risk at the Application Site. The Application Site is underlain by alluvium deposits overlying a relatively thin layer of London Clay at shallow depth, and the principal chalk aquifer beneath that. The Application Site is located within a groundwater Source Protection Zone relating to nearby public water supply boreholes, which abstract from the chalk. The Project has been designed such that the integrity of the clay aquiclude[2] will be retained (no breach of the clay layer), thus maintaining the existing protection provided to the underlying chalk aquifer from any contamination present at the Application Site. Perched groundwater levels (above the clay) are close to the surface in some parts of the Application Site, but the surrounding watercourses will serve to drain groundwater; scenarios under which these watercourses could not drain groundwater would be associated with fluvial flood events discussed above.

i.i.ix The Application Site is within the maximum flood extent associated with the failure of reservoirs provided by the EA. There are several reservoirs located in the Lee Valley; William Girling Reservoir is located to the north-east of the Application Site, and Banbury Reservoir to the south, owned and operated by Thames Water Utilities Ltd. (TWUL). The reservoirs are subject to a stringent maintenance and inspection regime under the Reservoirs Act 1975 (as amended), and therefore the risk is considered to be very low.

i.i.x The existing surface water drainage system would continue to operate while the phased construction progresses. Based on topography it is assessed

[2] An impermeable layer of geology or bedrock through which groundwater does not flow.

that flood risk from this drainage system in the event of extreme rainfall would not affect the earlier phases of development, nevertheless some temporary drainage may need to be in place during construction. Temporary drainage would discharge to Salmon's Brook or Enfield Ditch.

i.i.xi Some surface water drainage from the Application Site currently discharges to the Chingford combined trunk sewer via the combined drainage system. The Project would include a new surface water drainage scheme, and once redeveloped, only minimal areas, such as wheel washes would drain to the combined sewer. This reduction in potentially flash flows to the combined sewer would reduce the risk of sewer flooding at the Application Site and in the vicinity compared to the current situation. TWUL has confirmed that they have no record of flooding incidents at the Application Site as a result of surcharging public sewers.

i.i.xii A preliminary surface water drainage strategy has been prepared, including a preliminary assessment of the suitability of various Sustainable Drainage Systems (SuDS). The assessment addresses the quality, quantity and amenity impact on the future development proposals as well as the opportunity to combine various SuDS techniques to produce a recognised management/treatment train solution.

i.i.xiii The surface water strategy proposes the following SuDS:

a. rainwater harvesting;
b. green and/or brown roofs;
c. lined permeable paving;
d. lined filter trenches;
e. attenuation tanks; and
f. oil separators and catch pits.

i.i.xiv All potential sources of flood risk have been considered, and where a risk has been identified, sufficient mitigation in line with best practice is proposed. The Edmonton EcoPark is already allocated for the proposed use and therefore does not require application of the Sequential Test, and the proposed use is appropriate for the Flood Zone, meaning that the Exception Test does not need to be passed. A sequential approach has been taken to the layout of the Application Site, with the new development to be located in the lowest risk areas of the Application Site.

i.i.xv The mitigation measures set out in this FRA would ensure that the Project would not be subject to an unacceptable level of flood risk, and would also ensure no increase in flood risk elsewhere.

1 Introduction

1.1.1 This Flood Risk Assessment (FRA) has been prepared to support North London Waste Authority's (the Applicant's) application (the Application) to the Secretary of State for Energy and Climate Change for a Development Consent Order (DCO) pursuant to Section 37 of the Planning Act 2008 (as amended).

1.1.2 The Application is for the North London Heat and Power Project (the Project) comprising the construction, operation and maintenance of an Energy Recovery Facility (ERF) capable of an electrical output of around 70 megawatts (MW_e) at the Edmonton EcoPark in north London with associated development, including a Resource Recovery Facility (RRF). The proposed ERF would replace the existing Energy from Waste (EfW) facility at the Edmonton EcoPark.

1.1.3 The Project is a Nationally Significant Infrastructure Project for the purposes of Section 14(1)(a) and section 15 in Part 3 of the Planning Act 2008 (as amended) because it involves the construction of a generating station that would have a capacity of more than $50MW_e$.

1.2 Purpose of this document

1.2.1 This FRA forms part of a suite of documents accompanying the Application submitted in accordance with the requirements set out in section 55 of the Planning Act and Regulations 5, 6 and 7 of the Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 (APFP Regulations 2009), and should be read alongside those documents (see Project Navigation Document AD01.02). The FRA is submitted as Application Document AD05.14 and also forms Vol 2 Appendix 11.2 of the Environment Statement (ES) (AD06.02).

1.2.2 A flood risk assessment is required for all developments of more than 1 hectare (ha) in area, as set out in the National Planning Policy Framework (NPPF)[3]. The FRA has been produced in accordance with the NPPF as well as the National Planning Statement for Energy[4] and associated guidance, and all other relevant national, regional and local policy and guidance.

1.2.3 The FRA has been informed by a visit to the existing Edmonton EcoPark and surrounding area carried out by Amec Foster Wheeler E&I UK Ltd on 15 October 2014, and consultation with the Environment Agency (EA) and London Borough of Enfield (LB Enfield).

1.2.4 This Assessment forms part of a suite of documents accompanying the Application submitted in accordance with the requirements set out in section 55 of the Planning Act and Regulations 5, 6 and 7 of the

[3] Department for Communities and Local Government (2012) National Planning Policy Framework, March 2012.

[4] Department for Energy and Climate Change (2011) Overarching National Policy Statement for Energy (EN1): Planning for New Energy Infrastructure, Department of Energy and Climate Change, July 2011.

Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 (APFP Regulations 2009), and should be read alongside those documents (see Project Navigation Document AD01.02).

1.3 Document structure

1.3.1 The structure of the report is as follows:

a. Section 2 - description of the existing Application Site, including hydrology, topography, geology, hydrogeology and soils, and other aspects relating to flood risk;

b. Section 3 - describes the Project in relation to flood risk;

c. Section 4 - sets out the planning context for the Project, in terms of managing flood risk;

d. Section 5 - assesses flood risk at the Application Site from all sources;

e. Section 6 - describes the mitigation measures to be implemented to manage flood risk;

f. Section 7 – provides a summary of the proposed preliminary drainage strategy for the Project; and

g. Section 8 – sets out conclusions.

1.4 The Applicant

1.4.1 Established in 1986, the Applicant is a statutory authority whose principal responsibility is the disposal of waste collected by the seven north London boroughs of Barnet, Camden, Enfield, Hackney, Haringey, Islington and Waltham Forest (the Constituent Boroughs).

1.4.2 The Applicant is the UK's second largest waste disposal authority, handling approximately 3 per cent of the total national Local Authority Collected Waste (LACW) stream. Since 1994 the Applicant has managed its waste arisings predominantly through its waste management contract with LondonWaste Limited (LWL) and the use of the EfW facility at the existing Edmonton EcoPark and landfill outside of London.

1.4.3 LWL is a private waste management company wholly owned by the Applicant, and is the freeholder of the Edmonton EcoPark and the operator of the existing EfW facility. LWL has a current contract with the Applicant for management of its waste which expires in December 2025 with flexibility for termination sooner. The contract includes:

a. the reception, treatment and disposal of residual wastes;

b. the operation of Reuse and Recycling Centres (RRC), including the recycling of wastes and the transfer of residual wastes to a disposal point;

c. the reception and treatment of separately collected organic wastes;

d. the reception and transportation of other separately collected wastes for recycling by third parties; and

e. the reception and transportation of other separately collected clinical and offensive wastes for treatment by third parties.

1.5 The Application Site

1.5.1 The Application Site, as shown on the Site Location Plans (A_0001 and A_0002) in the Book of Plans (AD02.01), extends to approximately 22 hectares and is located wholly within the London Borough of Enfield (LB Enfield). The Application Site comprises the existing waste management site known as the Edmonton EcoPark where the permanent facilities would be located, part of Ardra Road, land around the existing water pumping station at Ardra Road, Deephams Farm Road, part of Lee Park Way and land to the west of the River Lee Navigation, and land to the north of Advent Way and east of the River Lee Navigation (part of which would form the Temporary Laydown Area and new Lee Park Way access road). The post code for the Edmonton EcoPark is N18 3AG and the grid reference is TQ 35750 92860.

1.5.2 The Application Site includes all land required to deliver the Project. This includes land that would be required temporarily to facilitate the development.

1.5.3 Both the Application Site and the Edmonton EcoPark (existing and proposed) are shown on Plan A_0003 and A_0004 contained within the Book of Plans (AD02.01). Throughout this report references to the Application Site refer to the proposed extent of the Project works, and Edmonton EcoPark refers to the operational site. Upon completion of the Project the operational site would consist of the Edmonton EcoPark and additional land required to provide new access arrangements and for a water pumping station adjacent to the Deephams Sewage Treatment Works outflow channel.

Edmonton EcoPark

1.5.4 The Edmonton EcoPark is an existing waste management complex of around 16 hectares.

1.5.5 Current use of the Edmonton EcoPark comprises:

a. an EfW facility which treats circa 540,000 tonnes per annum (tpa) of residual waste and generates around $40MW_e$ (gross) of electricity;

b. an In-Vessel Composting (IVC) facility which processes food, landscaping and other green waste from kerbside collections and Reuse and Recycling Centres (RRCs) as well as local parks departments. The facility currently manages around 30,000tpa, and has a permitted capacity of 45,000tpa;

c. a Bulky Waste Recycling Facility (BWRF) and Fuel Preparation Plant (FPP) which receive bulky waste from RRCs and direct deliveries. These facilities respectively recycle wood, metal, plastic, paper, card and construction waste; and separate oversized items and shred waste suitable for combustion. These integrated facilities manage over 200,000tpa;

d. an Incinerator Bottom Ash (IBA) Recycling Facility which processes ash from the existing EfW facility;

e. a fleet management and maintenance facility which provides parking and maintenance facilities for the Edmonton EcoPark fleet of operational vehicles;

f. associated offices, car parking and plant required to operate the facility; and

g. a former wharf and single storey building utilised by the Edmonton Sea Cadets under a lease.

1.5.6 In order to construct the proposed ERF, the existing BWRF and FPP activities would be relocated within the Application Site; the IVC facility would be decommissioned and the IBA recycling would take place off-site.

Temporary Laydown Area and eastern access

1.5.7 The proposed Temporary Laydown Area is an area of open scrubland located to the east of the River Lee Navigation and north of Advent Way. There is no public access to this area. The Temporary Laydown Area would be reinstated after construction and would not form part of the ongoing operational site.

1.5.8 In addition to the Temporary Laydown Area the Application Site includes land to the east of the existing Edmonton EcoPark which would be used for the new Lee Park Way entrance and landscaping along the eastern boundary.

Northern access

1.5.9 The Application Site also includes Deephams Farm Road and part of Ardra Road with land currently occupied by the EfW facility water pumping station between the junction of A1005 Meridian Way and Deephams Farm Road.

1.6 Surrounding area

1.6.1 The Application Site is located to the north of the A406 North Circular Road in an area that is predominantly industrial. The Lee Valley Regional Park (LVRP) is located to the east of the Edmonton EcoPark.

1.6.2 Land to the north and west of the Application Site is predominantly industrial in nature. Immediately to the north of the Edmonton EcoPark is an existing Materials Recovery Facility (MRF) which is operated by a commercial waste management company, alongside other industrial buildings. Further north is Deephams Sewage Treatment Works. Beyond the industrial area to the north-west is a residential area with Badma Close being the nearest residential street to the Application Site (approximately 60m from the nearest part of the boundary) and Zambezie Drive the nearest to the Edmonton EcoPark at approximately 125m west.

1.6.3 Eley Industrial Estate located to the west of the Application Site comprises a mixture of retail, industrial and warehouse units.

1.6.4 Advent Way is located to the south of the Application Site adjacent to the A406 North Circular Road. Beyond the A406 North Circular Road are retail and trading estates; this area is identified for future redevelopment to provide a housing-led mixed use development known as Meridian Water.

1.6.5 The LVRP and River Lee Navigation are immediately adjacent to the eastern boundary of the Edmonton EcoPark, and Lee Park Way, a private road which also forms National Cycle Network (NCN) Route 1, runs alongside the River Lee Navigation. To the east of the River Lee Navigation is the William Girling Reservoir along with an area currently occupied by Camden Plant Ltd. which is used for the crushing, screening and stockpiling of waste concrete, soil and other recyclable materials from construction and demolition. The nearest residential areas to the east of the Application Site and LVRP are located at Lower Hall Lane, approximately 550m from the Edmonton EcoPark and 150m from the eastern edge of the Application Site.

1.7 The Project

1.7.1 The Project would replace the existing EfW facility at Edmonton EcoPark, which is expected to cease operations in around 2025, with a new and more efficient ERF which would produce energy from residual waste, and associated development, including temporary works required to facilitate construction, demolition and commissioning. The proposed ERF would surpass the requirement under the Waste Framework Directive (Directive 2008/98/EC) to achieve an efficiency rating in excess of the prescribed level, and would therefore be classified as a waste recovery operation rather than disposal.

1.7.2 The main features of the Project once the proposed ERF and permanent associated works are constructed and the existing EfW facility is demolished comprise:

a. a northern area of the Edmonton EcoPark accommodating the proposed ERF;

b. a southern area of the Edmonton EcoPark accommodating the RRF and a visitor, community and education centre with offices and a base for the Edmonton Sea Cadets (‘EcoPark House’);

c. a central space, where the existing EfW facility is currently located, which would be available for future waste-related development;

d. a new landscape area along the edge with the River Lee Navigation; and

e. new northern and eastern access points to the Edmonton EcoPark.

1.7.3 During construction there is a need to accommodate a Temporary Laydown Area outside of the future operational site because of space constraints. This would be used to provide parking and accommodation for temporary staff (offices, staff welfare facilities), storage and fabrication areas, and associated access and utilities.

1.7.4 There are some aspects of the Project design that require flexibility and have therefore yet to be fixed, for example, the precise location and scale of the buildings associated with the Project. It would not be possible to fix these elements in advance of the detailed design and construction which would be undertaken following appointment of a contractor should the DCO be granted. In order to accommodate this and ensure a robust assessment of the likely significant environmental effects of the Project, the Application is based on the limits of deviation set out in the Book of Plans (AD02.01), which identifies:

a. works zones for each work or group of works (to establish the area in which the development can be located); and

b. maximum building envelopes (to establish the maximum building length, width, height and footprint).

1.7.5 The Book of Plans (AD02.01) is supplemented by Illustrative Plans (included in the Design Code Principles, AD02.02) that set out the indicative form and location of buildings, structures, plant and equipment, in line with the limits of deviation established by the draft DCO (AD03.01).

1.7.6 A separate Environmental Permit would need to be obtained from the Environment Agency (EA) for the operation of the waste facility under the Environmental Permitting (England and Wales) Regulations 2010. The existing EfW facility at the Edmonton EcoPark is subject to an Environmental Permit issued by the EA. The Applicant is currently in discussions with the EA regarding an application for the new Environmental Permit(s) associated with the proposed ERF with a view to submitting an application in parallel with the DCO process.

Principal development (Works No.1a)

1.7.7 The principal development comprises the construction of an ERF located at the Edmonton EcoPark, fuelled by residual waste and capable of an electrical output of around $70MW_e$ (gross) of electricity. The principal development consists of the following development, located within the limits of deviation shown on Drawing C_0002 and within the building envelopes shown on Drawing C_0003 (in the Book of Plans (AD02.01)):

(i) a main building housing:

(a) a tipping hall;

(b) waste bunker and waste handling equipment;

(c) two process lines (with each line having a capacity of 350,000 tonnes of waste per annum), consisting of a moving grate, furnace, boiler and a flue gas treatment plant;

(d) facilities for the recovery of incinerator bottom ash and air pollution control residue;

(e) steam turbine(s) for electricity generation including equipment for heat off-take; and

(f) control room containing the operational and environmental control and monitoring systems, and offices.

(ii) entry and exit ramps to the ERF;

(iii) a stack containing flues for flue gas exhaust;

(iv) cooling equipment; and

(v) an observation platform enclosure.

Associated development (Works No. 1b – 7)

1.7.8 Associated development within the meaning of section 115(2) of the Planning 2008 Act (as amended) in connection with the Nationally Significant Infrastructure Project referred to in Works No.1a, comprising:

(a) Works No.1b – works required to provide buildings, structures, plant and equipment needed for the operation of the ERF as shown on Drawing C_0002 (AD02.01) comprising:

(i) a wastewater treatment facility;

(ii) a water pre-treatment plant;

(iii) external stores and workshops;

(iv) a fuelling area and fuel storage, vehicle wash, transport offices and staff facilities, toilets, natural gas intake and management compound, and fire control water tank(s); and

(v) electrical substation(s).

(b) Works No.2 – the construction of a resource recovery facility comprising the following building, structures and plant, as shown on Drawing C_0004 and within the building envelope shown on Drawing C_0005 (AD02.01):

(i) a Recycling and Fuel Preparation Facility (RFPF);

(ii) a RRC;

(iii) offices, and staff and visitor welfare facilities;

(iv) odour abatement and dust suppression plant and equipment; and

(v) fire control water tank(s) and pump house and equipment.

(c) Works No.3 – the construction of a building to provide visitor, community and education facilities, office accommodation, and a boat canopy, as shown on Drawing C_0006 and within the building envelope shown on Drawing C_0007 (AD02.01).

(d) Works No.4 – utilities and infrastructure work, landscaping, access, security and lighting, and weighbridges, as shown on Drawing C_0008 (AD02.01), comprising:

(i) With regard to the following:

(a) potable water;

(b) waste water;

(c) surface water;

(d) foul water;

(e) raw water;

(f) electricity;

(g) gas; and

(h) CCTV, telecoms and data,

works could include:

- the diversion, repositioning, decommissioning, removal, replacement, modification or upgrading of existing pipes, cables, systems and associated apparatus;
- the laying or installation of new pipes, cables, systems and associated apparatus; and
- the creation of connections to existing or new pipes, cables, systems and associated apparatus.

(ii) the erection of a raw water pumping station;

(iii) stabilisation works to the eastern bank of Salmon's Brook;

(iv) the construction of surface water pumps, pipework and attenuation tanks;

(v) landscaping works;

(vi) the installation of areas of green roof and/or brown roof;

(vii) the widening of the existing entrance into the Edmonton EcoPark from Advent Way, including modification or replacement of the bridge over Enfield Ditch;

(viii) construction within the Edmonton EcoPark of vehicle and cycle parking, vehicle, cycle and pedestrian routes, and weighbridges;

(ix) construction of an access into the Edmonton EcoPark from Lee Park Way, including bridging over Enfield Ditch;

(x) improvements to Lee Park Way including vehicle barriers and the creation of segregated pedestrian and cycle paths;

(xi) improvements to Deephams Farm Road and use of Deephams Farm Road as an access to the Edmonton EcoPark;

(xii) the resurfacing of Ardra Road (if required);

(xiii) security, fencing, and lighting works and equipment;

(xiv) the erection of security facilities and equipment and gatehouses within the operational site at access points from Advent Way, Ardra Road, and Lee Park Way;

(xv) the upgrade and maintenance of the existing bridge over the River Lee Navigation; and

(xvi) the installation of photovoltaic panels at roof level of the ERF and RRF.

(e) Works No.5 – works for the creation of the Temporary Laydown Area and its temporary use, as shown on Drawing C_0009 (AD02.01), as follows:

(i) areas of hardstanding;

(ii) the erection of fencing, hoarding or any other means of enclosure;

(iii) the erection of security facilities and equipment and gatehouses;

(iv) vehicle parking;

(v) office and staff welfare accommodation;

(vi) storage, fabrication, laydown area;

(vii) foul water storage and pumps and surface water attenuation storage and pumps;

(viii) utility works including electricity, water, CCTV, telecoms and data;

(ix) the creation of vehicular, cycle and pedestrian access from Lee Park Way to the Temporary Laydown Area; and

(x) restoration of the Temporary Laydown Area.

(f) Works No.6 – site preparation and demolition works within the area as shown on Drawing C_0010 (AD02.01), comprising:

(i) demolition of existing buildings, structures and plant excluding demolition of the existing EfW facility;

(ii) construction of a temporary ash storage building;

(iii) realignment of the exit ramp from the existing EfW facility; and

(iv) works to prepare the land shown on Drawing C_0008 (AD02.01) for the construction of works numbers 1a, 1b, 2, 3, 4 and 5.

(g) Works No.7 – as shown on Drawing C_0011 (AD02.01), comprising decommissioning and demolition of the existing EfW facility and removal of:

(i) the existing stack;

(ii) demolition of the existing water pumping station on Ardra Road; and

(iii) making good the cleared areas.

1.7.9 The draft DCO also identifies such other works as may be necessary or expedient for the purposes of or in connection with the construction, operation and maintenance of the authorised development which do not give rise to any materially new or materially different environmental effects from those assessed and set out in the Environmental Statement (ES) (AD06.02).

1.8 Stages of development

1.8.1 The proposed ERF is intended to be operational before the end of 2025, but with the precise timing of the replacement to be determined. In order to do this, the following key steps are required:

a. obtain a DCO for the new facility and associated developments;

b. obtain relevant environmental permit(s) and other licences, consents and permits needed;

c. identify a suitable technology supplier;

d. agree and arrange source(s) of funding;

e. enter into contract(s) for design, build and operation of new facility and associated development;

f. move to operation of new facility; and

g. decommission and demolish the existing EfW facility.

1.8.2 Site preparation and construction would be undertaken over a number of years and it is expected that the earliest construction would commence is 2019/20, although this may be later. Construction would be implemented in stages to ensure that essential waste management operations remain functioning throughout. This is especially relevant for the existing EfW facility and associated support facilities.

1.8.3 The stages of the Project are as follows:

a. Stage 1a: site preparation and enabling works;

b. Stage 1b: construction of RRF, EcoPark House and commencement of use of Temporary Laydown Area;

c. Stage 1c: operation of RRF, EcoPark House and demolition/clearance of northern area;

d. Stage 1d: construction of ERF;

e. Stage 2: commissioning of ERF alongside operation of EfW facility, i.e. transition period;

f. Stage 3: operation of ERF, RRF and EcoPark House, demolition of EfW facility; and

g. Stage 4: operation of ERF, RRF and EcoPark House, i.e. final operational situation.

Stage 1a

1.8.4 Stage 1a involves a series of site preparation and enabling works required for the Project. The works would include:

a. enabling works along Deephams Farm Road to create the Deephams Farm Road access;

b. demolition of clinical waste building and maintenance workshop building;

c. infill of artificial pond and clearance of landscaped area to form temporary storage and parking area;

d. layout of replacement fleet parking areas and temporary support buildings on the site of the maintenance workshop;

e. establishment of hoarded demolition work sites with safe pedestrian and vehicular access to the existing EfW facility main entrance and staff car parks. Access to the existing EfW facility would continue to be from the existing Edmonton EcoPark access;

f. relocation of Edmonton Sea Cadets to existing EfW facility meeting rooms with safe pedestrian and vehicular access via the existing Edmonton EcoPark access at Advent Way to the main entrance and staff car parks; storage of Edmonton Sea Cadets equipment in a container located at front of the existing EfW facility and relocate their boats to an off-site location provided by the Edmonton Sea Cadets;

g. diversion of utilities and services affected by demolition and clearance works including diversion of the sewer trunk main owned by Thames Water Utilities Limited (TWUL) which runs under the proposed location of the RRF;

h. demolition and clearance of EcoPark House and RRF construction zones;

i. creation of new Lee Park Way access and temporary diversion of footpaths and cycleways; and

j. establishment of the Temporary Laydown Area to the north of Advent Way and east of the River Lee Navigation to provide for site offices; storage of construction materials, plant and machinery; fabrication/sub-assembly; and construction staff/contractor vehicle parking. Temporary diversion of footpaths and cycleways at the Temporary Laydown Area access points.

1.8.5 The existing EfW facility would continue to operate at current capacity. The existing IBA recycling facility would continue to process ash from the existing EfW facility. The existing BWRF, FPP and IVC would continue to operate in this period.

1.8.6 Operational vehicles would continue to access the Edmonton EcoPark via the access at Advent Way. This accounts for approximately 1,063 one way vehicle movements per day.

1.8.7 Traffic associated with the Stage 1a demolition and enabling works would arrive at the Edmonton EcoPark via the existing access on Advent Way.

Stage 1b

1.8.8 During Stage 1b, the RRF and EcoPark House buildings would be constructed in the southern part of the Edmonton EcoPark. It would be necessary to construct these buildings prior to the construction of the proposed ERF and demolition of the operations north of the existing EfW facility. The works required during this stage of construction would include:

a. commencement of use of Temporary Laydown Area;

b. relocation of LWL vehicle fleet to the north of existing EfW facility;

c. construction of EcoPark House;

d. construction of RRF and its weighbridges;

e. erection of temporary ash storage building;

f. layout of staff and visitor parking area immediately adjacent to EcoPark House;

g. commencement of use by staff and visitor vehicles of the new Lee Park Way access;

h. construction of the attenuation tank and associated drainage of the RRF sub-catchment; and

i. existing EfW facility exit ramp arrangements aligned with RRF construction area and required RRF operational vehicles routes.

1.8.9 The existing EfW facility would continue to operate at current capacity. The Edmonton Sea Cadets would continue to occupy space in the existing EfW facility.

1.8.10 The existing BWRF, FPP and IVC would continue to operate in this period, until the RRF is completed (see Stage 1c). The IBA recycling facility would continue to process ash from the existing EfW facility.

1.8.11 Operational vehicles would continue to access the Edmonton EcoPark via the existing Edmonton EcoPark access from Advent Way. The new Lee Park Way access would become available and be used by some staff and Edmonton Sea Cadets traffic.

1.8.12 Traffic associated with the construction of the RRF and EcoPark House would arrive at the Edmonton EcoPark via the existing access on Advent Way. Some traffic may arrive at the Temporary Laydown Area, travelling from the Temporary Laydown Area to the Edmonton EcoPark via Walthamstow Avenue and the existing access. Some light vehicles including construction staff shuttle buses may travel to the Edmonton EcoPark via the new Lee Park Way access.

Stage 1c

1.8.13 During this stage of construction the facilities to the north of the existing EfW facility would be demolished to make way for the proposed ERF. The works required involve:

a. completion of RRF and transfer of FPP/BWRF operations;

b. completion of EcoPark House and occupation by the Edmonton Sea Cadets;

c. relocation of Edmonton EcoPark stores;

d. disconnection of obsolete services and utilities within demolition zones;

e. demolition and clearance of existing FPP area;

f. demolition and clearance of existing BWRF area;

g. demolition and clearance of existing IBA area; and

h. demolition and clearance of existing IVC facility – composting activities to be relocated off-site and bulking facilities provided within the RRF to enable transport to third party treatment sites.

1.8.14 The existing EfW facility would continue to operate at current capacity, with a temporary ash storage building provided to replace the existing IBA area and allow the transfer of ash off-site for recycling.

1.8.15 The Recycling and Fuel Preparation Facility (RFPF) operations would commence within the RRF, with capacity to treat around 390,000 tpa. The RRC element of the RRF building would be open to members of the public and small businesses with access via the new Lee Park Way access. On completion of EcoPark House this would be available for community and education activities, the Edmonton Sea Cadets and for office accommodation associated with operation of the Edmonton EcoPark.

1.8.16 Operational vehicles would continue to access the Edmonton EcoPark via the existing access on Advent Way to serve both the existing EfW facility and proposed RRF. Members of the public and small business vehicles visiting the RRC element of the RRF, users of EcoPark House and staff would access the Edmonton EcoPark via the new Lee Park Way access.

1.8.17 Traffic associated with the northern Application Site clearance would use the new Deephams Farm Road access.

Stage 1d

1.8.18 During Stage 1d, the main build for the proposed ERF would occur within a defined work zone at the northern area of the Edmonton EcoPark. The works involve:

a. construction of ERF including piling and excavation works, civil and structural works, establishment of new utilities connections;

b. construction of the surface water attenuation tank(s) and associated drainage of the ERF sub-catchment;

c. erection of a new pumping station and associated pipework to provide raw water from Deephams Sewage Treatment Works outflow channel; and

d. partial landscaping.

1.8.19 The majority of heavy goods vehicles associated with the construction of the proposed ERF would arrive at the Edmonton EcoPark via the Deephams Farm Road access. Vehicle movements associated with the delivery of concrete would be undertaken directly to the Edmonton EcoPark while approximately 50 per cent of all other construction vehicle movements would be to the Temporary Laydown Area, with onward movement to the Edmonton EcoPark when required. The majority of these vehicles would travel via the A406 North Circular Road and A1055 Meridian Way to the Deephams Farm Road access. However, any abnormal loads may travel between the Temporary Laydown Area and the Edmonton EcoPark via the existing access. This would be undertaken at a time that minimises any conflict with Edmonton EcoPark operational vehicles.

1.8.20 The existing EfW facility would continue to operate at current capacity and the proposed RRF and EcoPark House would be operational.

1.8.21 Operational vehicles would continue to access the Edmonton EcoPark via the existing access on Advent Way to serve both the existing EfW facility and RRF. Members of the public and small businesses visiting the RRC element of the RRF, users of EcoPark House and staff would access the Edmonton EcoPark via the new Lee Park Way access.

Stage 2

1.8.22 This stage marks the completion of the proposed ERF, commissioning of the facility and start of operations. The existing EfW facility would then be ready for decommissioning and demolition. The works required involve:

a. commissioning of proposed ERF;

b. installation of ERF weighbridges;

c. relocation of operations contractors compound from adjacent to the existing EfW facility to adjacent to the southern side of the ERF;

d. relocation of operational stores adjacent to the ERF;

e. relocation of operational fleet depot to adjacent to ERF; and

f. completion of landscaping works that are not linked to or affected by the EfW facility demolition.

1.8.23 The commissioning stage of the proposed ERF is estimated to take between six and twelve months. The commissioning stage is necessary in order to test all of the equipment and processes before the proposed ERF is fully operational. During this stage both the existing EfW facility and the proposed ERF would be operational as waste inputs are gradually transferred from the existing EfW facility to the proposed ERF.

1.8.24 Landscaping and relocation of support facilities would take place during the ERF commissioning stage with use of the Deephams Farm Road access remaining in place for the operations contractor’s use, alongside staff shuttle buses from Lee Park Way as required.

1.8.25 The existing EfW facility would continue operation at a reduced capacity as incoming waste is transferred to the proposed ERF to allow its commissioning. The proposed ERF would increase the proportion of the waste that it takes as its commissioning progresses and both treatment lines are brought online.

1.8.26 The proposed RRF and EcoPark House would be operational.

1.8.27 Operational vehicles would continue to access the Edmonton EcoPark via Advent Way as before to serve both the existing EfW facility and proposed ERF and RRF. Some operational vehicles travelling to the ERF would use the Deephams Farm Road access. Members of the public and local businesses visiting the RRC element of the RRF would access the Edmonton EcoPark via the new Lee Park Way access.

Stage 3

1.8.28 Decommissioning, stripping out and demolition of the existing EfW facility would commence after the proposed ERF is fully commissioned and tests including the reliability period have been successfully completed. The works required would involve:

a. hoarding of the demolition work zone;

b. clearance of northern half of existing EfW facility site – once cleared the northern area of the EfW facility site would be used as a laydown for demolition equipment which is required before the demolition of the main EfW facility building can proceed;

c. completion of fleet parking and facilities area;

d. construction of widened southern entrance and new security gatehouse;

e. demolition and decommissioning of water pumping station;

f. demolition of main EfW facility building;
g. excavation of bunker and infilling with suitable material;
h. levelling of site and make good;
i. completion of Edmonton EcoPark landscaping works;
j. completion of staff car parks and surface water attenuation tanks on removal of EfW facility exit ramp; and
k. restoration of the Temporary Laydown Area.

1.8.29 The proposed ERF would operate at the capacity required with each process line capable of 350,000 tonnes per annum with a total capacity of the facility at 700,000 tonnes per annum. The proposed RRF and EcoPark House would also be operational.

1.8.30 Operational vehicles would continue to access the Edmonton EcoPark via the existing access on Advent Way as existing to serve both the ERF and RRF. Members of the public and small businesses visiting the RRC element of the RRF, users of EcoPark House and staff would access the Edmonton EcoPark via the new Lee Park Way access.

1.8.31 Traffic associated with the decommissioning and demolition of the existing EfW facility would travel to and from the Edmonton EcoPark via the existing Edmonton EcoPark access on Advent Way to minimise any conflicts with the operational ERF. Some vehicles associated with the removal of materials may be marshalled at the Temporary Laydown Area, waiting there until required on the Edmonton EcoPark. The new Deephams Farm Road access may also be used, if necessary.

Stage 4

1.8.32 Stage 4 would see the full operation of all new facilities. The proposed ERF would operate at full required capacity with each process line capable of processing 350,000 tonnes per annum with a total capacity of the facility at 700,000 tonnes per annum. The RRF would operate with a capacity of around 390,000tpa.

1.8.33 EcoPark House would be occupied by the site operator and the Edmonton Sea Cadets, and would also be available for other community and education activities.

1.8.34 Operational vehicles would continue to access the Edmonton EcoPark via the existing access on Advent Way to serve both the ERF and RRF while some movements would be undertaken using the Deephams Farm Road access. Members of the public and small businesses visiting the RRC element of the RRF, users of EcoPark House and staff would access the Edmonton EcoPark via the new Lee Park Way access.

2 The existing Application Site

2.1 Application Site description

2.1.1 The following photographs are included in Appendix A to provide context:

a. A1 shows Enfield Ditch along the southern boundary of the Edmonton EcoPark;

b. A2 shows the landscaped area in the north-east part of the Edmonton EcoPark;

c. A3 shows Enfield Ditch along the eastern boundary of the Edmonton EcoPark;

d. A4 shows Salmon’s Brook at the north-west boundary of the Edmonton EcoPark;

e. A5 shows Enfield Ditch looking north towards the wharf;

f. A6 shows the River Lee Navigation from the wharf in the Edmonton EcoPark;

g. A7 shows the north part of the Edmonton EcoPark from the roof of the tipping hall; and

h. A8 shows the east part of the Application Site looking towards the William Girling Reservoir.

2.1.2 The existing Application Site layout is illustrated on Existing Site Plan (E0001) in the Design Code Principles (AD02.02).

2.1.3 An approximate breakdown of the different land cover types is given in Table 2.1. Approximately 5.2 ha of the operational site (31 per cent) is soft landscaped (grassed areas).

Table 2.1: Summary of current land cover

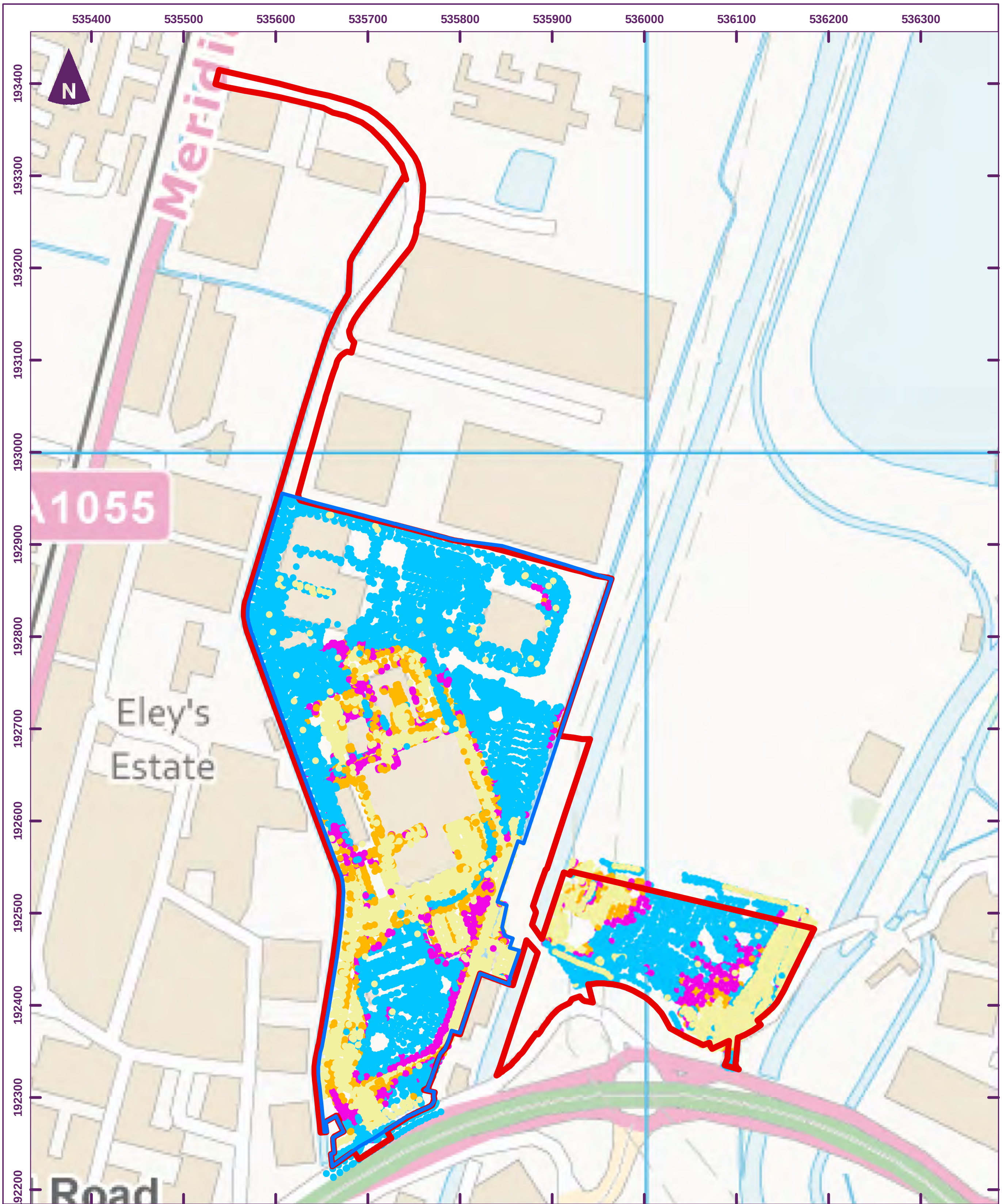
Land Use Component	Area (m^2)	Area (ha)
Roadways	35,000	3.5
Soft landscaping	51,500	5.2
Hardstanding	47,000	4.7
Roof	35,000	3.5
Total	**168,500**	**16.9**

2.2 Topography

2.2.1 Landscope Engineering Ltd carried out topographic surveys of the existing Edmonton EcoPark and the Temporary Laydown Area in April 2011 and March 2015 respectively. An existing levels drawing, including spot heights, is provided in Existing site topography (E0004) drawing in the Design Code Principles (AD02.02). The topography of the Application Site is indicated in Figure 2.1, which is based upon the surveyed data.

2.2.2 Ground elevations at Edmonton EcoPark range from around 10.0m AOD to 13.5m AOD, with some isolated areas at higher levels than this. Levels are highest across the north part of the Edmonton EcoPark, and at the landscaped area in the north-east where the pond is located. Levels fall generally from north to south, and then to east and west, towards the watercourses that flank the Edmonton EcoPark. There is a high point in the south part of the Edmonton EcoPark at the grass landscaped area, where levels are in the range 11m AOD to 13m AOD. Low points on the Edmonton EcoPark are located in the north-west adjacent to the effluent treatment plant; in the centre adjacent to the south of the turbine hall; and in the south-west corner.

2.2.3 Currently the topography of the Temporary Laydown Area slopes towards both the River Lee Navigation to the west and the River Lea to the east. There is currently bunding on the northern and eastern edges.



Key

- Application Site boundary
- Operational Site boundary
- Less than 10.66mAOD
- 10.66-10.78mAOD
- 10.79-10.91mAOD
- 10.92mAOD and above

0 25 50 100 150 200 Metres

Scale at A4: 1:6,000

North London Heat and Power Project
Flood Risk Assessment

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Figure 2.1
Site topography

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2.3 Hydrology

2.3.1 Hydrology features at the Application Site are shown on Figure 2.2. The River Lee Navigation passes between the Edmonton EcoPark and the Temporary Laydown Area, approximately 20m to the east of, and aligned with, the eastern side of the Edmonton EcoPark. This watercourse flows south through the LVRP, and is part of the River Lee catchment which flows through Hackney Marsh and Stratford Marsh into Bow Creek and the River Thames approximately 11km further south. The Lee New Cut (also known as the River Lee) is located approximately 25m to the east of the Application Site, being located just to the east of the Temporary Laydown Area, and thus approximately 300m east of the Edmonton EcoPark.

2.3.2 Enfield Ditch runs parallel with the River Lee Navigation, immediately adjacent to Edmonton EcoPark's eastern boundary. It flows south, before flowing south-west, where it joins Salmon's Brook in the south-west corner of the Edmonton EcoPark. The watercourse is partly culverted. There are bridges over Enfield Ditch to access the wharf and the main entrance at Advent Way.

2.3.3 Salmon's Brook runs south along the western boundary of the Application Site. The brook north to south and is known as the Pymmes Brook downstream of the Application Site. It is part of the River Lee catchment which is a tributary of the Thames.

2.3.4 The Thames tidal reach extends up the River Lee to the Lee Bridge Sluices which are north of Hackney Marshes, and approximately 7km downstream of the Application Site.

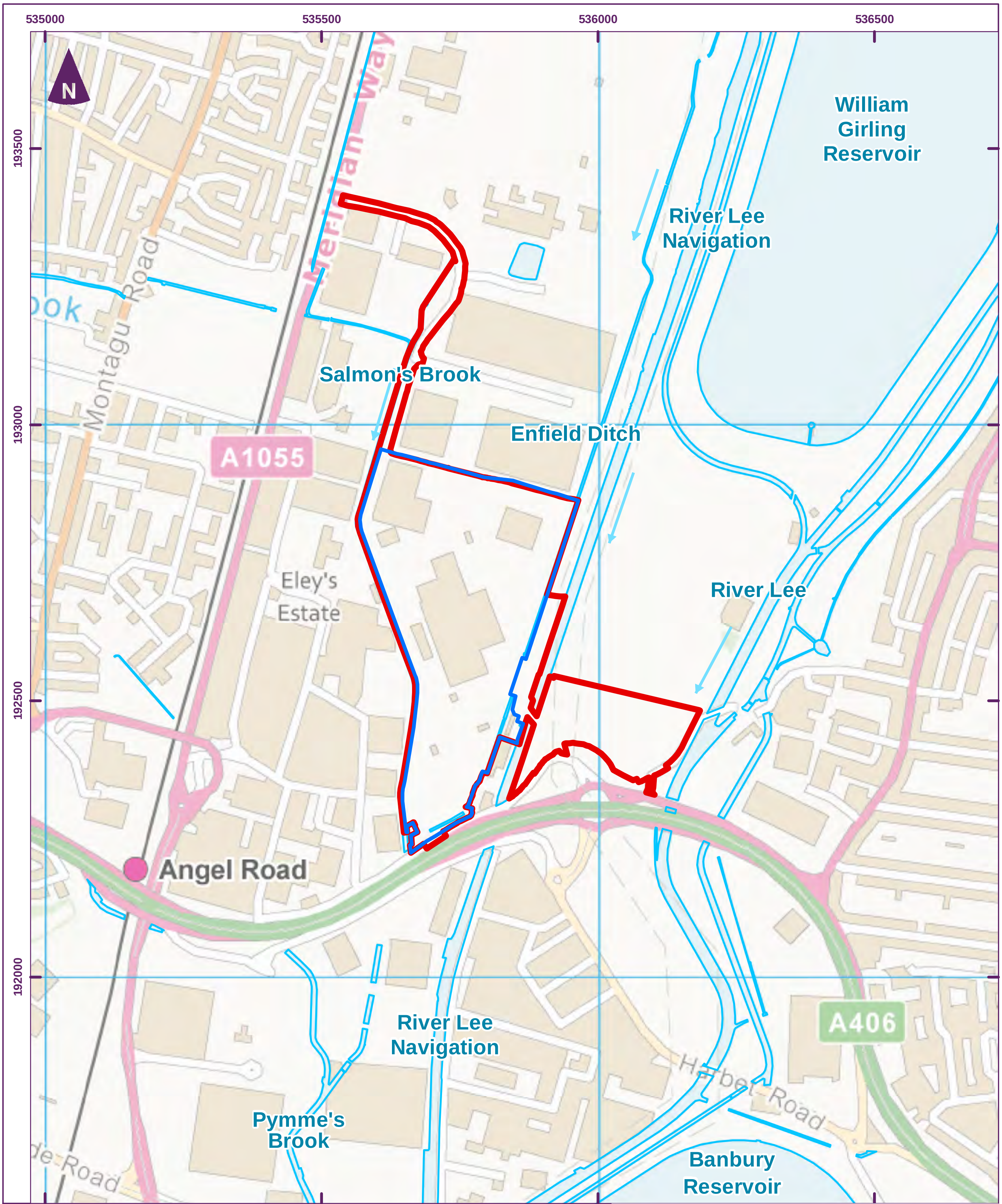
2.3.5 Salmon's Brook, Enfield Ditch and River Lee Navigation, as well as the River Lee are main rivers, which means they fall under the regulation of the EA.

2.3.6 There are several raised offline water supply reservoirs located in a line running north south through the LVRP to the east of the Application Site. The reservoir immediately to the northeast of the Application Site is the William Girling Reservoir. The reservoirs are owned and operated by Thames Water Utilities Ltd. (TWUL).

2.3.7 There is a small man-made, lined pond in the landscaped area in the north-east part of the existing the Edmonton EcoPark.

2.3.8 Long term average rainfall for Salmon's Brook catchment to TQ 35700 92550 is given as 648mm/year in the data supplied with the Flood Estimation Handbook[5].

[5] Centre for Ecology and Hydrology (1999) Wallingford: Flood Estimation Handbook (FEH CD-ROM).



Key

Application Site boundary

Operational Site boundary

0 50 100 200 300 Metres

Scale at A4: 1:10,000

North London Heat and Power Project
Flood Risk Assessment

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Figure 2.2
Hydrology features

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2.4 Existing drainage

2.4.1 The majority of surface water from the existing Edmonton EcoPark discharges to Enfield Ditch via an attenuation tank. Water is pumped from the tank into the ditch. The discharge point is located in the middle of the eastern boundary of Edmonton EcoPark, to the north of wharf. Rainfall falling onto natural landscaped areas at the Application Site infiltrates to ground.

2.4.2 Some surface water (from comparatively limited areas) is discharged to the TWUL Chingford combined trunk sewer, which crosses the Application Site, entering at the southern boundary and running along the western boundary to the north-west corner. Contaminated run-off, from the Edmonton EcoPark operations, boiler house, ash blending plant and recycling and fuel preparation facility, is pumped to the effluent treatment plant, located in the north-west part of the Application Site, before being discharged to the Chingford combined trunk sewer.

2.4.3 Historically, surface water was also discharged via two outfalls located in the north-east and north-west corners of the Application Site, discharging into Enfield Ditch and Salmon's Brook respectively. However these two outfalls are now sealed off, and are not used. The location of Salmons Brook outfall is shown in the foreground of photograph A4 in Appendix A, (but not the outfall itself). The outfall in the north-east corner of the Application Site was not found during the site visit as the location was fenced off and overgrown.

2.4.4 The existing surface water drainage at Edmonton EcoPark is shown on drawing 35180/LON/CVD/002/D in the Utilities Strategy (AD05.10).

2.5 Geology, hydrogeology and soils

Geology

2.5.1 Geology for the Application Site is shown by online British Geological Society (BGS) mapping and BGS Geology Map 1:50,000 series Sheet 256: North London[6]. This gives the solid geology as London Clay overlying the Lambeth Group (comprising mottled clay with sand and pebble beds), the Thanet Sand Formation and the chalk. Superficial deposits, which lie over the clay, are alluvium (clay, silt, sand and gravel) overlying the Kempton Park Gravels.

2.5.2 Information from the EA shows that the superficial deposits are classed as Secondary aquifers, capable of supporting some local water supplies, and stream baseflow[7] The clay is a non-aquifer, but the chalk below that is a Principal aquifer which supports strategic water supply in the Thames Basin, and baseflows.

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[6] BGS, online Geology of Britain viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html, (accessed 24 August 2015).

[7] EA (2014) online What's in your backyard, http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e, (accessed 24 August 2015).

2.5.3 The clay layer is expected to act as an aquiclude which can protect the chalk aquifer below from risk of contamination as a consequence of activities at the surface.

2.5.4 Hydrogeological investigations at the Application Site have been carried out by Amec Foster Wheeler E&I UK Ltd in recent years and are summarised in the Hydrogeological Risk Assessment (Vol 2 Appendix 7.2 of the ES (AD06.02). The report summarises detailed geological information based on a number of boreholes drilled at the Application Site. Figure 5 of that report shows the thickness of the London Clay, which is seen to range between 2m and 19m across the Application Site, being thickest in the north-east part of the Application Site, and thinnest in the south. The depth to the base of the clay layer is shown in Figure 6 of that report; this shows that the base of the clay is deepest in the north of the Application Site, and nearest the surface in the south of the Application Site, ranging from +3.5m AOD in the south to -13m AOD in the north. This information is summarised in Table 2.2.

Table 2.2: Depth and thickness of the clay layer at the Application Site

	Range	
	Lower	**Upper**
Top of clay m AOD	+3.5	+5.9
Bottom of clay m AOD	-13	+3.5
Clay thickness (m)	2	19

Groundwater levels

2.5.5 Groundwater levels have been monitored at the Application Site since 2011, including winter periods. Groundwater elevations have been measured between 7.12m and 9.45m AOD, which equates to between approximately 2.5m and 8.5m below ground level (bgl). Further information on groundwater is provided in the Hydrogeological Risk Assessment (Vol 2 Appendix 7.2 of the ES (AD06.02)).

Source Protection Zone

2.5.6 Most of the Application Site is located within the inner zone (Zone 1) of a groundwater Source Protection Zone (SPZ) relating to public water supply sourced from the chalk and superficial aquifers. The water supply boreholes are located between 450m and 900m east of the Application Site. The north-west corner of the Application Site is within Zone 2 (the outer zone) of the SPZ. Zone 1 indicates the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50m. Zone 2 is defined by a 400 day travel time from a point below the water table. This zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction. The SPZ is shown in Figure 2.3.

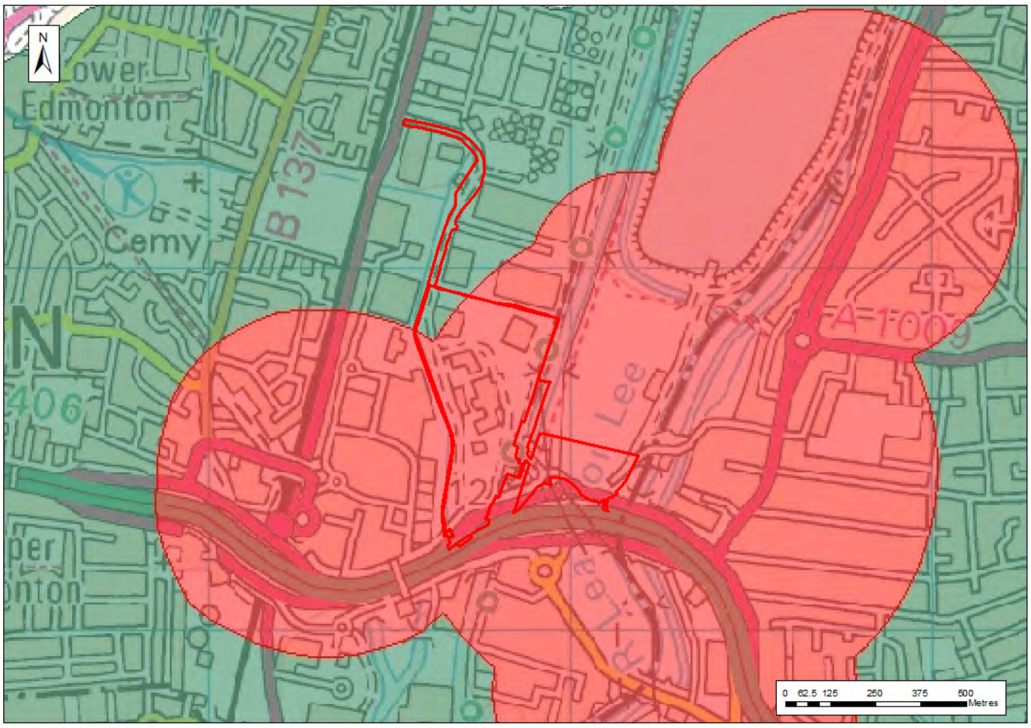

Figure 2.3: Source Protection Zones at the Application Site

Key

Red: Zone 1 (inner zone) indicating 50 day travel time from any point below the water table to the source.

Green: Zone 2 (outer zone) defined by a 400 day travel time from a point below the water table to the source

Soils

2.5.7 Natural soils at the Application Site (where they exist) are shown on the Cranfield Soils Institute online mapping[8] to be *"loamy and clayey floodplain soils with naturally high groundwater"* (classified as Soilscape 20) across most of the Application Site. Part of the northwest corner of the Application Site is classed as *"freely draining, slightly acid, loamy soils"* (Soilscape 6).

2.5.8 The Winter Rainfall Acceptance Potential map from the Flood Studies Report[9] gives the natural soils at the Application Site location as clayey, or loamy over clayey soils, with an impermeable layer at shallow depth (soil type 4).

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[8] LANDIS (2014) Soils Institute online information, http://www.landis.org.uk/soilscapes/, accessed August 2015.

[9] NERC (1975) Flood Studies Report, Natural Environment Research Council. http://www.nlwp.net/downloads/consultation2015/13_Flood_Risk_Sequential_Test_Report.pdf, (accessed August 2015).

2.5.9 The geology at the Application Site (alluvium and gravels overlying clay at a relatively shallow depth) would tend to support this natural soils classification. As the Application Site is developed however, there is now a layer of made ground across the Application Site.

3 Proposed ground cover

3.1.1 Areas of hardstanding by building type, and landscape areas for the Project, are shown in Table 3.1.

Table 3.1: Ground cover at the Application Site

Ground cover Component	Application boundary	
	Area (m2)	Area (ha)
Roof (standard)	31,369	3.1
Green Roof	3,001	0.3
Brown Roof	4,845	0.5
Roads	52,245	5.2
Hard landscape	49,593	5.0
Soft landscape	79,130	7.9
Total	**220,183**	**22.0**

Note: values quoted above are for the Application Site, including areas outside of Edmonton EcoPark, such as the Temporary Laydown Area and road improvements. Numbers quoted above have been rounded and may not sum to the total. Ground cover areas for the Temporary Laydown Area are set out in Table 3.2 below.

Table 3.2: Ground cover for the Temporary Laydown Area

	Ground cover component	Application Site	
		Area (m2)	Area (ha)
T1	Parking	9,782	1.0
T2	Site accommodation	3,002	0.3
T3	Storage	12,047	1.2
T4	Parking	4,110	0.4
T5	Landscaped areas	3,300	0.3
	Total	**32,241**	**3.2**

Note: numbers quoted above have been rounded and may not sum to the total.

4 Planning context

4.1.1 This section of the report sets out the relevant national, regional and local legislation, policy and guidance which are relevant to the FRA. To avoid duplication, policies specifically related to drainage are included in the Preliminary Drainage Strategy included in Appendix C.

4.2 National Policy Statement for Energy (NPS EN-1)

4.2.1 The Overarching National Policy Statement for Energy4 (NPS EN-1) sets out government policy on nationally significant energy infrastructure, and has effect on the decisions by the Secretary of State on applications for energy developments that fall within the scope of the NPS and provides the primary basis for decisions. Nationally significant infrastructure includes electricity generating stations generating more than 50 megawatts onshore, including generation from waste.

4.2.2 The NPS EN-1 states at Paragraph 4.5.3 "*the IPC needs to be satisfied that energy infrastructure developments are sustainable and, having regard to regulatory and other constraints, are as attractive, durable and adaptable (including taking account of natural hazards such as flooding) as they can be"*4*.* Section 5.7 of the Policy explains the requirements for flood risk assessment and mitigation in detail, referring to Planning Policy Statement 25[10] (which preceded NPPF Planning Policy Guidance: Flood Risk and Coastal Change) or successor documents. The requirements of NPS EN-1, together with the section of this report in which they are addressed, are included in Table 4.1 below.

Table 4.1: Requirements of NPS EN-1

Requirement	Section of this report
Be proportionate to the risk and appropriate to the scale, nature and location of the project	Whole report
Consider the risk of flooding arising from the project in addition to the risk of flooding to the project	Sections 5, 6 and 7
Take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made;	Section 4.1.1
Be undertaken by competent people, as early as possible in the process of preparing the proposal;	Whole report
Consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels, flood storage areas and other artificial features, together with the consequences of their failure;	Sections 5, 6 and 7
Consider the vulnerability of those using the site, including arrangements for safe access	Sections 4.4.4 and 6.1
Consider and quantify the different types of flooding (whether from natural and human sources and including	Sections 5 and 6

[10] Department for Communities and Local Government (2009) Planning Policy Statement 25: Development and Flood Risk Practice Guidance, Updated December 2009.

Requirement	Section of this report
joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made	
Consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;	Sections 5, 6 and 7
Include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project;	Section 6.1.23
Consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems;	Section 7
Consider if there is a need to be safe and remain operational during a worst case flood event over the development's lifetime;	Section 4.4
Be supported by appropriate data and information, including historical information on previous events.	Sections 2 and 5

4.3 National Policy Statement for Renewable Energy Infrastructure (NPS EN-3)

4.3.1 Section 2.3 of National Policy Statement for Renewable Energy Infrastructure (NPS EN-3)[11] covers climate change adaptation. This sets out that proposals for EfW generating stations should set out how the plant will be resilient to increased risk of flooding. This has been addressed in this FRA through the consideration of the anticipated effects of climate change on flood risk in the future.

4.4 National Planning Policy Framework

4.4.1 The NPPF[12] requires a flood risk assessment be undertaken for all developments of 1ha or more in area. The FRA *"must demonstrate that the development would be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, would reduce flood risk overall".*

Flood Zone classification

4.4.2 For the purpose of flood risk assessment, land is classified into zones of different fluvial or tidal flood risk, as shown in Table 4.2 taken from the

[11] Department for Energy and Climate Change (2011) National Policy Statement for Renewable Energy Infrastructure (EN-3), Department of Energy and Climate Change, July 2011.
[12] Department for Communities and Local Government (2012) National Planning Policy Framework, March 2012

National Planning Practice Guidance (NPPG)[13] which supports the NPPF. The Application Site is located in Flood Zones 1 and 2. As reported in Section 5, the Application Site is partly within Flood Zone 2, which indicates that it is at medium probability of flooding from the nearby watercourses, in this case fluvial or river. The remainder of the Application Site is in Flood Zone 1 which indicates a low probability of flooding.

Table 4.2: Flood Zone classification (Table 1 from National Planning Practice Guidance: Flood Risk and Coastal Change)

Flood Zone	Definition
Flood Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding (0.1% annual exceedance probability AEP).
Flood Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (between the 1% AEP event and the 0.1% AEP event); or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (between the 0.5% AEP event and the 0.1% AEP event).
Flood Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding (at risk from the 1% AEP fluvial event); or Land having a 1 in 200 or greater annual probability of sea flooding (at risk from the 0.5% AEP flood event).
Flood Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. This Flood Zone is defined based on local circumstances but is generally land which would flood with an annual probability of 1 in 20 (5% AEP) or greater in any year or land designed to flood in an extreme (0.1% AEP) flood.

Development vulnerability and Flood Zone compatibility

4.4.3 The NPPF classifies land uses in terms of their flood risk vulnerability. The Project would be classed as waste handling facilities which are classified as Less Vulnerable to the consequences of flooding, as shown in the excerpt from the guidelines shown in Table 4.3. Owing to the power generation elements of the proposed ERF, this section of the development in particular would be classified as 'Essential Infrastructure'. Although the notes to the PPG advise that *"in Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood"*, none of this part of the Project would be located in Flood Zone 3, so this requirement does not apply. Irrespective of this fact, the proposed ERF has been designed to remain operational in times of flood. Other buildings forming part of the Project would be for offices, as well as storage and other general industry, all of which are included in the Less Vulnerable category.

4.4.4 Table 3 of the NPPG shows which development vulnerability types are appropriate in which flood zone. This Table is shown below as

4.4.5 Table 4.4. It indicates that 'Less Vulnerable' development is appropriate for Flood Zones 1, 2 and 3a, and no Exception Test is therefore required. There

[13] National Planning Practice Guidance, http://planningguidance.planningportal.gov.uk/.

are no restrictions on vulnerability types within Zone 1. This compatibility does not preclude Sequential Test, which is discussed in the next section.

Table 4.3 Flood Risk vulnerability classification (from Table 2 National Planning Practice Guidance: Flood Risk and Coastal Change)

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.
Less Vulnerable
Police, ambulance and fire stations which are not required to be operational during flooding. 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. 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.

4.4.6 Vulnerability classes are: Essential Infrastructure, Highly Vulnerable, More Vulnerable, Less Vulnerable and Water Compatible.

Table 4.4: Flood Risk Vulnerability and Flood Zone Compatibility (Table 3 of National Planning Practice Guidance)

Flood Zones	**Flood Risk Vulnerability Classification**				
	Essential infrastructure	**Highly vulnerable**	**More vulnerable**	**Less vulnerable**	**Water compatible**
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key: ✓ Development is appropriate; ✗ Development should not be permitted.

Sequential Test

4.4.7 The NPPF requires a Sequential Test to be applied to all new development. The purpose of the Sequential Test is to allocate development to land at low risk of flooding, in Flood Zone 1, where possible, and only if there is no suitable land in this zone, to then consider land in Flood Zone 2. Only if there is no suitable land available in Flood Zone 2 would Flood Zone 3 be considered.

4.4.8 The Sequential Test is generally applied at a strategic level by the local authority when developing local plans. However it is not required in the case of the Project because the Edmonton EcoPark is being redeveloped without a change of use. The Edmonton EcoPark is also allocated as a waste site in Enfield's Local Plan and further detail is provided in the Edmonton EcoPark Supplementary Planning Document (Edmonton EcoPark SPD)[14] which requires the Edmonton EcoPark to continue to be used for sustainable waste management, prioritising recycling and energy recovery in particular. Future development on the Application Site is required to provide the heat for a local heat network to supply low cost energy to homes and businesses in the borough. The Edmonton EcoPark SPD requires new development to be of a high quality design, use sustainable design and construction methods and reduce visual and environmental impacts.

4.5 National Planning Policy Guidance

4.5.1 The NPPG is an online guidance resource intended to support the NPPF. The Flood Risk and Coastal Change guidance has been followed in the preparation of this FRA. Guidance is provided on numerous relevant flood risk considerations, including the Sequential and Exception Tests, the sequential approach, making developments safe from flood risk, and flood warning and evacuation.

4.6 Strategic Flood Risk Assessment

4.6.1 A North London Strategic Flood Risk Assessment was produced for the North London Waste Plan[15], which provided a high level assessment of flood risk across seven of the Constituent Boroughs. Conclusions from the study about LB Enfield included:

a. that the primary source of flood risk to Enfield Borough was found to be from fluvial flooding, with the Lower Lee, Pymmes Brook, Salmons Brook and tributaries providing the highest flood risk;

b. that the King George V and William Girling reservoirs pose a risk to the downstream properties. It is anticipated that the Flood Management Plans and associated inundation mapping will provide a more accurate appraisal and assessment of flood risk presented by the reservoir[16];

[14] LB Enfield (2013) Edmonton EcoPark Planning Brief Supplementary Planning Document to the London Plan.

[15] North London Waste Plan (2008) North London Strategic Flood Risk Assessment: North London Waste Plan, prepared by Mouchel, August 2008.

[16] Reservoir flood risk mapping has now been produced by the EA, as discussed later in Section 5 of this report.

c. an assessment of risks from sewer and surface water flooding was undertaken which indicated that the risk of sewers flooding is generally low across Enfield Borough; and

d. groundwater flooding was found to be a relatively low risk. However the local geology does increase the risk of groundwater flooding.

4.6.2 The LB Enfield produced a Level 2 Strategic Flood Risk Assessment (Level 2 SFRA) in July 2013[17]. The report considered flood risk in detail in two regeneration areas – Ponders End Waterfront Priority Regeneration Area to the north of the Edmonton EcoPark and Meridian Water Priority Regeneration Area immediately to the south of the Edmonton EcoPark. The River Lee Navigation, the Pymmes Brook and Salmon's Brook flow south from the vicinity of the Application Site through the proposed Meridian Water site.

4.6.3 The Level 2 SFRA makes recommendations for how flood risk should be managed at these two regeneration areas. Of note is that part of a potential flood compensatory storage area has been identified in the Meridian Water masterplan in the LVRP in the area proposed as the Project's Temporary Laydown Area (shown as Figure 4.13 in the Level 2 SFRA as the Lower Hall Lane site). There are insufficient details of these future schemes to be able to address the implications for the Project at this time.

4.7 Enfield Development Management Document

4.7.1 LB Enfield published a Development Management Document (DMD) in November 2014. Section 10.5 covers Flood Risk and Appendix 10 includes the minimum requirements for site specific Flood Risk Assessments, all of which are addressed in this report. Policies specifically relating to drainage are included in the Preliminary Drainage Strategy included in Appendix C.

4.8 Enfield Local Flood Risk Management Strategy

4.8.1 Enfield's draft Local Flood Risk Management Strategy[18] is currently at public consultation stage. As of the date of writing, the final version had not yet been published. Review of the draft Local Flood Risk Management Strategy indicated that there are no policies (in addition to those included in the DMD discussed above) or strategy plans that would directly impact the conclusions of this FRA.

4.9 London Plan

4.9.1 The London Plan[19] sets out requirements for managing flood risk and sustainable drainage. Policies specifically relating to drainage are included in the Preliminary Drainage Strategy included in Appendix C.

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[17] LB Enfield (2013) Level 2 Strategic Flood Risk Assessment, London Borough of Enfield, July 2013.
[18] LB Enfield (2015) Local Flood Risk Management Strategy, Draft Report, March 2015.
[19] Greater London Authority (GLA) (2015) The London Plan, the Spatial Development Strategy for London Consolidated with Alterations since 2015, March 2015.

4.10 Environment Agency

4.10.1 The EA in its regulatory role will assess FRAs for all planning applications for developments of more than 1ha[20]. The EA has been consulted throughout the preparation of the FRA. Responses addressing specific queries are include in Appendix B. Responses specifically relating to drainage are included in the preliminary drainage strategy, included in Appendix C.

4.11 Climate change

4.11.1 Climate change is expected to result in more intense rainfall events. The NPPG provides guidance on how to account for this over a development lifetime. A 20 per cent factor on peak river flows should be applied to baseline data for the period 2025-2115, and a 20 per cent factor on peak rainfall intensities is recommended for the period 2055 – 2085. These factors have been applied as part of the drainage strategy included in Appendix C and summarised in Section 7. The EA included a climate change scenario in their flood modelling, as discussed in Section 5.

[20] EA (2013) Sites over 1 hectare factsheet Hertfordshire and North London Area, Environment Agency, October 2013

5 Flood risk

5.1 Potential sources of flood risk

5.1.1 Flood risk from all sources is considered in this section of the report. The potential flood risks at the Application Site are summarised in Table 5.1.

Table 5.1: Summary of flood risks identified

Source of flood risk	Potential risk to the Application Site	Comment
Fluvial	Yes	The Application Site is partly within Flood Zones 1 and 2. Part of the Laydown Area is in Flood zone 3.
Tidal	No	The Application Site is upstream of tidal influence and ground levels are significantly above sea level.
Groundwater	Yes	The geology at the Application Site includes Principal and Secondary aquifers so there is groundwater present.
Sewers and drainage infrastructure	Yes	There is an existing drainage system at the Application Site. There is a combined trunk sewer running beneath the Application Site to which some Application Site surface run-off is discharged.
Artificial sources e.g. canals, reservoirs	Yes	The William Girling Reservoir and other raised embankment reservoirs are located to the northeast and southeast of the Application Site.
Overland flows - surface water run on	Yes	Run on from the land north of the Application Site has been be considered
Overland flows - surface water run off	Yes	Surface water from rainfall will managed on-site

5.2 Fluvial flood risk

5.2.1 The Application Site is potentially at risk from the nearby watercourses, including Salmon’s Brook, Enfield Ditch, and River Lee Navigation watercourses. The EA has provided flood risk mapping for the Application Site, shown at Figure 5.1 and in Appendix B. This indicates that most of the Application Site is located in Flood Zone 1, but parts of the Application Site are in Flood Zone 2, i.e. at risk during an extreme fluvial flood (a 0.1 per cent AEP event). These areas are in the centre of the Edmonton EcoPark where the existing EfW facility is located, along the south-west boundary adjacent to Salmon’s Brook, and on part of the wharf. The proposed ERF and RRF are not located within Flood Zone 3. A small area of land on the wharf is in Flood Zone 3, but it is outside the Application Site.

5.2.2 The Temporary Laydown Area, to be used during construction, is all within Flood Zone 2, with the exception of a narrow strip of land adjacent to the eastern boundary which is in Flood Zone 3.

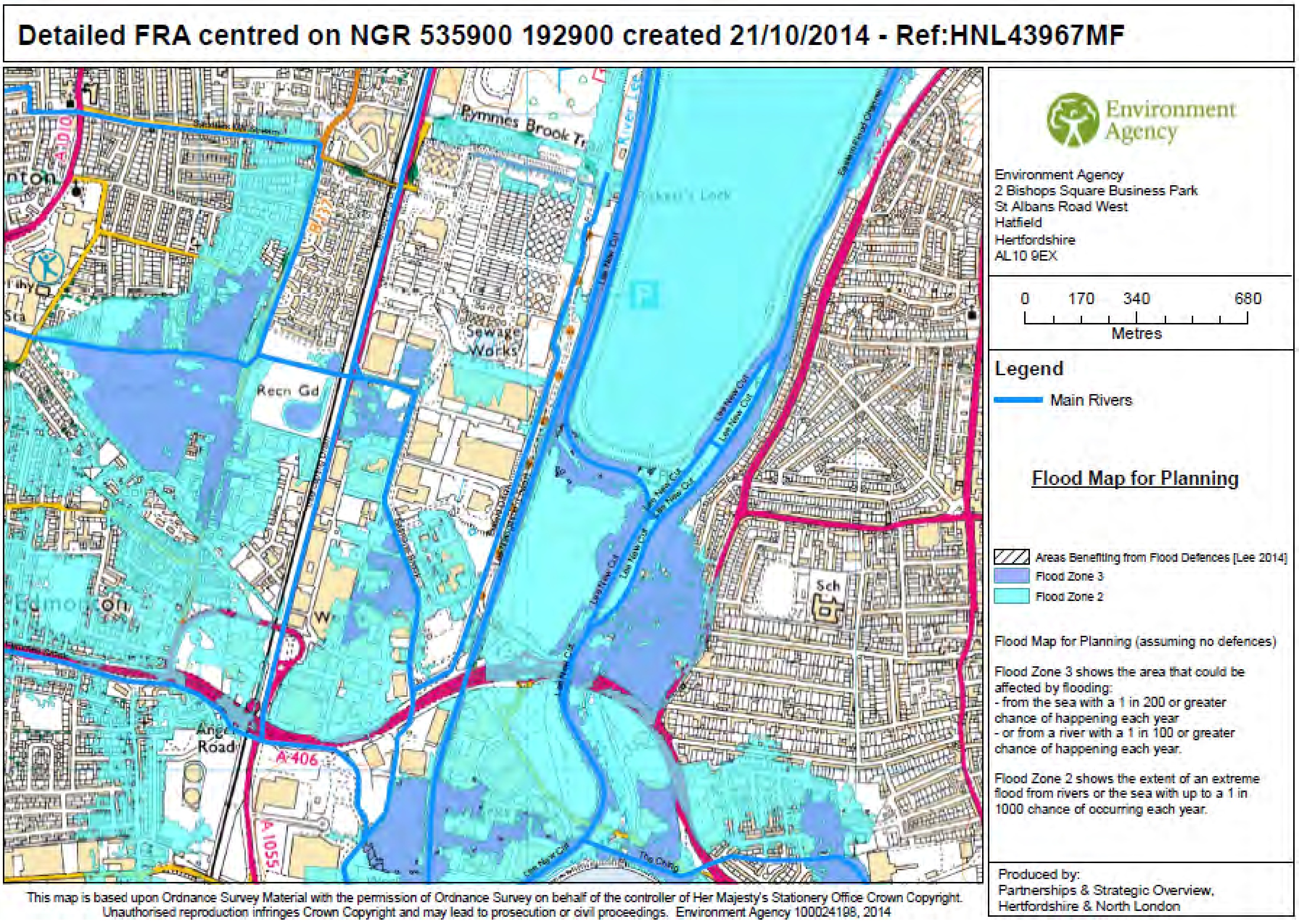


Figure 5.1: Environment Agency Flood Zone mapping

5.2.3 Figure 5.1 shows the undefended present day flood extent. Modelling of the defended scenario (i.e. with the existing flood defences in place) has already been undertaken by the EA, and this has been reviewed in this FRA. The modelled scenarios represent all formal flood defences within the modelled domain, the results of which are presented in Figure 5.2. The results of the defended scenarios indicate a much smaller area of the Application Site impacted by the 0.1 per cent AEP event than in the undefended scenario.

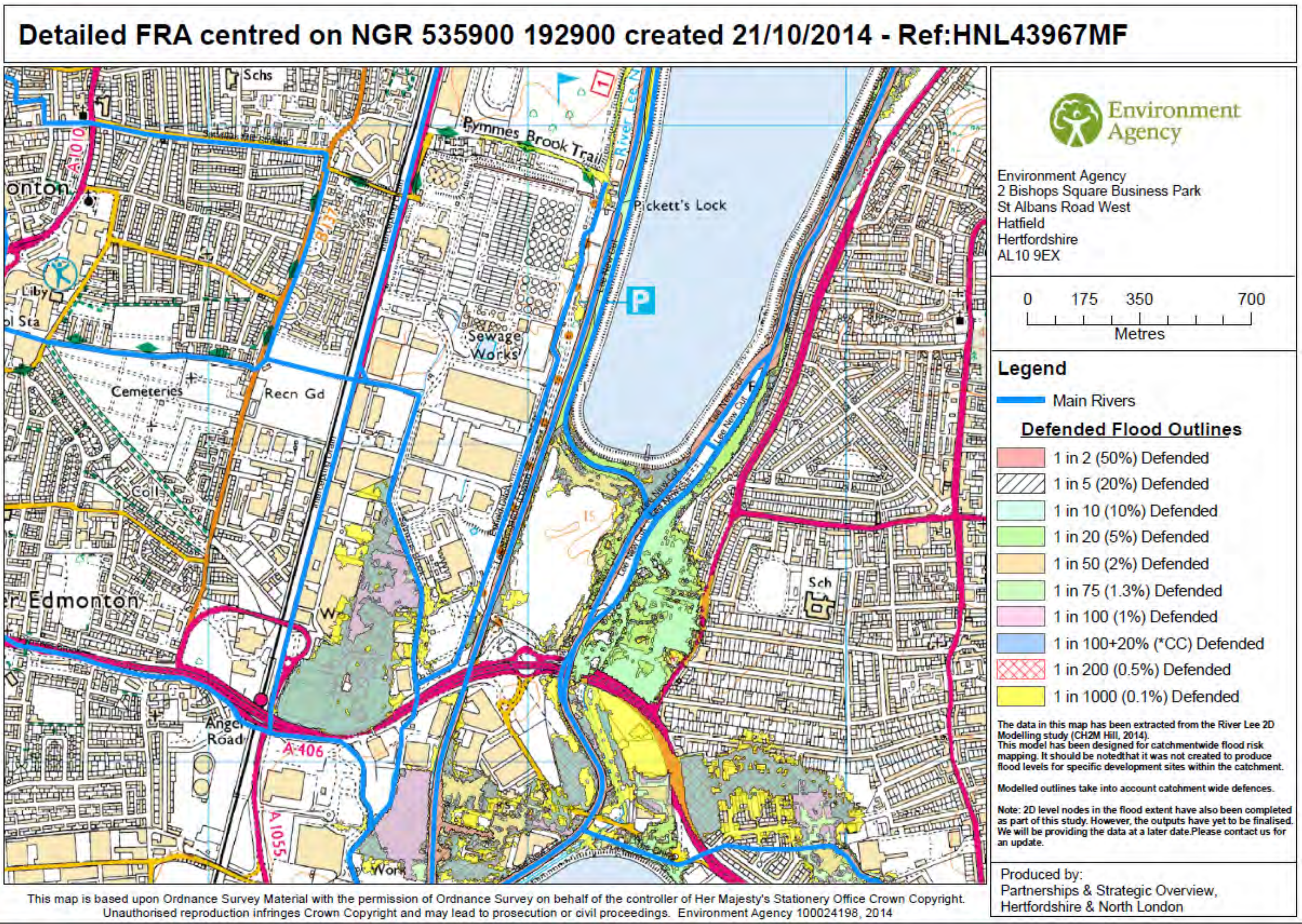


Figure 5.2: Flood mapping from the Environment Agency - defended scenario

5.2.4 The new modelling also includes a 'with climate change scenario[21]' for the 1 per cent AEP event. This results in small areas of flooding on the Application Site in three locations:

a. a car park near the southern access adjacent to Enfield Ditch (along the southern boundary of the Edmonton EcoPark);

b. adjacent to Salmon's Brook along the western Edmonton EcoPark boundary; and

c. on the wharf.

[21] According to Figure 5.2, climate change was incorporated in the modelling by increasing the peak flows for the 1% AEP event by 20%, as per the recommended allowance in the NPPF.

5.2.5 These areas are not within the present day 1 per cent AEP defended extent.

5.2.6 The proposed EcoPark House is located on the wharf and is within Flood Zone 2 and partly within the defended 0.1 per cent AEP and the defended 1 per cent AEP with climate change extents. The proposed improvement to the southern access is also within the defended 1 per cent AEP with climate change extent.

5.2.7 The majority of the Temporary Laydown Area is outside of the 0.1 per cent AEP defended extent and is therefore at low risk from fluvial flooding. However a narrow strip of land along the eastern boundary is at risk from the 2 per cent AEP defended flood event (1 in 50 year on average), and an additional strip of land along the western boundary is impacted by the 1 per cent AEP with climate change event. It is necessary to consider climate change impacts at the Temporary Laydown Area since it will be in use up to 2029 when construction ends.

5.2.8 In-river flood levels from the defended model were provided at both 1D and 2D nodes at and in the vicinity of the Application Site. These are included with all the mapping (Product 4 data provided) in Appendix B. In-river (1D) flood levels relating to the 1 per cent AEP, 1 per cent AEP with climate change, and the 0.1 per cent AEP defended events are given in Table 5.2.

Table 5.2: Modelled in-river flood levels adjacent to the Application Site (mAOD) – defended scenario

	100 year (1% AEP)	**100 year + climate change (20%) 1% AEP + cc**	**1000 year 0.1% AEP**
Salmon's Brook	10.33 – 10.52	10.66-10.78	10.81-10.92
Enfield Ditch	10.34 – 10.36	10.67 (no change)	10.82 (no change)
CBA (Lee Navigation)	10.58-10.62	10.86-11.05	11.09 – 11.41

The range in levels gives the flood level at the downstream node nearest to the south boundary of the Application Site (lower figure) and that for the upstream node nearest the north boundary of the Application Site (higher figure)

5.2.9 This shows, for example, that the 1 per cent AEP plus climate change flood level in Salmons Brook adjacent to the Application Site is 10.66m AOD at the south end of the Application Site rising to 10.78m AOD at the north end. The small area where this flood extends onto the Application Site (adjacent to the watercourse and south of the existing EfW facility) is closest to node SA.054, which reaches a level of 10.72m AOD in the 1 per cent AEP event with climate change.

5.2.10 Flood levels in Enfield Ditch from the 1 per cent AEP with climate change event in the defended scenario are constant at 10.67m AOD along the reach adjacent to the Edmonton EcoPark. The level in the River Lee Navigation closest to the wharf (Node CBA 19) is 10.92m AOD, but as indicated the 2D node mapping included in Appendix B, this water level does not reach the Application Site – water levels of 10.67m AOD, associated with Enfield Ditch are experienced at the wharf.

5.2.11 Measures to mitigate for fluvial flood risk are discussed at Section 6.1 of the FRA.

5.2.12 In the event of a failure of flood defences in the vicinity or upstream of the Edmonton EcoPark, floodwater may extend onto the main part of the Edmonton EcoPark, as indicated in the EA's Flood Map for Planning, included in Appendix B. There will remain a residual risk on-site that such a flood event could occur. The north part of the Edmonton EcoPark where the ERF is to be located, is above the residual flood level and not at risk. Irrespective of the on-site flood risk, there would also be the possibility that the surrounding area could be flooded, which could impact access and egress to the Application Site. Measures to mitigate for residual flood risk are discussed in Section 6.

5.3 Groundwater flood risk

5.3.1 Groundwater levels measured in winter 2011/12 were at least 2.6m below ground level, across the Application Site. The shallow Kempton Park Gravels aquifer is in hydraulic continuity with Enfield Ditch and Salmon's Brook which borders the Application Site. These watercourses therefore serve to control groundwater levels in the area by draining the shallow Kempton Park Gravels aquifer, and it is considered unlikely that groundwater levels would rise by more than 2.6m and breach the ground surface. Under the circumstances that these watercourses could not drain groundwater at the Application Site due to high water levels in the nearby watercourses, this would be associated with a fluvial event, as considered in Section 5.2 above.

5.4 Surface water flood risk

Surface run-off

5.4.1 Currently the Edmonton EcoPark's formal drainage network drains partly to Enfield Ditch via a pumped discharge, and partly to the combined trunk sewer (Chingford Sewer). As discussed in Section 2.5, the two outfalls in the north of the Edmonton EcoPark, to Enfield Ditch and Salmon's Brook, which formerly formed part of the surface water drainage system, are sealed off.

5.4.2 There is potential for the drainage system to be overwhelmed (an exceedance event), or the pumps to fail, which could result in flooding on-site. In the event of a heavy rainfall event some of the water will permeate into natural landscaped areas, some will reach the existing drains, and, when the capacity of the drainage system is exceeded, it may run-off the Application Site, following the topography, into the watercourses to the west (Salmon's Brook), south and east of the Edmonton EcoPark (Enfield Ditch).

5.4.3 A surface water drainage scheme would be implemented for the Project which will manage surface run-off from the design rain event, but during the early phases of construction of the proposed ERF the existing drainage system would still operate, so the risk of flooding onto the newly developed areas must be considered. It is noted from the topography at the Edmonton EcoPark (Section 2.3) that surface run-off would flow generally to the centre of the Edmonton EcoPark, which is the low part of the Edmonton EcoPark, and then east or west towards Enfield Ditch or Salmon's Brook. Since the new development areas are in the south and north of the Edmonton EcoPark, they would not therefore tend to be affected by these surface water flows. The run-off of excess surface water to Enfield Ditch and or Salmon's Brook would limit the depth to which the existing site could flood during such an event at present.

5.4.4 An exception is the proposed Lee Valley Heat Network Decentralised Energy Centre which does not form part of this project and is planned be constructed prior to the Project, situated in a relative low point at the south of the Edmonton EcoPark. Surface run-off to this area would be limited since the area to the north is landscaped so flows from it would be minimal. The wharf is also at a relatively low elevation, but surface run-off would not flow onto this area in the event of surface water flooding, since Enfield Ditch lies between it and the main part of the Edmonton EcoPark.

5.4.5 It will be necessary to install temporary drainage during the construction phase, to mitigate for flood risk to some parts of the Project within Edmonton EcoPark. Details of this will be identified by the contractor as the construction plans for the Application Site are developed through detailed design.

5.4.6 It may also be necessary to install some temporary drainage during the construction phase, to mitigate for flood risk to some parts of the construction site. The requirement for this would be identified by the contractor as the construction plans are developed.

5.4.7 Arrangements for both permanent and temporary drainage are discussed further in the Preliminary Drainage Strategy in Appendix C.

Surface run-on

5.4.8 Surface run-on refers to incident rainfall flowing onto the Application Site from adjacent land, following the local topography. This usually occurs where there is an extensive area of hardstanding immediately adjacent and uphill of the site in question. In the case of the Application Site, this is not the case. Watercourses bound the south, east and west edges of Edmonton EcoPark, which would prevent surface water run-on. The land at the northern boundary is level, with very little slope which would limit the rates of any run-on. There is a landscape buffer between the Ardra Road Industrial Area (the area to the north) and Edmonton EcoPark, which would be maintained in the Project, and this would serve to slow and attenuate any flows onto the Application Site from the Ardra Road industrial area. There is a similar lack of hardstanding area adjacent to the Temporary Laydown Area, and ground elevations are flat, reducing the likelihood of run-off occurring in the first place. The risk of surface water run-on is therefore considered to be low.

5.5 Sewer flooding

5.5.1 The Edmonton EcoPark is served by an on-site drainage system, which, as discussed above, could be overwhelmed during an extreme rainfall event. The capacity of this system is not known. This existing system would be removed and/or replaced in phases as the Edmonton EcoPark is redeveloped, thus incrementally reducing the risk of sewer flooding on-site as redevelopment occurs. Eventually the entire system would be replaced with a system designed to modern standards, thus reducing the risk of sewer flooding on the Edmonton EcoPark.

5.5.2 Surface water from part of the Application Site currently drains (via an on-site treatment works) to the TWUL Chingford Sewer (Section 2.5); the intention being to ensure that potentially contaminated water is not discharged to local watercourses. As discussed above, the Project would include a new surface water drainage scheme, and once redeveloped, only surface water from very limited areas such as wheel washing facilities would drain to the TWUL public sewer network. This would result in a reduction in potentially flashy flows to the combined sewer would reduce the risk of sewer flooding both at the Application Site and in the vicinity, providing betterment compared to the existing situation. Furthermore, TWUL have confirmed that they have no record of flooding incidents at the Application Site as a result of surcharging public sewers, indicating that the risk of sewer flooding from their network is already low at present.

5.5.3 There are no public surface water only sewers in the vicinity of the Edmonton EcoPark, which might present a sewer related flood risk to the Edmonton EcoPark.

5.6 Artificial sources

5.6.1 The EA have undertaken high level modelling of the impact of reservoir failure, along any point of the reservoir embankment, to determine maximum reservoir flood extents, as shown in Figure 5.3. The Edmonton EcoPark is identified as being at risk of flooding in the event of a failure in a reservoir dam/wall. There are a number of reservoirs located along the Lee Valley, and those closest to the Application Site are the William Girling Reservoir to the north-east of the Application Site, and Banbury Reservoir to the south-east. These are raised embankment off-line storage reservoirs owned and operated by TWUL. These reservoirs are classed as ‘large raised reservoirs’ under the Reservoirs Act 1975 (as amended by the Flood and Water Management Act 2010), which applies to all reservoirs capable of holding a volume of water in excess of 10,000m^3 above the natural level of any part of the surrounding land. As such, these reservoirs are subject to stringent safety requirements to ensure that any risk is managed. For example, all large raised reservoirs must be inspected at least once every 10 years by an independent qualified civil engineer (or ‘Inspecting Engineer’). A qualified civil engineer (a ‘Supervising Engineer’) must be employed to supervise the reservoir and keep its owners advised of its behaviour in any respect that might affect safety, including a site visit at least once a year (more frequently if recommended by the Inspecting Engineer). Any structural weakness in the reservoir embankments would be highlighted at an early stage, and appropriate action would be taken by TWUL to ensure the risk of flooding is managed acceptably. Therefore the flood risk from the reservoirs is assessed as being low, as whilst the consequence is potentially high, the probability of occurrence is very low.

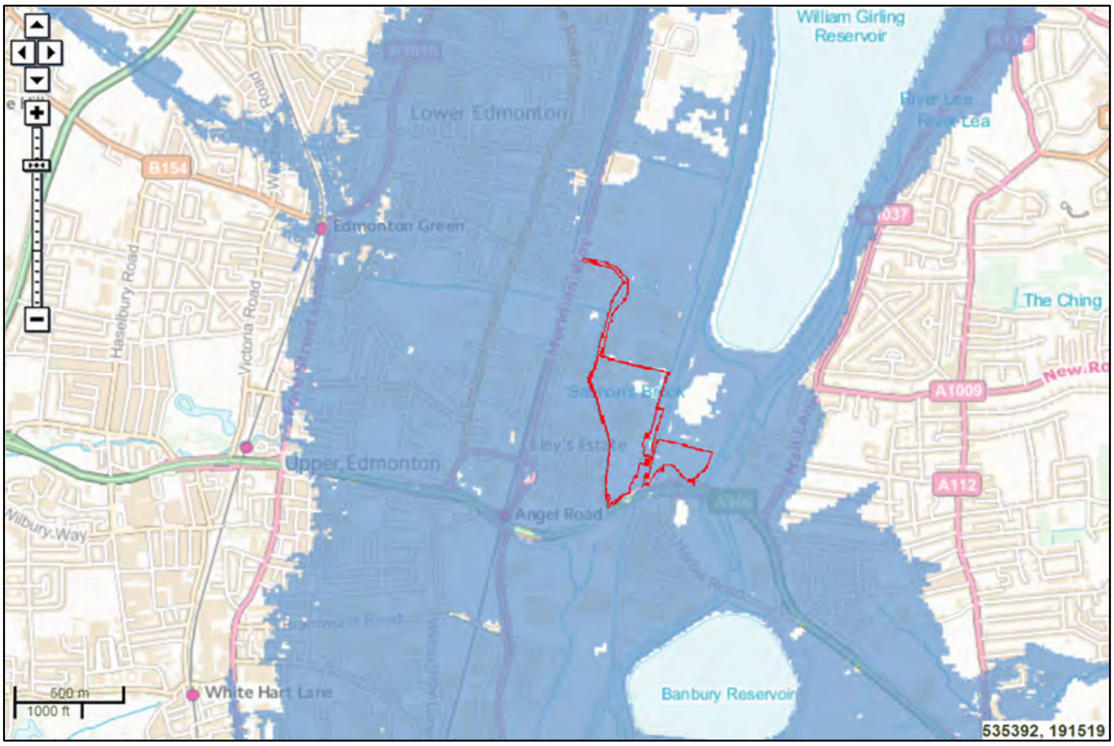


Figure 5.3: Reservoir flood inundation zone modelled by the Environment Agency

5.6.2 The shading on the map shows the area that could be flooded if a large reservoir were to fail and release the water it holds. Since this is a worst case scenario, it is unlikely that any actual flood would be this large.

6 Mitigation for flood risk

6.1 Fluvial flood risk

Flood Zones classification

6.1.1 The Project, comprising waste treatment as well as general industry, offices, storage and distribution, is classed as 'Less Vulnerable' to flood risk, as discussed in Section 4 of the FRA. It is therefore appropriate for Flood Zone 2. The proposed ERF is classed as Essential Infrastrucure, also appropriate for Flood Zone 2. The Edmonton Sea Cadet activities are classed as 'Water Compatible[22]'.

Sequential approach

6.1.2 The centre of the Edmonton EcoPark, where the existing EfW facility is located, is in Flood Zone 2; the proposal is to move development from that area to other parts of the Application Site in Flood Zone 1, at low risk for flooding. A sequential approach to development layout has therefore been followed as required by NPPF.

6.1.3 The proposed layout for the Laydown Area, is shown in Indicative Works: Temporary laydown Area (D_0012) in the Design Code Principles (AD02.02). Temporary accommodation (site offices etc.) and storage of construction material is to be located outside the areas at risk from the 1 per cent AEP with climate change flood event. Land within those extents is allocated to parking, landscape, and site access.

Flood storage compensation – Eco Park House

6.1.4 Part of EcoPark House on the wharf would be located within the defended 1 per cent AEP with climate change extent. The footprint of the proposed building would replace and extend beyond that of the existing Edmonton Sea Cadet's building, as shown in Figure 6.1. Flood compensation would be provided for the net loss of floodplain storage due to the construction of the new building.

6.1.5 The 2D node data in Appendix B confirms that the risk of flooding onto the wharf is from Enfield Ditch to the west, rather than the River Lee Navigation. The 100 year (1 per cent AEP) plus climate change defended flood level (in river level) at Enfield Ditch at the nearest modelling node ED01.12d is 10.67m AOD.

6.1.6 From the site topographic survey (Existing Site Topography (E_0004) in the Design Code Principles (AD02.02) levels at the wharf at the south end of the existing Edmonton Sea Cadet's building vary from a minimum 10.29m AOD to around 10.62m AOD, as seen in the excerpt at Figure 6.2. This implies a maximum flood depth of 0.38m (10.67m AOD – 10.29m AOD) in this location.

[22] "Water based recreation; outdoor sports and recreation and essential facilities such as changing rooms", from Table 2, Flood Risk and Coastal Change, NPPG.

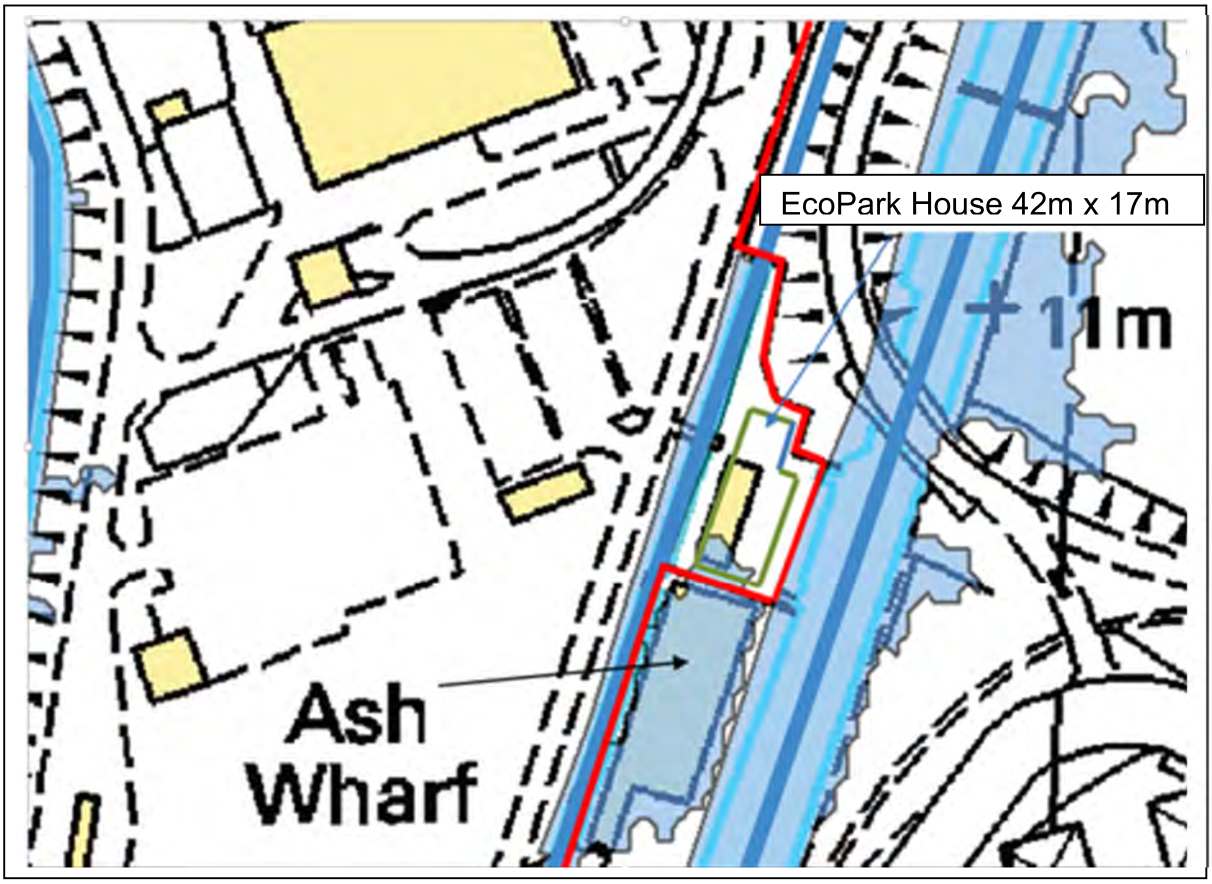


Figure 6.1: EcoPark House overlaid on flood map showing the 1 per cent AEP plus climate change defended flood extent

Figure 6.2: Excerpt from Topography Survey – existing sea cadet building on the wharf

6.1.7 The new building would have a footprint of approximately 626m². The footprint of the building within the flood extent is estimated conservatively by manual measurement to be approximately 87m² on the basis of the parameters shown on Indicative Work: EcoPark House (D_0004) in the Design Code Principles (AD02.02).

6.1.8 The existing building footprint within the flood extent is estimated as 58m². Thus the net increase in footprint is 87 – 58 = 29m². The additional flood volume displaced by the new building is therefore estimated conservatively as 29 x 0.4m = 11.6m³.

6.1.9 This volume would be compensated for by profiling the west bank, on a level for level basis, of Enfield Ditch upstream of the wharf at the landscaped area on the Edmonton EcoPark. The compensation storage would be provided within the area shown (on the existing topography) in Figure 6.3. This area in the context of the wider site is shown in Figure 6.4. To ensure level for level compensation, two horizontal slices would be considered when setting out the storage volume: 10.29m AOD – 10.49m AOD and 10.49m AOD – 10.67m AOD; approximately 5.5m³ volume of storage would be provided in each slice. Additional areas would be required for profiling/grading the soil around the excavation. The compensation storage would be in place before above ground construction of EcoPark House begins.

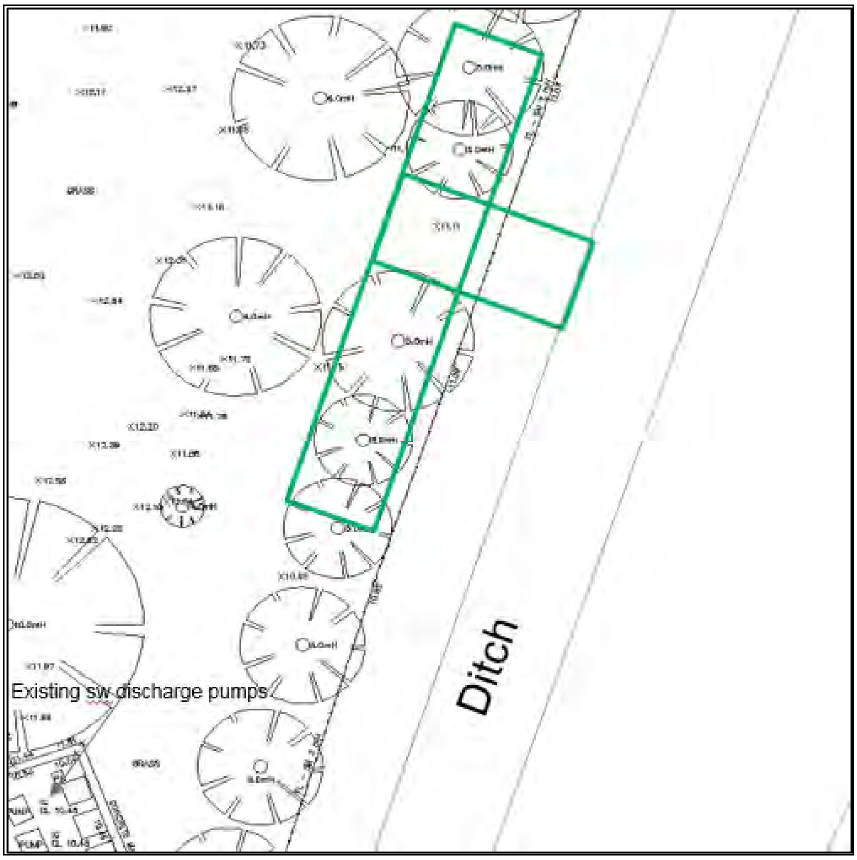


Figure 6.3: EcoPark House flood storage compensation

Figure 6.4: EcoPark House flood storage compensation shown in wider site context

Floodplain storage compensation – Southern Access Road

6.1.10 Part of the improved southern access road would be located within the defended 1 per cent AEP with climate change flood extent of Enfield Ditch. The 1 per cent AEP plus climate change flood map is shown in Figure 6.5. An excerpt from the topographic survey in Figure 6.6, and with the proposed development overlaid in Figure 6.7.

Figure 6.5: Flood map showing the 1% AEP plus climate change defended flood extent

Notes: Existing car parking area circled in red

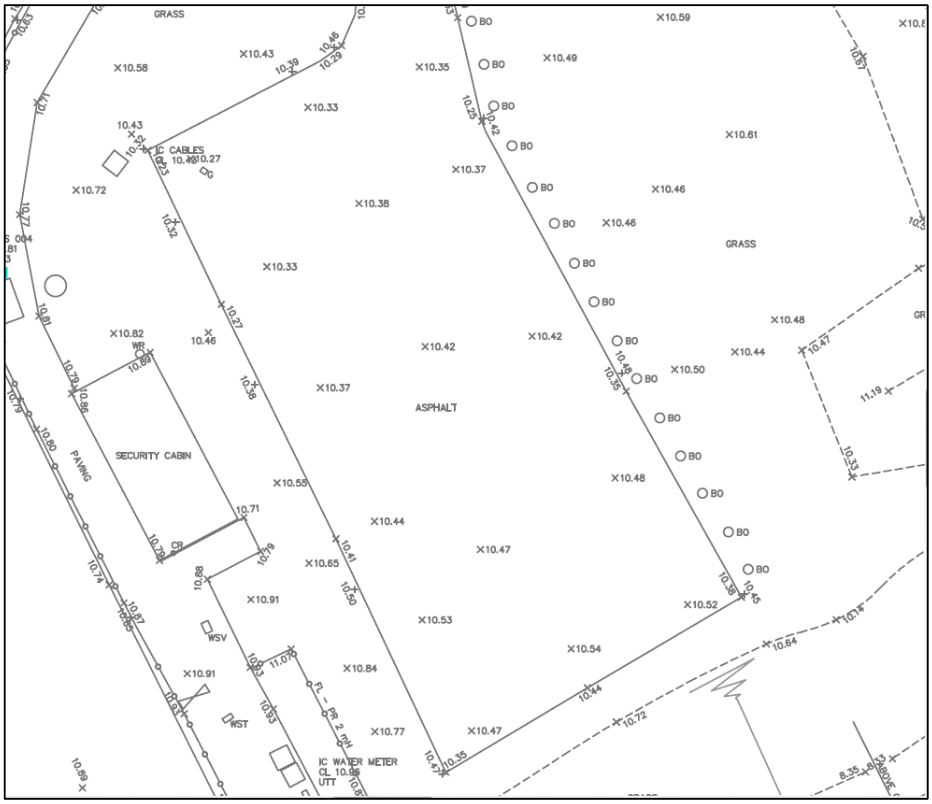


Figure 6.6: Excerpt from Topography Survey – existing car park

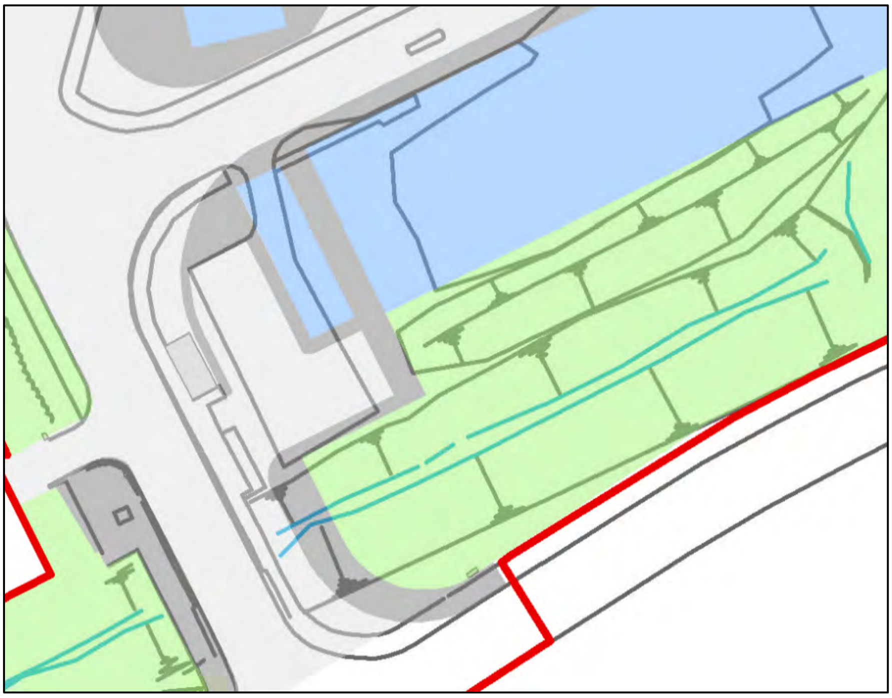


Figure 6.7: Existing and proposed Application Site layout – improved Advent Way access

Showing Application Site boundary (red), existing Application Site layout (dark grey lines) and proposed Application Site layout in colour: access road (grey), hardstanding (dark grey), buildings (blue) and landscaping (green)

6.1.11 Flood compensation would be provided for the net loss of floodplain storage. The compensation storage would be provided on the banks of Enfield Ditch upstream on a level for level basis. The cross section of the bridge opening would remain as per the existing bridge, so as to not increase or decrease flow constriction.

6.1.12 The 100 year + cc defended flood level (in river level) in the Enfield Ditch at node ED01.005 is 10.67m AOD. Ground levels in the car park vary from a 10.54m AOD in the southern half to a minimum of 10.27m AOD in the nort-west corner. This implies a maximum flood depth of 0.4m in this location. However, the vast majority of the car park is between 10.47m AOD (0.2m depth) and 10.33m AOD (0.34m depth). The average depth of water of 0.35m has been conservatively estimated in the car park, which is sufficiently conservative for compensation storage volume calculations.

6.1.13 The area of the car park is approximately 245m^2. Based upon a conservative assumption that the entire car park would be raised out of the floodwater as part of the Project, the volume of compensation has been estimated conservatively to be approximately 86m^3 (0.35m x 245m^2).

6.1.14 In addition to the floodplain lost in the car park, the widened bridge crossing itself would also result in a slight reduction in floodplain storage, as a result of it being surcharged during the 1 per cent AEP plus climate change event. The cross section of the bridge opening would remain as per the existing bridge, which spans the watercourse and retains the sloping banks of the watercourse beneath the opening. As a result, only the top slice of the floodwaters would be displaced by the bridge, i.e. the volume of water above the soffit of the bridge.

6.1.15 Details of the improved southern access bridge are provided in the Book of Plans. The soffit of the bridge is at 10.445m AOD. The in-channel water level is 10.67m AOD, resulting in a displaced depth of approximately 0.23m. This would occur over the surface area of the extended bridge crossing, which has been estimated to be approximately 12.5m wide and 7.25m long, i.e. an area of approximately 90m^2. This equates to a displaced volume of approximately 21m^3.

6.1.16 The volumes calculated above (86m^3 + 21m^3 = 107m^3 in total) would be compensated for by profiling the northern bank, on a level for level basis, of Enfield Ditch upstream of the improved southern access crossing. To ensure that a level for level basis is possible, a compensation area (350m^2) with a surface area greater than the surface areas of the floodplain to be lost has been identified (245m^2 + 90m^2). These are indicated in Figure 6.8.

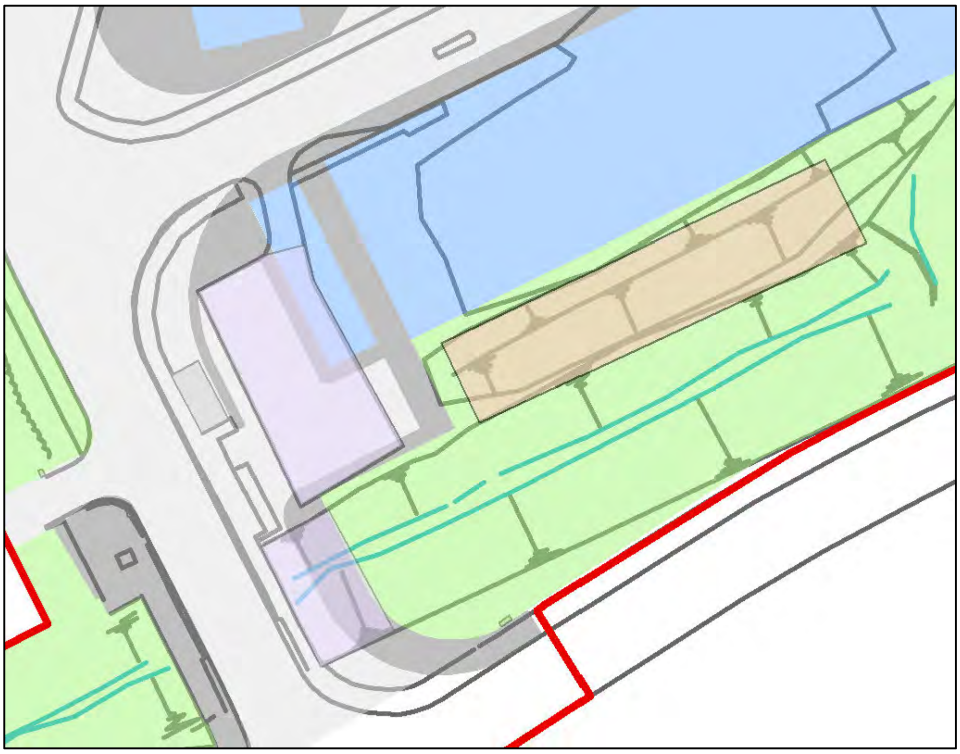


Figure 6.8: Floodplain compensation area

Showing the car park and improved southern access crossing in light purple, and the floodplain compensation area in brown.

6.1.17 On the basis that a total volume of approximately 107m³ is required, and a compensation area of approximately 350m² has been identified, this would result in an excavated area with an average depth of approximately 0.3m. This should be easily achievable in this area without requiring unachievably steep side slopes.

6.1.18 To ensure level for level compensation, two horizontal slices would be considered when setting out the storage volume: 10.27m AOD – 10.49m AOD and 10.49m AOD – 10.67m AOD; 50 per cent of the total volume of storage would be provided in each slice. Additional areas would be required for profiling/grading the soil around the excavation. The compensation storage would be in place before construction works to improve the southern access begins.

Eastern watercourse crossings

6.1.19 A new crossing is proposed to be constructed across Enfield Ditch, to allow access to the Application Site from Lee Park Way to the east of the Edmonton EcoPark. The layout is shown in proposed access: Lee Park Way plan (D_0021) in the Design Code Principles (AD02.02). The bridge soffit is at a minimum of 11.22m AOD, and indicates a 15m a clear span design. The west bridge support at ground level is at an elevation of 11.07m AOD (as measured from the drawing), which is above the 1 per cent AEP with climate change flood level of 10.67m AOD and allows more than 0.3m freeboard. It is assessed that the bridge does not therefore impact on flood risk from Enfield Ditch. EA flood defence consent would need to be obtained for works within 8m of the river bank.

Finished floor levels

6.1.20 Interpretation of the flood map indicates that risk of the flooding onto the wharf is from Enfield Ditch to the west, rather than the Lee Navigation. The 100 year (1 per cent AEP) plus climate change defended flood level (in - river level) at Enfield Ditch at the nearest modelling node ED01.12d is 10.67m AOD.

6.1.21 Finished floor levels (FFL) for the visitor centre would be set above this level with a freeboard allowance of 0.3m; FFL would therefore be 10.97m AOD.

Safe access and egress

6.1.22 The main access route on to the Temporary Laydown Area is from Walthamstow Avenue to the south. This access route passes through an area at risk of flooding from the 2 per cent AEP flood, as shown on Figure 5.2. There would be no safe access to or from the Temporary Laydown Area in the event of a fluvial flood. The Temporary Laydown Area would be evacuated before the onset of flooding, as outlined in the Emergency Plan.

Residual flood risk

6.1.23 There remains a residual flood risk at the Application Site in the event of an extreme flood, especially under the worst case scenario of failure of flood defences. The flood extent would be that shown in as Flood Zone 2 (0.1 per cent AEP) in the EA's flood map, as shown in Figure 5.1. Under this scenario, flooding would be largely limited to the central part of the Edmonton EcoPark, which would be made available for future development once the existing EfW facility is demolished.

Emergency Flood Plan

6.1.24 The Project is compliant with flood risk vulnerability classifications, and appropriate mitigation has been put in place to manage flood risk, as discussed above, but mitigation is also required to manage the residual flood risk described.

6.1.25 Requirements for managing residual flood risk were discussed with the EA (at a meeting on 18 February 2015), who stated that there should be safe access and egress from the Application Site in the event of this failure scenario, or (if this was not provided) the Emergency Flood Plan should be agreed with the local council Emergency Planning Team.

6.1.26 LB Enfield Emergency Planning Team were consulted on 18 March 2015 and stated that they would only be concerned with the contents of the Emergency Plan if the impact of a flood at the Application Site were to cause a negative impact on the Borough. From a response perspective, the actions taken at the Application Site to deal with flooding would be for the operator to decide.

6.1.27 The Emergency Flood Plan would be put in place as part of the overall Site Emergency Plan. This would be prepared prior to occupation of the Application Site, in liaison with, the EA, LB Enfield Emergency Planning

Team and the Emergency Services. Measures to be considered would include:

a. the site operator signing up to the EA Flood Warning system, to receive Flood Alerts (from the Lower River Lee from Hoddesdon to Canning Town alert area) and Flood Warnings (for the Lower River Lee at Enfield);

b. evacuation of the Application Site when a Flood Warning is received for the Lower River Lee at Enfield, and vehicles to be moved from the area at residual flood risk (as identified as Flood Zone 2 in Figure 5.1) to parts of the Application Site at lower risk; and

c. ideally evacuation is only needed when a Flood Warning is received and it is forecast that a Severe Flood Warning would be issued. It would need to be confirmed with the EA whether that refinement is possible.

6.1.28 An emergency flood plan will be drawn up for the construction period, if required by the EA, as set out on the Code of Construction Practice (CoCP) (AD05.12), submitted as part of the Application.

6.1.29 This level of mitigation represents an appropriate risk-averse response to the flood risk at the Edmonton EcoPark, although it is recognised that a balance needs to be struck between an overly conservative response that could result in the Application Site being evacuated more frequently than is necessary and an appropriate level of response. In due course the site operator may undertake additional studies in order to refine and amend the Emergency Flood Plan procedure, in agreement with statutory authorities.

6.1.30 To mitigate for flood risk to the Temporary Laydown Area, which is partly at risk from the 2 per cent AEP event, and partly at risk from the 1 per cent AEP with climate change event, the Temporary Laydown Area would be evacuated when a Flood Warning is received from the EA for the Lower River Lee at Enfield. This would reduce the risk of site occupants being ‘islanded’ by being surrounded by floodwaters on all sides, with the Application Site having been evacuated before this could occur. The system for receiving flood warnings and evacuating the Temporary Laydown Area would be in place before the area is in use. The need for this Emergency Flood Plan during the construction phase is included within the CoCP (AD05.12).

Surface run-off

6.1.31 Surface run-off would be managed through a sustainable drainage strategy which is discussed in Section 7. Attenuation to limit flows off the Application Site in line with current guidance, including for the different construction phases, is set out in Section 7 of this report. During construction phases there may be the need for temporary drainage to protect areas of new development from flood risk from the existing drainage system, as noted in the CoCP (AD05.12).

Surface run-on

6.1.32 The soft landscape strip proposed along the northern boundary of the Edmonton EcoPark would serve to slow and attenuate surface water flows onto the Application Site from adjacent land to the north. No further mitigation with respect to surface water run-on should be necessary.

6.2 Artificial sources

6.2.1 Flood risk from the William Girling Reservoir would be managed by TWUL through inspection and supervision under the Reservoirs Act, as discussed in Section 5.5. No additional mitigation is required.

7 Surface water management

7.1 Introduction

7.1.1 A preliminary drainage strategy has been prepared for the Project and is included in Appendix C. The key points from the Preliminary Drainage Strategy are summarised below.

7.2 Preliminary Drainage Strategy

7.2.1 A preliminary drainage strategy has been prepared with due consideration of all relevant policies and in consultation with the EA and LB Enfield. Discharge rates have been determined and attenuation storage volumes calculated. A preliminary SuDS selection assessment has been undertaken to assess the suitability of various SuDS with respect to the site constraints, as well as quality, quantity, ecological and amenity benefits and the opportunity to combine SuDS techniques to produce a recognised management/treatment solution. Finally, a preliminary SuDS drainage strategy for the Application Site has been determined, which can subsequently be used as the basis for detailed drainage design at the appropriate time.

7.2.2 The following strategy is proposed:

a. rainwater harvesting would be installed and used for all or some of the following uses: toilet flushing in the administrative offices; vehicle washing; and for dust and fire suppression;

b. the Project will include brown and/or green roofs covering a total area of approximately 7,845m^2 including on the proposed ERF and EcoPark House;

c. lined pervious paving in appropriate areas, such as general car parking areas and roads which would be frequented by light traffic, but not vehicles with potentially polluting wastes or deliveries;

d. lined filter trenches have been identified as an effective upstream treatment to remove sediment and fine silts. They would form part of the three stage SuDS train to treat surface water from hardstanding areas;

e. three separate attenuation tanks (serving the three distinct areas of the Edmonton EcoPark) to provide the storage necessary to limit peak discharges to greenfield run-off rates. The use of a sealed pipe network and tanks has the benefit of being able to contain any contamination if necessary (during a pollution incident or spillage for example), which could then be pumped and either treated at the on-site waste water treatment works, or tankered for off-site disposal if necessary;

f. peak discharges would be limited to greenfield run-off rates for all events up to and including the 1 in 100 year with climate change storm event;

g. surface water would be discharged to a nearby watercourse. This method would avoid both discharge to the sewer network (least sustainable discharge option) and minimise the risk of impacting the highly sensitive principal aquifer that underlies the Application Site, which is used for public water supply;

h. it is proposed to discharge the attenuated flows to Enfield Ditch. This is the preferred option because of the current lack of flow in Enfield Ditch and the existing frequent high flow levels in Salmon's Brook;

i. because of the relatively flat topography the drainage solution may require some degree of pumping to discharge the run-off from site. Pumping would be kept to a minimum and used only when necessary;

j. where appropriate, oil separators would be used, at locations to be determined as part of the detailed design. Trapped gullies would also provide a treatment train component; and

k. the Temporary Laydown Area would utilise SuDS, in the form of swales, filter strips, and a retention pond or below ground tanks to attenuate flows and limit discharge to greenfield runoff rate.

7.2.3 The piped network would be designed in accordance with Sewers for Adoption[23], i.e. capable of conveying the 1 in 30 year event. For events in excess of the capacity of the drainage network, i.e. exceedance events up to the 1 in 100 year event, surface water would be conveyed as overland flow via the road network to the on-site car parks. Slight raising around the edges of the Application Site may be necessary to ensure this. As described in Sections 5 and 6, only very small portions of the Application Site are located within the 1 per cent AEP plus climate change extent, for which compensation storage is already proposed, and therefore it should be possible to achieve this without impacting the conclusions of the FRA.

[23] Water UK (2012) Sewers for Adoption 7th Edition - A Design & Construction Guide for Developer.

8 Conclusions

8.1.1 This FRA and accompanying drainage strategy have been prepared in line with NPS EN-1, the NPPF and all other relevant national, regional and local policy and guidance.

8.1.2 All potential sources of flood risk have been considered, and where a risk has been identified, sufficient mitigation in line with best practice is proposed. The Edmonton EcoPark is already allocated for the proposed use and therefore does not require application of the Sequential Test, and the proposed use is appropriate for the Flood Zone, meaning that the Exception Test does not need to be passed. A sequential approach has been taken to the layout of the Application Site, with the new development to be located in the lowest risk areas of the Application Site.

8.1.3 The mitigation measures set out in this FRA would ensure that the Project would not be subject to an unacceptable level of flood risk, and would also ensure no increase in flood risk elsewhere.

Appendix A: Site Photos

A1 Enfield Ditch southern boundary of site, close to site entrance at southwest

A2 Landscaped area in northeast of site

A3 Enfield Ditch, eastern boundary of site

A4 Salmons Brook, northwest of site looking south, industrial estate to west of site

A5 Enfield Ditch looking north from bridge to Ash Wharf

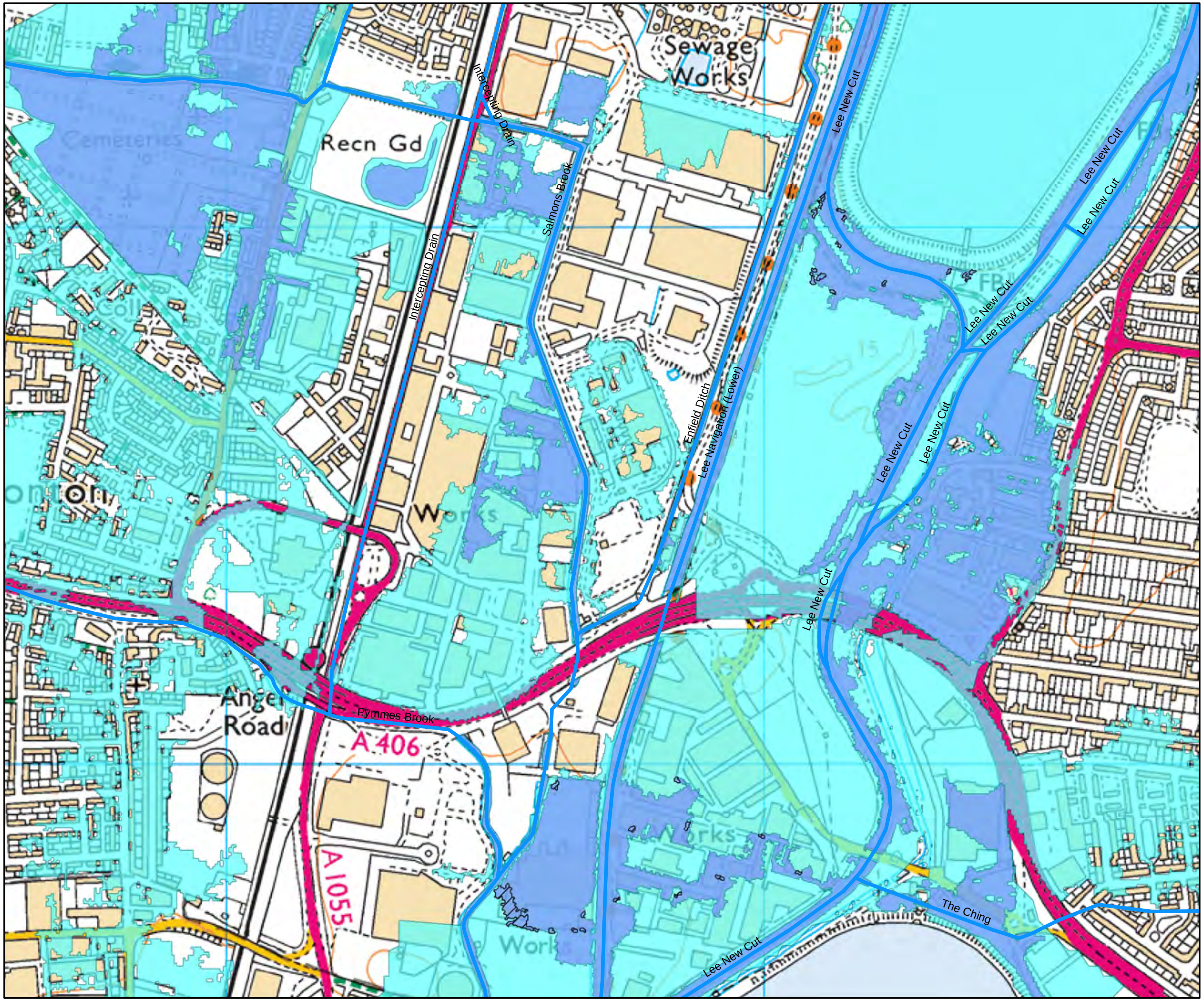
A6 Lee Navigation, looking northeast from Ash Wharf

A7 Looking north across the site from the roof of the tipping hall

A8 Looking east from roof of tipping hall, William Girling Reservoir in distance

Appendix B: Environment Agency Correspondence and Flood Risk Information

Detailed FRA centred on 535900, 192900 created 24/06/2015 - Ref:HNL47534MF



Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

0 130 260 520
Metres

Legend

Main Rivers

Flood Map for Planning

Areas Benefiting from Flood Defences [Lee 2014]
Flood Zone 3
Flood Zone 2

Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

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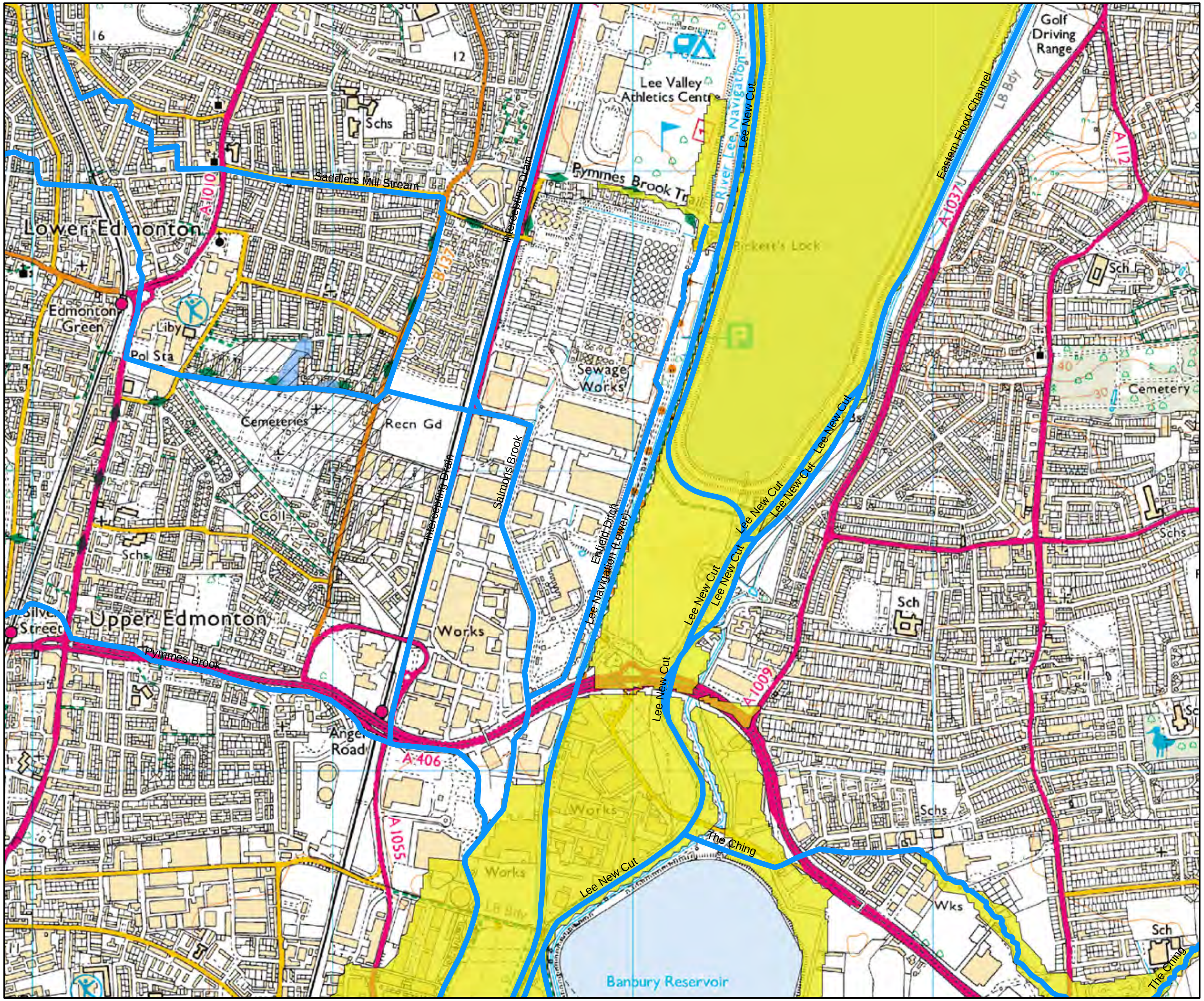

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AL10 9EX

0 225 450 900
Metres

Legend

Main Rivers

Flood Event Outlines

2000
1987
1947

The historic flood event outlines are based on a combination of anecdotal evidence, Environment Agency staff observations and survey.
Our historic flood event outlines do not provide a definitive record of flooding.
It is possible that there will be an absence of datain places where we have not been able to record the extent of flooding.
It is also possible for errors occur in the digitisation of historic records of flooding.

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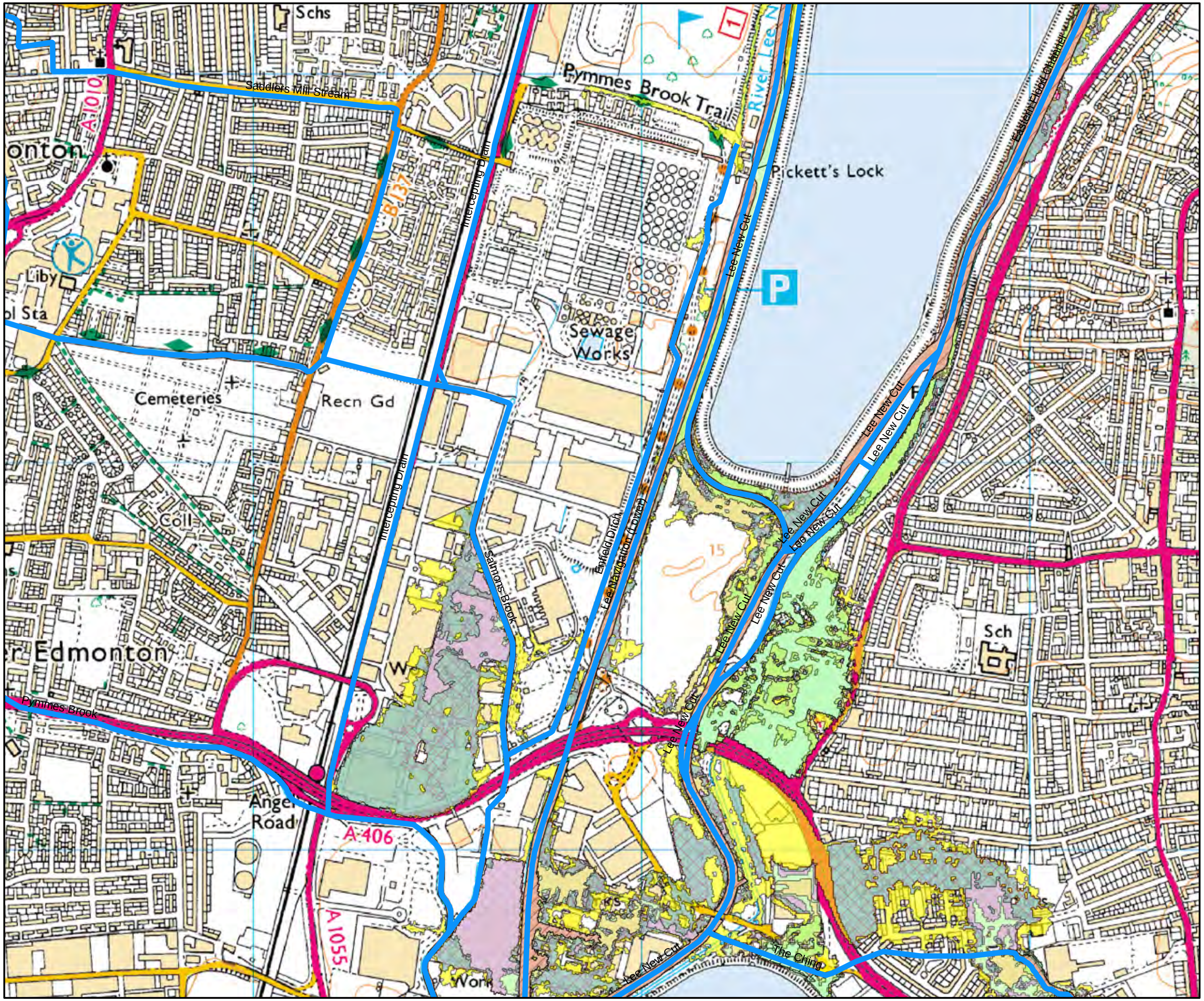

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St Albans Road West
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Metres

Legend

Main Rivers

Defended Flood Outlines

- 1 in 2 (50%) Defended
- 1 in 5 (20%) Defended
- 1 in 10 (10%) Defended
- 1 in 20 (5%) Defended
- 1 in 50 (2%) Defended
- 1 in 75 (1.3%) Defended
- 1 in 100 (1%) Defended
- 1 in 100+20% (*CC) Defended
- 1 in 200 (0.5%) Defended
- 1 in 1000 (0.1%) Defended

The data in this map has been extracted from the River Lee 2D Modelling study (CH2M Hill, 2014). This model has been designed for catchmentwide flood risk mapping. It should be notedthat it was not created to produce flood levels for specific development sites within the catchment.

Modelled outlines take into account catchment wide defences.

Note: 2D level nodes in the flood extent have also been completed as part of this study. However, the outputs have yet to be finalised. We will be providing the data at a later date.Please contact us for an update.

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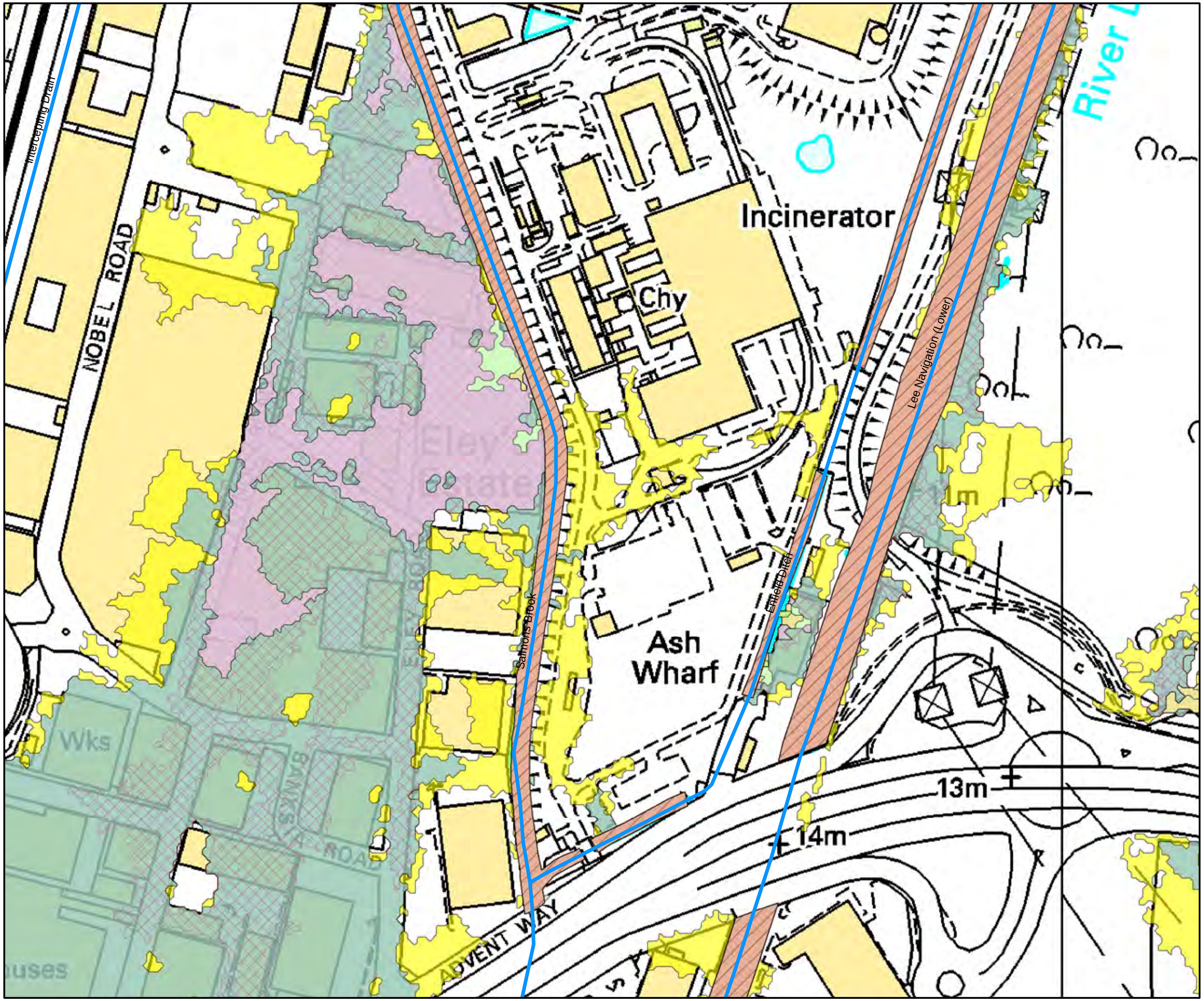

Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

0 45 90 180
Metres

Legend

- Main Rivers

Defended Flood Outlines

- 1 in 2 (50%) Defended
- 1 in 5 (20%) Defended
- 1 in 10 (10%) Defended
- 1 in 20 (5%) Defended
- 1 in 50 (2%) Defended
- 1 in 75 (1.3%) Defended
- 1 in 100 (1%) Defended
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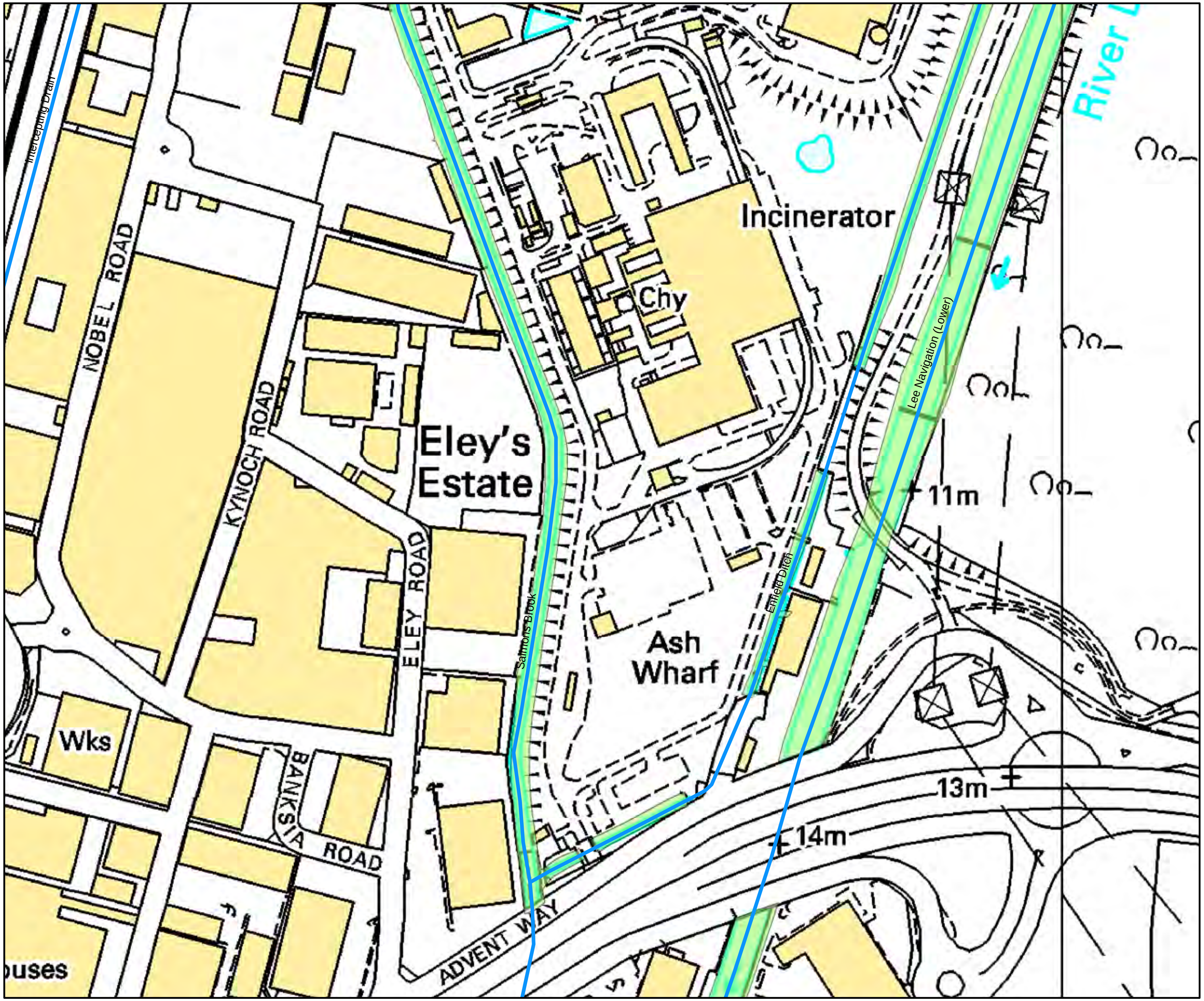

Environment Agency

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St Albans Road West
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Metres

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Main Rivers

Defended Flood Outlines

1 in 20 (5%) Defended

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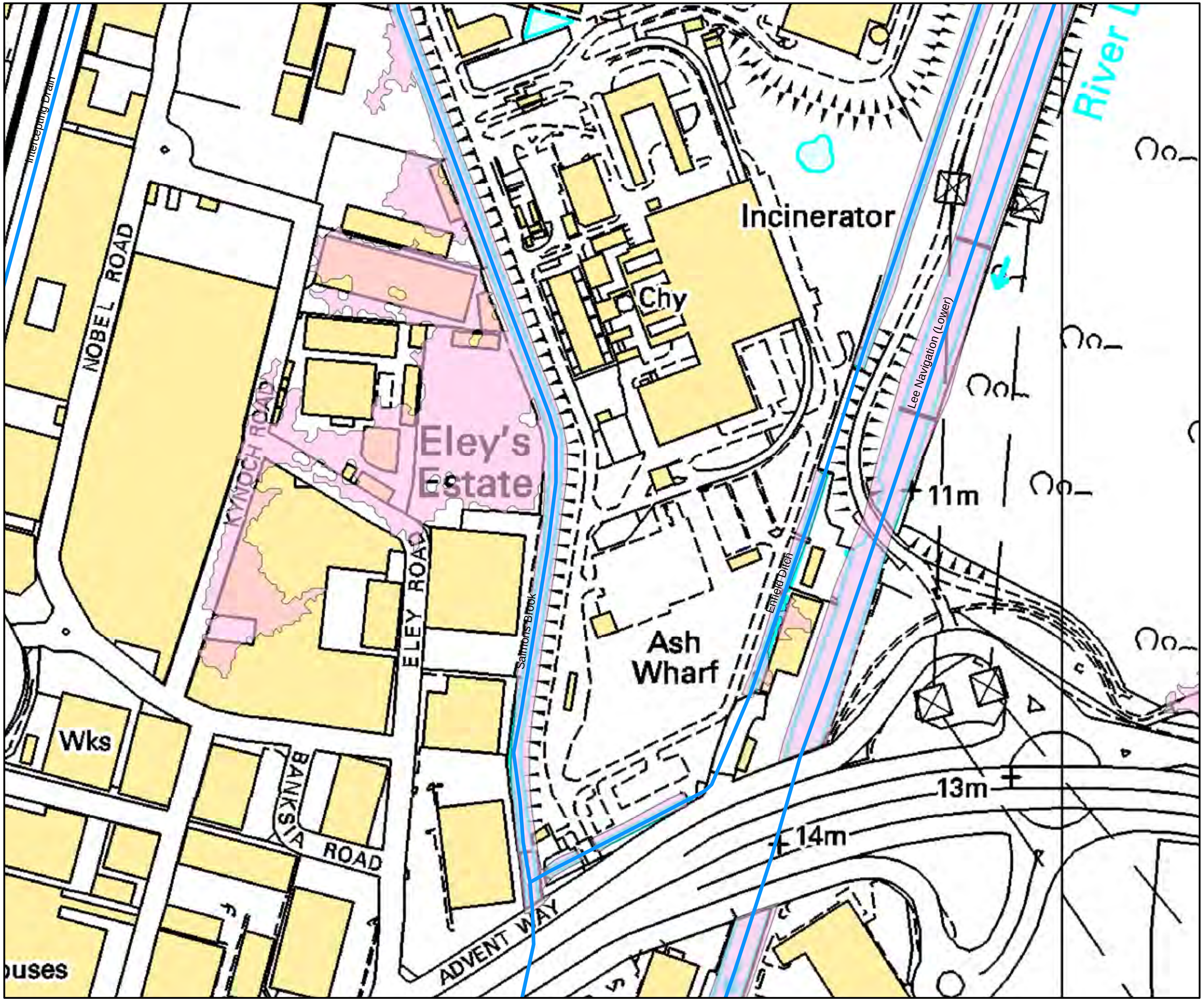

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Metres

Legend

Main Rivers

Defended Flood Outlines

1 in 100 (1%) Defended

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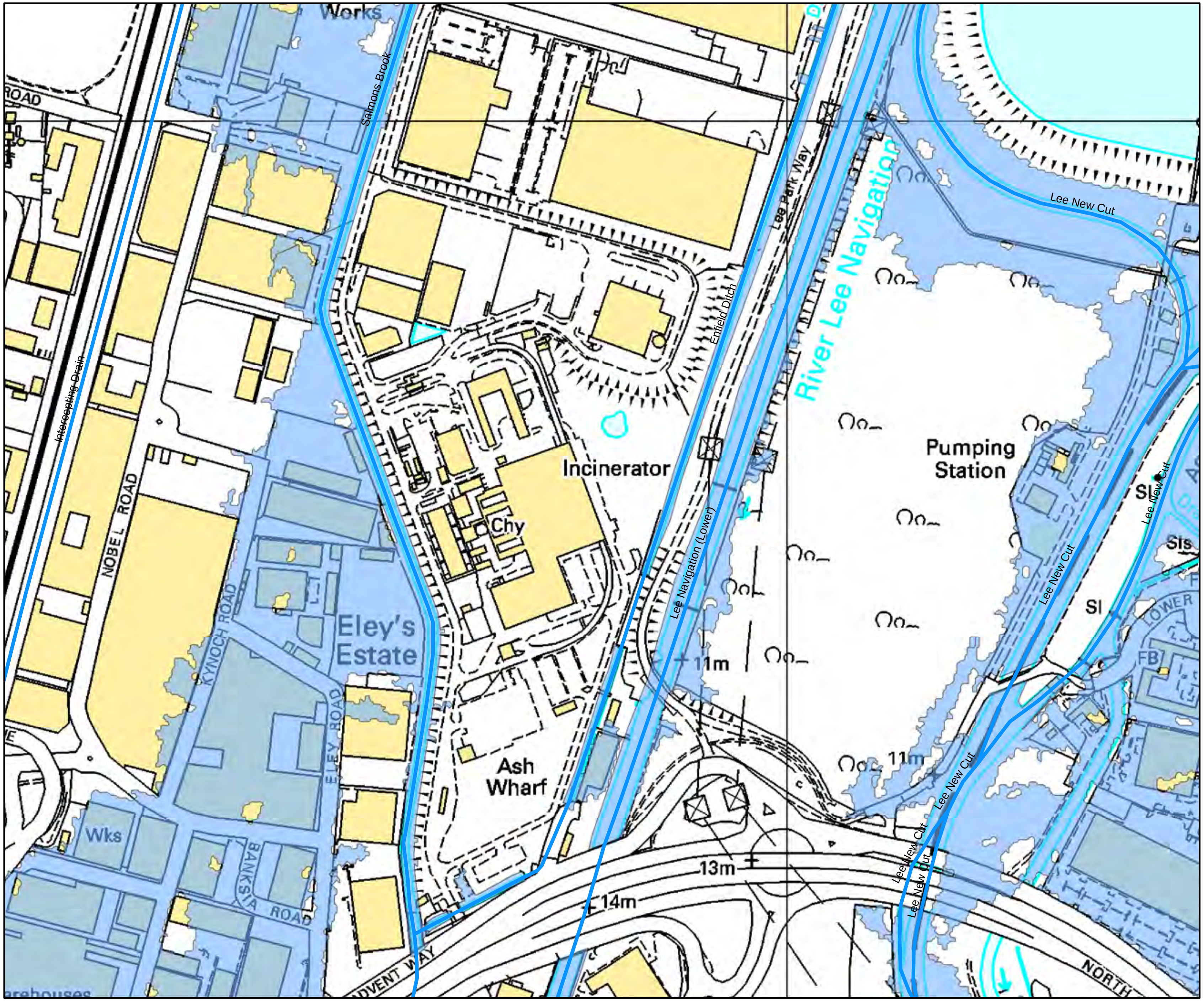

Environment Agency
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St Albans Road West
Hatfield
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AL10 9EX

0 62.5 125 250
Metres

Legend

Main Rivers

Defended Flood Outlines

1 in 100+20% (*CC) Defended

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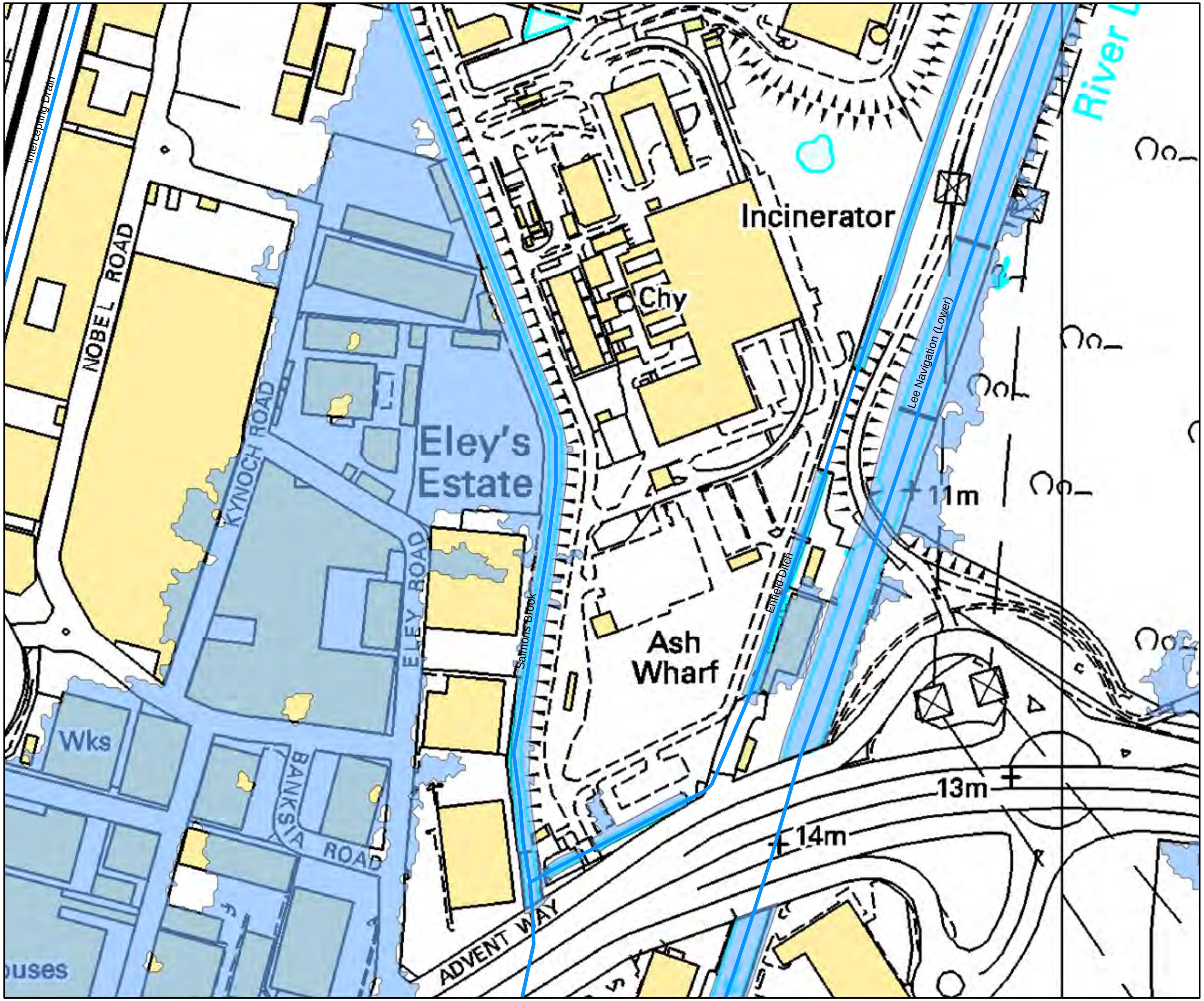

Environment Agency
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St Albans Road West
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0 45 90 180
Metres

Legend

Main Rivers

Defended Flood Outlines

1 in 100+20% (*CC) Defended

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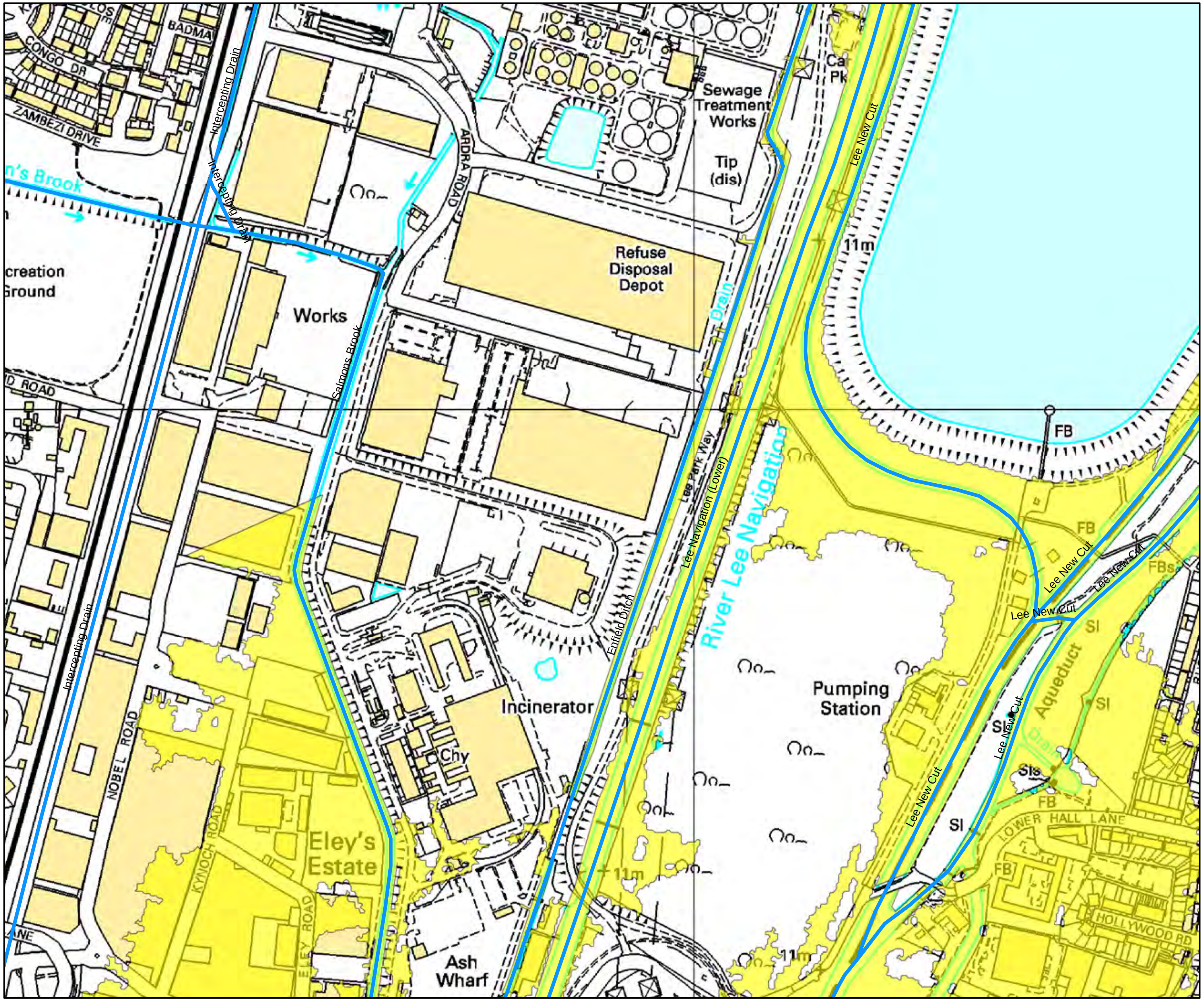

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St Albans Road West
Hatfield
Hertfordshire
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0 60 120 240
Metres

Legend

Main Rivers

Defended Flood Outlines

1 in 1000 (0.1%) Defended

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Note: 2D level nodes in the flood extent have also been completed as part of this study. However, the outputs have yet to be finalised. We will be providing the data at a later date.Please contact us for an update.

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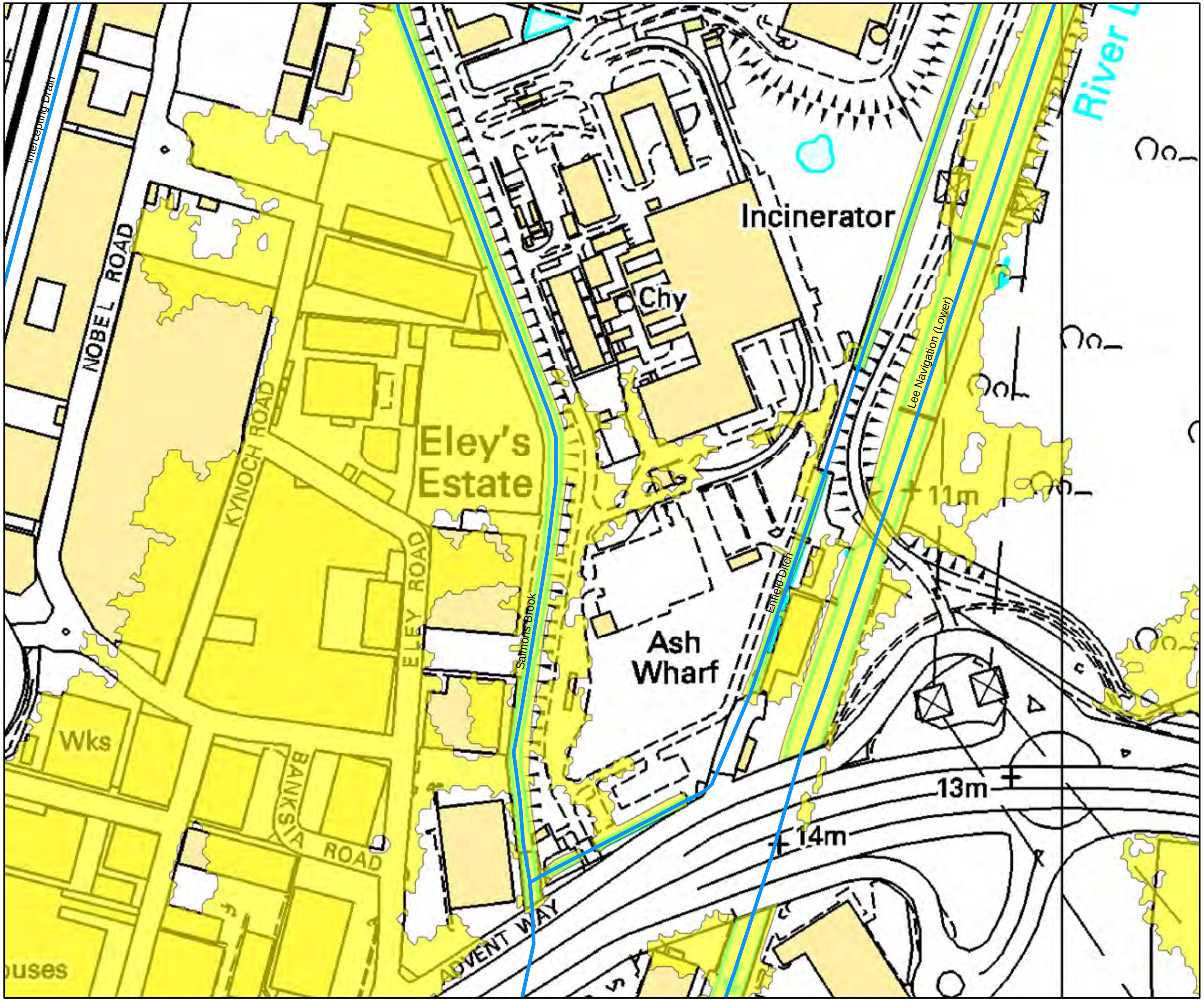

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Metres

Legend

Main Rivers

Defended Flood Outlines

1 in 1000 (0.1%) Defended

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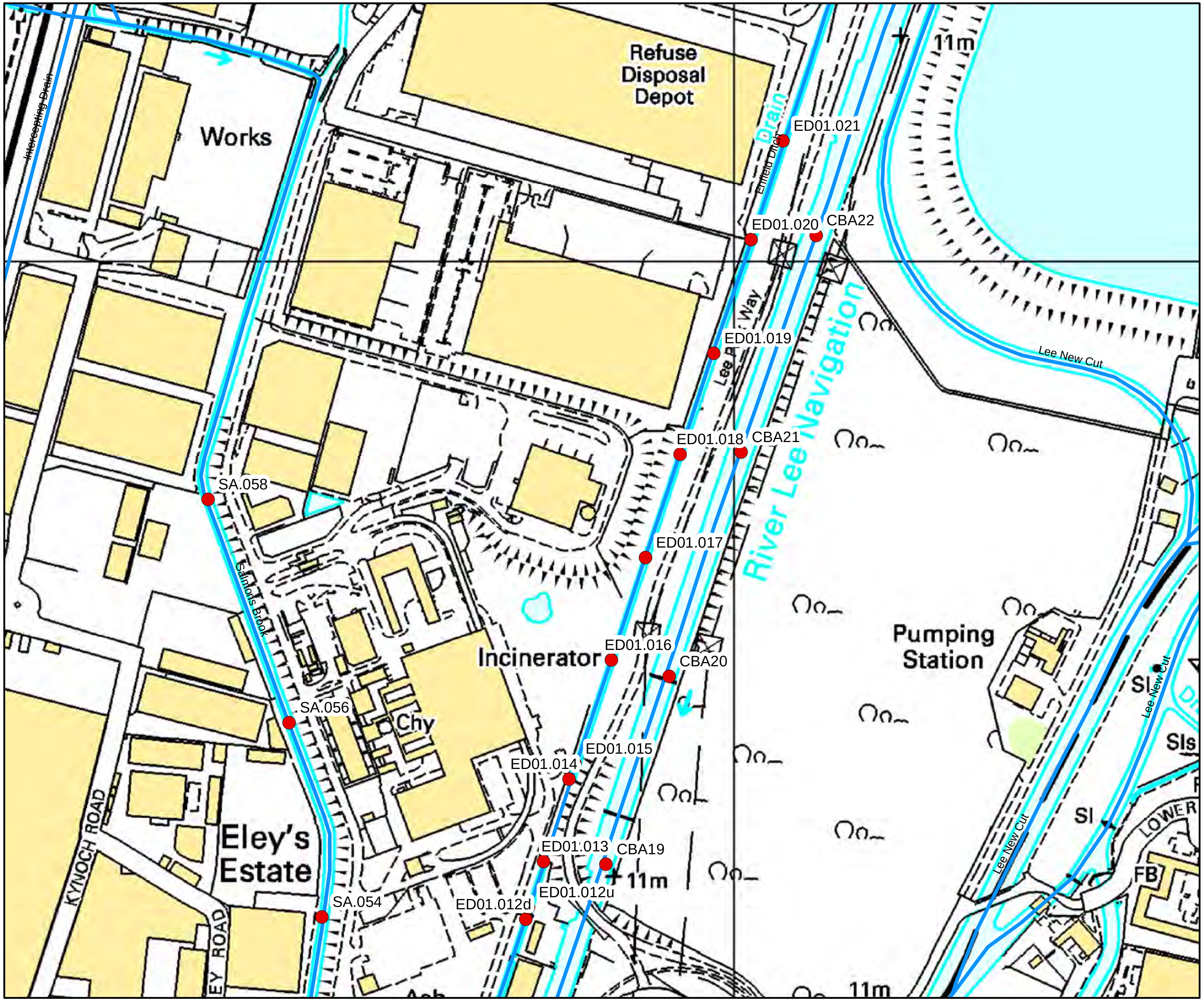

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Hatfield
Hertfordshire
AL10 9EX

0 45 90 180
Metres

Legend

Main Rivers

1D Node Results

1D Nodes

The data in this map has been extracted from the River Lee 2D Modelling study (CH2M Hill, 2014).
This model has been designed for catchmentwide flood risk mapping. It should be notedthat it was not created to produce flood levels for specific development sites within the catchment.

Modelled outlines take into account catchment wide defences.

Note: 2D level nodes in the flood extent have also been completed as part of this study. However, the outputs have yet to be finalised. We will be providing the data at a later date.Please contact us for an update.

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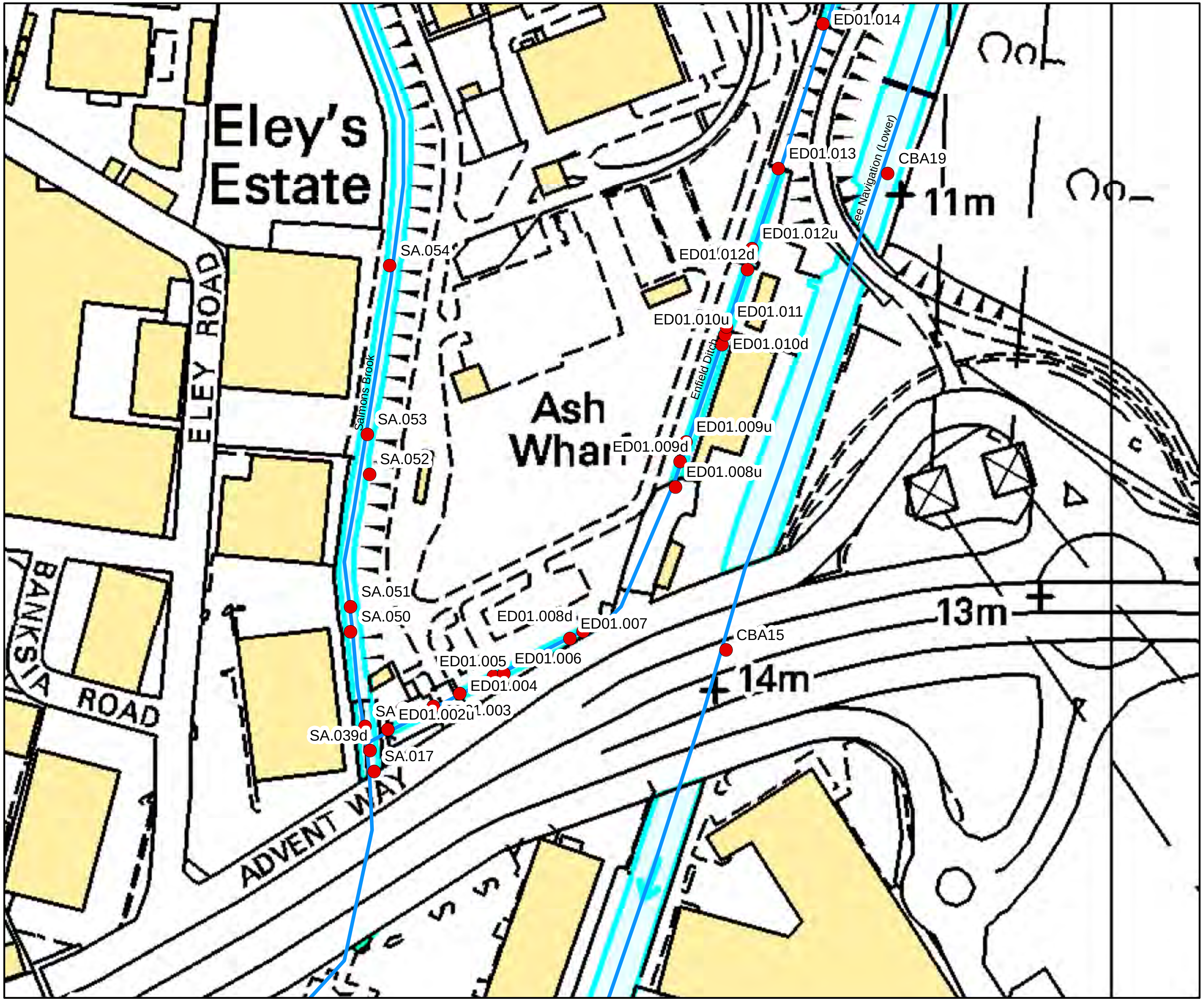

Environment Agency

Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

0 30 60 120
Metres

Legend

Main Rivers

1D Node Results

1D Nodes

The data in this map has been extracted from the River Lee 2D Flood Mapping Study (CH2M Hill, 2014). This was a catchment-scale mapping study, so may need local updates for site-specific decisions. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.

Modelled outlines take into account catchment-wide defences.

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Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Environment Agency ref: HNL47534MF

The data in this map has been extracted from the River Lee 2D Modelling study (CH2M Hill, 2014).

Caution:
This model has been designed for catchmentwide flood risk mapping. It should be notedthat it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences.

All flood levels are given in metres Above Ordnance Datum (mAOD)
All flows are given in cubic metres per second (cumecs)

MODELLED FLOOD LEVEL

				Return Period								
Node Label	**Easting**	**Northing**	**Watercourse**	**2 yr**	**5 yr**	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**100 yr + 20%**	**200 yr**	**1000 yr**
CBA15	535820	192286	Lower Lee	10.38	10.38	10.38	10.40	10.51	10.58	10.86	10.73	11.09
CBA19	535896	192508	Lower Lee	10.38	10.38	10.38	10.40	10.52	10.59	10.92	10.77	11.20
CBA20	535947	192661	Lower Lee	10.38	10.38	10.38	10.40	10.52	10.60	10.96	10.80	11.26
CBA21	536006	192844	Lower Lee	10.38	10.38	10.38	10.40	10.52	10.61	11.00	10.83	11.32
ED01.002u	535663	192249	Lower Lee	9.03	9.15	9.26	9.39	9.90	10.34	10.67	10.48	10.82
ED01.003	535684	192260	Lower Lee	9.04	9.15	9.26	9.39	9.90	10.34	10.67	10.48	10.82
ED01.004	535697	192265	Lower Lee	9.04	9.15	9.26	9.39	9.90	10.34	10.67	10.48	10.82
ED01.005	535712	192274	Lower Lee	9.04	9.15	9.26	9.39	9.90	10.34	10.67	10.48	10.82
ED01.006	535717	192275	Lower Lee	9.05	9.16	9.27	9.39	9.90	10.34	10.67	10.48	10.82
ED01.007	535748	192291	Lower Lee	9.05	9.16	9.27	9.39	9.90	10.34	10.67	10.48	10.82
ED01.008d	535754	192294	Lower Lee	9.05	9.16	9.27	9.39	9.90	10.34	10.67	10.48	10.82
ED01.008u	535797	192362	Lower Lee	9.05	9.16	9.27	9.39	9.90	10.34	10.67	10.48	10.82
ED01.009d	535799	192373	Lower Lee	9.05	9.16	9.27	9.39	9.90	10.34	10.67	10.48	10.82
ED01.009u	535802	192383	Lower Lee	9.08	9.18	9.29	9.41	9.90	10.34	10.67	10.48	10.82
ED01.010d	535819	192428	Lower Lee	9.10	9.20	9.30	9.41	9.90	10.34	10.67	10.48	10.82
ED01.010u	535820	192432	Lower Lee	9.13	9.22	9.32	9.43	9.91	10.34	10.67	10.48	10.82
ED01.011	535821	192436	Lower Lee	9.13	9.22	9.32	9.44	9.91	10.34	10.67	10.48	10.82
ED01.012d	535830	192463	Lower Lee	9.15	9.23	9.32	9.44	9.91	10.34	10.67	10.48	10.82
ED01.012u	535833	192473	Lower Lee	9.15	9.23	9.32	9.44	9.91	10.34	10.67	10.48	10.82
ED01.013	535845	192510	Lower Lee	9.16	9.24	9.33	9.44	9.91	10.34	10.67	10.48	10.82
ED01.014	535866	192577	Lower Lee	9.18	9.25	9.34	9.45	9.91	10.35	10.67	10.48	10.82
ED01.015	535870	192590	Lower Lee	9.20	9.26	9.34	9.45	9.91	10.35	10.67	10.48	10.82
ED01.016	535900	192674	Lower Lee	9.33	9.34	9.39	9.47	9.91	10.35	10.67	10.48	10.82
ED01.017	535928	192758	Lower Lee	9.39	9.40	9.43	9.50	9.92	10.35	10.67	10.48	10.82
ED01.018	535956	192842	Lower Lee	9.47	9.48	9.50	9.53	9.92	10.35	10.67	10.48	10.82
ED01.019	535984	192924	Lower Lee	9.53	9.53	9.54	9.57	9.92	10.35	10.67	10.48	10.82
ED01.020	536014	193017	Lower Lee	9.59	9.60	9.60	9.62	9.93	10.35	10.67	10.49	10.82

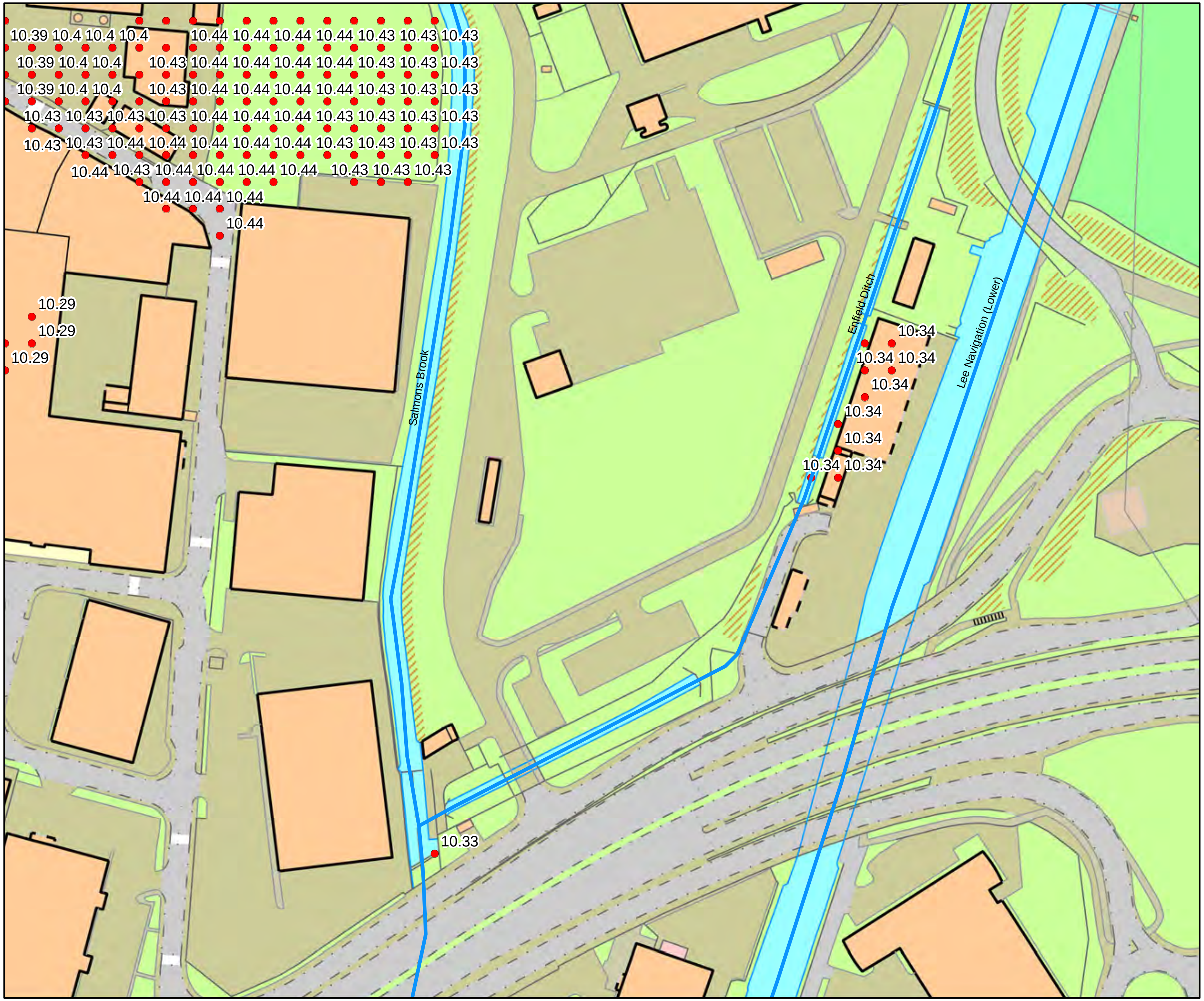
SA.017	535657	192229	Lower Lee	9.00	9.13	9.24	9.37	9.89	10.33	10.66	10.47	10.81
SA.039	535653	192250	Lower Lee	9.01	9.13	9.25	9.37	9.89	10.33	10.66	10.48	10.82
SA.039d	535655	192239	Lower Lee	9.01	9.13	9.25	9.37	9.89	10.33	10.66	10.48	10.82
SA.050	535646	192294	Lower Lee	9.02	9.14	9.26	9.38	9.90	10.34	10.67	10.48	10.82
SA.051	535646	192306	Lower Lee	9.04	9.17	9.28	9.41	9.91	10.36	10.68	10.50	10.83
SA.052	535655	192367	Lower Lee	9.07	9.20	9.32	9.45	9.94	10.39	10.70	10.52	10.85
SA.053	535654	192386	Lower Lee	9.07	9.20	9.31	9.44	9.93	10.38	10.70	10.52	10.85
SA.054	535664	192465	Lower Lee	9.11	9.25	9.36	9.49	9.97	10.42	10.72	10.55	10.87
SA.056	535637	192623	Lower Lee	9.19	9.33	9.44	9.57	10.02	10.46	10.74	10.58	10.88
SA.058	535571	192805	Lower Lee	9.31	9.45	9.56	9.68	10.09	10.52	10.78	10.63	10.92

MODELLED FLOWS

				Return Period								
Node Label	**Easting**	**Northing**	**Watercourse**	**2 yr**	**5 yr**	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**100 yr + 20%**	**200 yr**	**1000 yr**
CBA15	535820	192286	Lower Lee	0.81	0.85	0.87	1.19	8.04	13.88	35.60	25.78	55.07
CBA19	535896	192508	Lower Lee	0.81	0.85	0.87	1.19	8.04	13.88	35.45	25.83	53.49
CBA20	535947	192661	Lower Lee	0.81	0.85	0.87	1.19	8.04	13.87	35.61	25.78	54.92
CBA21	536006	192844	Lower Lee	0.81	0.85	0.87	1.20	8.04	13.85	35.72	25.82	57.24
ED01.002u	535663	192249	Lower Lee	0.54	0.55	0.57	0.60	0.72	1.26	1.94	1.12	3.11
ED01.003	535684	192260	Lower Lee	0.53	0.54	0.56	0.59	0.71	1.24	1.90	1.13	3.11
ED01.004	535697	192265	Lower Lee	0.53	0.54	0.56	0.59	0.71	1.24	1.90	1.13	3.11
ED01.005	535712	192274	Lower Lee	0.53	0.54	0.56	0.58	0.71	1.21	1.85	1.12	3.11
ED01.006	535717	192275	Lower Lee	0.53	0.54	0.56	0.58	0.71	1.20	1.82	1.12	3.11
ED01.007	535748	192291	Lower Lee	0.53	0.53	0.55	0.58	0.70	1.14	1.66	1.10	3.11
ED01.008d	535754	192294	Lower Lee	0.52	0.53	0.55	0.57	0.69	1.13	1.63	1.09	3.11
ED01.008u	535797	192362	Lower Lee	0.52	0.53	0.54	0.56	0.68	1.12	1.63	1.09	3.11
ED01.009d	535799	192373	Lower Lee	0.51	0.52	0.54	0.56	0.68	1.10	1.56	1.05	3.11
ED01.009u	535802	192383	Lower Lee	0.51	0.52	0.54	0.56	0.68	1.10	1.56	1.05	3.11
ED01.010d	535819	192428	Lower Lee	0.51	0.52	0.53	0.55	0.67	1.06	1.43	1.00	3.11
ED01.010u	535820	192432	Lower Lee	0.51	0.52	0.53	0.55	0.67	1.06	1.43	1.00	3.11
ED01.011	535821	192436	Lower Lee	0.51	0.52	0.53	0.55	0.67	1.06	1.42	1.00	3.11
ED01.012d	535830	192463	Lower Lee	0.51	0.52	0.53	0.55	0.66	1.04	1.41	1.00	3.11
ED01.012u	535833	192473	Lower Lee	0.51	0.52	0.53	0.55	0.66	1.04	1.41	1.00	3.11
ED01.013	535845	192510	Lower Lee	0.51	0.51	0.52	0.54	0.65	1.03	1.40	0.98	3.11
ED01.014	535866	192577	Lower Lee	0.50	0.51	0.51	0.53	0.64	1.01	1.40	0.96	3.11
ED01.015	535870	192590	Lower Lee	0.50	0.51	0.51	0.53	0.64	1.00	1.40	0.95	3.12
ED01.016	535900	192674	Lower Lee	0.50	0.50	0.51	0.52	0.62	0.96	1.34	0.92	3.14
ED01.017	535928	192758	Lower Lee	0.50	0.50	0.51	0.52	0.60	0.92	1.30	0.88	1.44
ED01.018	535956	192842	Lower Lee	0.50	0.50	0.50	0.51	0.59	0.87	1.25	0.84	1.37
ED01.019	535984	192924	Lower Lee	0.50	0.50	0.50	0.51	0.57	0.83	1.21	0.84	1.33
ED01.020	536014	193017	Lower Lee	0.50	0.50	0.50	0.51	0.56	0.79	1.18	0.84	1.28
SA.017	535657	192229	Lower Lee	12.18	14.06	15.36	16.91	19.41	24.32	26.68	25.63	27.43

SA.039	535653	192250	Lower Lee	11.70	13.57	14.88	16.43	19.21	24.04	26.11	25.36	27.27
SA.039d	535655	192239	Lower Lee	12.18	14.06	15.36	16.91	19.42	24.33	26.65	25.56	27.36
SA.050	535646	192294	Lower Lee	11.64	13.50	14.81	16.35	19.13	23.95	25.98	25.21	27.02
SA.051	535646	192306	Lower Lee	11.64	13.50	14.81	16.35	19.14	23.94	25.98	25.19	27.03
SA.052	535655	192367	Lower Lee	11.65	13.51	14.82	16.35	19.17	23.98	26.05	25.23	27.14
SA.053	535654	192386	Lower Lee	11.65	13.51	14.82	16.35	19.17	23.99	26.05	25.25	27.15
SA.054	535664	192465	Lower Lee	11.65	13.51	14.82	16.36	19.19	24.06	26.14	25.35	27.28
SA.056	535637	192623	Lower Lee	11.66	13.51	14.84	16.36	19.25	24.21	27.72	26.45	30.40
SA.058	535571	192805	Lower Lee	11.62	13.46	14.77	16.29	19.22	24.24	28.26	26.74	31.97

Detailed FRA centred on 535900, 192900 created 15/07/2015 - Ref:HNL47534MF



Environment Agency

Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

0 45 90
Metres

Legend

Main Rivers

2D Node Results: Heights

1 in 100 (1%) Defended M03

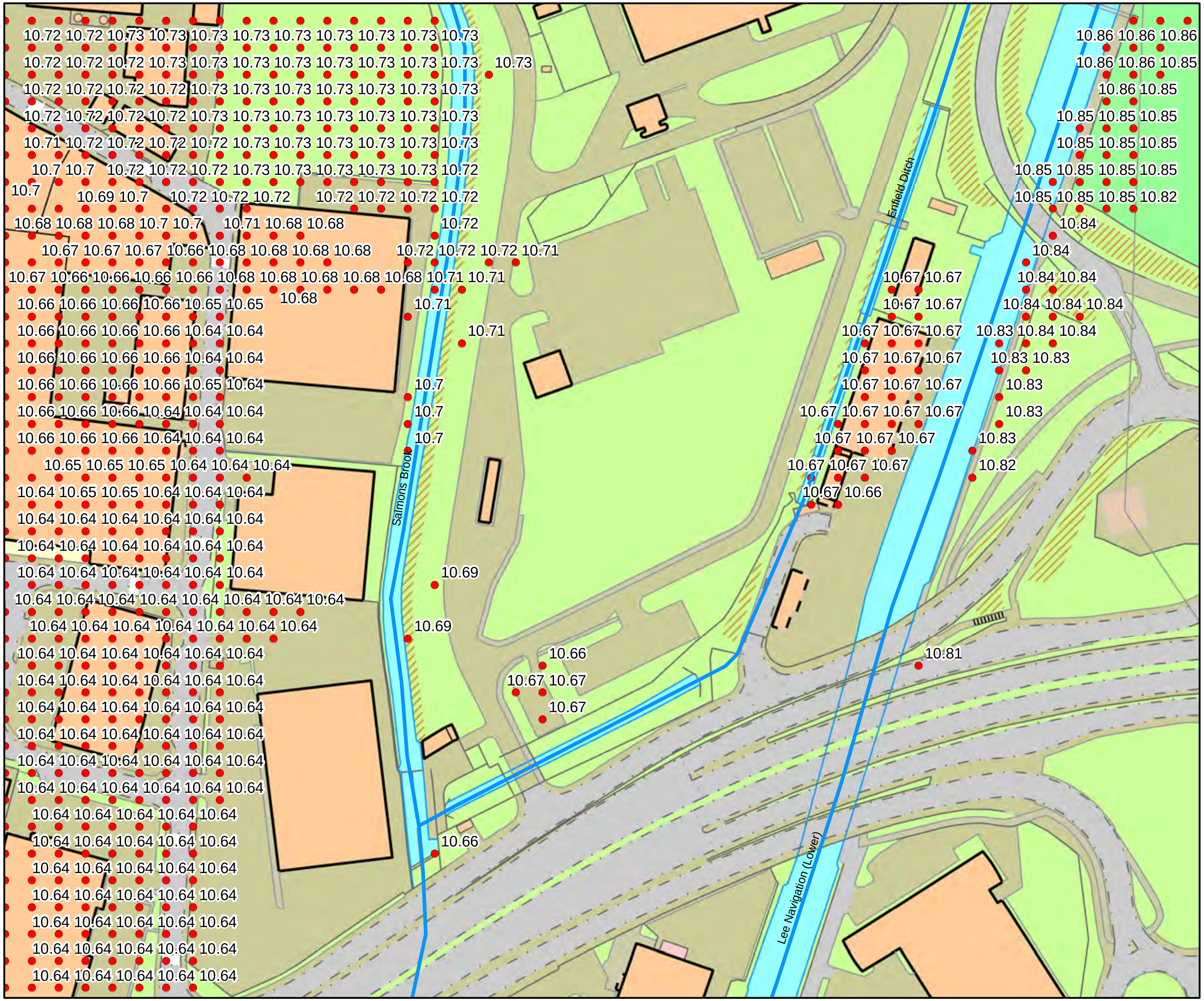
The data in this map has been extracted from the River Lee 2D Flood Mapping Study (CH2M Hill, 2014). This was a catchment-scale mapping study, so may need local updates for site-specific decisions. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.

Modelled outlines take into account catchment-wide defences.

Updates to model M03 were undertaken by the Lower Hall Sluices Operational Scenario Modelling (CH2M Hill, 2014), and updates to model M04 by the Lower Lee Tributaries Economic Appraisal project (CH2M Hill, 2015).

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA centred on 535900, 192900 created 15/07/2015 - Ref:HNL47534MF



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Hertfordshire
AL10 9EX

0 45 90
Metres

Legend

Main Rivers

2D Node Results: Heights

1 in 100+20% (*CC) Defended M03

The data in this map has been extracted from the River Lee 2D Flood Mapping Study (CH2M Hill, 2014). This was a catchment-scale mapping study, so may need local updates for site-specific decisions. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.

Modelled outlines take into account catchment-wide defences.

Updates to model M03 were undertaken by the Lower Hall Sluices Operational Scenario Modelling (CH2M Hill, 2014), and updates to model M04 by the Lower Lee Tributaries Economic Appraisal project (CH2M Hill, 2015).

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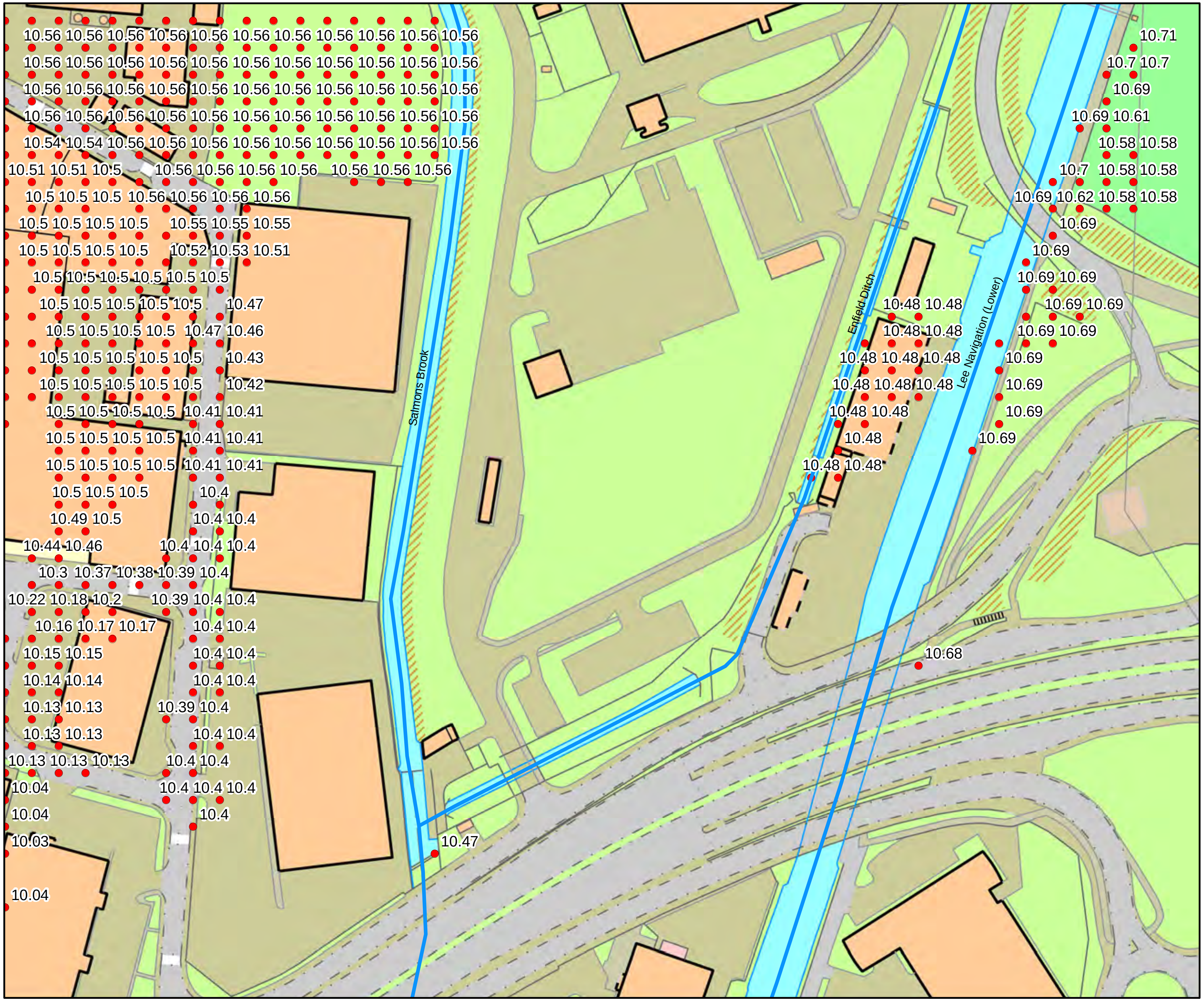
Detailed FRA centred on 535900, 192900 created 15/07/2015 - Ref:HNL47534MF



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Hatfield
Hertfordshire
AL10 9EX

0 45 90
Metres

Legend

Main Rivers

2D Node Results: Heights

1 in 200 (0.5%) Defended M03

The data in this map has been extracted from the River Lee 2D Flood Mapping Study (CH2M Hill, 2014). This was a catchment-scale mapping study, so may need local updates for site-specific decisions. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.

Modelled outlines take into account catchment-wide defences.

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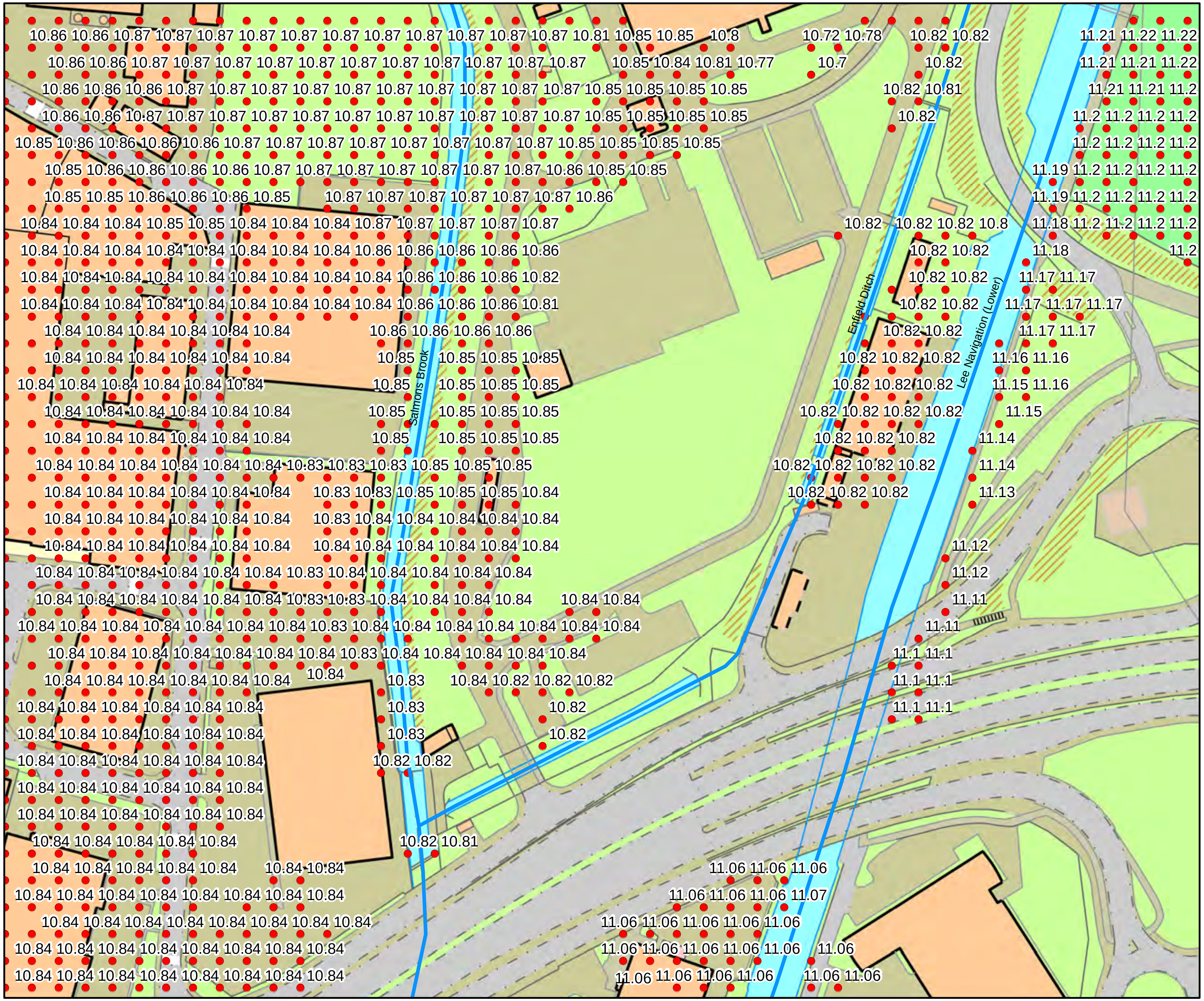
Detailed FRA centred on 535900, 192900 created 15/07/2015 - Ref:HNL47534MF



Environment Agency

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2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

0 45 90

Metres

Legend

Main Rivers

2D Node Results: Heights

1 in 1000 (0.1%) Defended M03

The data in this map has been extracted from the River Lee 2D Flood Mapping Study (CH2M Hill, 2014). This was a catchment-scale mapping study, so may need local updates for site-specific decisions. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.

Modelled outlines take into account catchment-wide defences.

Updates to model M03 were undertaken by the Lower Hall Sluices Operational Scenario Modelling (CH2M Hill, 2014), and updates to model M04 by the Lower Lee Tributaries Economic Appraisal project (CH2M Hill, 2015).

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Contact: enquiries@environment-agency.gov.uk 08708 506506

Environment Agency

[redacted]

Our ref: NE/2014/121509/01-L01
Your ref: -

Date: 10 November 2014

Dear [redacted]

Flood risk enquiry with regards the North London Waste Authority's intention to submit a planning application for the development of a energy recovery facility at the Edmonton Ecopark as a replacement for the existing energy centre.

London Waste Limited, Ecopark, Advent Way, N18 3AG

Thank you for contacting the Environment Agency.

Following your email dated 6 October, please find below the answers to your questions. I understand that your request for flood level data has already been responded to by our Customer and Engagement team.

Question 1
Our current thoughts are that runoff from the site will be discharged partly via the Thames Water sewer running adjacent to the site, and partly to surface watercourses (the Enfield Ditch, the Salmons Brook and the River Lee are near to the site, and the site currently holds two discharge consents. Can you please confirm what level of attenuation will be required before discharge off site to any watercourse.

Discharges to the Enfield Ditch, the Salmons Brook and this part of the River Lee must be limited to a maximum of three times the calculated Greenfield runoff rate. This is in accordance with the London Plan (July 2011) Policy 5.13 and the Supplementary Planning Guidance (SPG) on Sustainable Design and Construction - section 3.4.10.

Any new outfalls will require our Flood Defence Consent (FDC) under the terms of the Water Resources Act 1991 and the Land Drainage Byelaws 1981.

Question 2
The site is a waste site, and because of intensive development there will not be space for surface based drainage (SuDS). We are considering green roofs and rainwater harvesting in our design. We are not considering infiltration of runoff at the site because of relatively high groundwater levels (the site is also on an inner SPZ zone). Can you provide information on what treatment will be required for runoff from the waste site prior to being discharged to a watercourse (during the operation of the site) in addition to oil interceptors, and settlement in attenuation tanks on site?

As it is a waste site and contamination of surface water falling on the sites hard standing is likely, only clean roof water from sealed piped systems should be discharged to the

Cont/d..

watercourse.

The Environmental Permitting Regulations make it an offence to cause or knowingly permit any discharge that will result in the input of pollutants to surface waters.

Your Flood Risk Assessment (FRA) will need to consider the SUDS hierarchy and justify why each SUDS type cannot be used. We understand that infiltration may not be an option but other non infiltration SUDS like tanked permeable paving should not be discounted as they can have water quality benefits. Our SUDS requirements for sites over one Hectare are attached to this response.

Question 3
The site is within the flood inundation zone from the William Girling Reservoir located a short distance to the northeast of the site. I would like to know a little more about how this flood zone was determined. What mitigation measures if any, would you require at the new development in order to manage this risk?

The flood risk from reservoirs is residual but still needs to be appropriately explored within the FRA.

For information relating to the determination of the reservoirs flood zone, please contact our national enquiries helpdesk at enquires@environment-agency.gov.uk.

If you have any further queries please contact northlondonplanning@environment-agency.gov.uk.

Yours sincerely

[redacted]

Telephone: [redacted]
E-mail: northlondonplanning@environment-agency.gov.uk
Address: Environment Agency, Ergon House, Horseferry Road, London SW1P 2AL

creating a better place

Environment Agency

[redacted]

[redacted]

Our ref: NE/2015/122397/01-L01
Your ref: -

Date: 19 March 2015

Dear [redacted]

Flood Compensation Storage.

London Waste Limited, Ecopark, Advent Way, N18 3AG

Thank you for contacting the Environment Agency.

Following your email dated 27 February 2015, please find below the answer to the questions

Question 1
Will it be acceptable to treat the existing sea cadet building on Ash Wharf as the baseline scenario when considering the impact on flood plain storage from the new development?

Yes, you may be able to count the sea cadet building as pre-existing built footprint. This is provided it is a solid structure, not designed to flood. For example, if it were on stilts then the area of the void could not be counted. If it had a structure similar to a car port with open sides then it could not be counted.

Question 2
If the baseline scenario includes the sea cadet building, then the impact on flood plain storage from the new building is (conservatively estimated) 11 m^3. This is quite a small volume, but not negligible. Could you confirm whether the EA will require flood compensation storage for that volume?

We will need level for level flood plain storage compensation for any increase in built footprint up to the flood height on site (see below to determine the appropriate level).

Question 3
If the baseline scenario is considered to be without existing buildings then the compensation volume is larger, (conservatively estimated) $33m^3$. From the EA flood map it appears that flooding onto Ash Wharf is from the Enfield Ditch, not the Lee Navigation, and I have used the flood level from that watercourse to determine the flood volumes. Please let me know if you think that is not the case.

The water level in the Enfield Ditch reaches 10.67mAOD during the 1 in 100 chance in any given year, including an allowance for climate change, flood event.

Cont/d..

The water level in the Lee Navigation reaches 10.92mAOD during the 1 in 100 chance in any given year, including an allowance for climate change, flood event.

You will need to carry out a topographical survey of the site to see if it is protected from either of these levels by higher ground or the river wall.

Question 4
If compensation storage is required will it be acceptable to provide that on the west bank of the Enfield Ditch adjacent to Ash Wharf, on the opposite bank to where the flooding occurs? i.e. by re profiling the bank to provide level for level storage?

See comments for section 3, you will need to establish the source of flooding on the site using a topographic survey before you can decide on the most appropriate place for flood storage compensation.

If re-profiling the bank is shown to be acceptable with regard to the above, then your flood storage compensation must not increase flood risk to unintended areas so if the land to the west of the Enfield ditch were protected from flooding by raised ground, it would not be appropriate to remove this ground to provide flood storage compensation, unless all the affected land is in your ownership and of a compatible use or the water can be contained by providing another area of raised ground.

Question 5
If it is to be provided on the west bank of the Enfield Ditch will it be sufficient to demonstrate (e.g. by survey drawing and GIS calculations) that level for level storage compensation has been provided? Could you confirm it won't be necessary to model the flood flows along the Enfield Ditch in that case?

If you do not make any of the rivers narrower and provide level for level flood storage compensation then it will not be necessary for you to model the flood flows.

Please see attached "FSC" information sheet for more details on Level for level flood storage compensation.

I didn't comment on the attachment to the email as it provided no extra data to the above.

If you have any further questions please contact me on 0203 263 8054 or email me at northlondonplanning@environment-agency.gov.uk, quoting the reference at the beginning of this letter.

Yours sincerely

[redacted]

Telephone: [redacted]
E-mail: northlondonplanning@environment-agency.gov.uk
Address: Environment Agency, Ergon House, Horseferry Road, London SW1P 2AL

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Environment Agency

[redacted]

Our ref: NE/2015/123165/01-L01
Your ref: -

Date: 13 July 2015

Dear [redacted]

Flood risk enquiry relating to the development of an energy recovery facility at the Edmonton Ecopark as a replacement for the existing energy centre.

London Waste Limited, Ecopark, Advent Way, N18 3AG.

Thank you for contacting the Environment Agency. I understand that you have just had a telephone conversation with my colleague Joe Barton in our flood risk team who was able to answer the queries raised in your emails dated 23 June 2015.

Further to this conversation I would like to clarify our position regarding the proposed bund and any proposed infiltration within Source Protection Zone 1 (SPZ1).

Proposed bund
We do not have any objections to a proposed bund on site providing it is entirely outside of the 1 in 100yr + climate change flood extent. If it does fall within this extent then compensation will need to be provided on a level for level basis.

Infiltration
The site lies within Zone 1 of a groundwater source protection zone (SPZ). Groundwater protection zones protect water that is abstracted for public supply and so they are vulnerable to pollution with regards to site drainage entering the ground.

No infiltration based sustainable drainage systems should be constructed on land that is affected by contamination as contaminants can remobilise and cause groundwater pollution.

Any soakaway would need to be constructed in natural ground, such that it's base is at least 1m above the highest seasonal water table and in any case no deeper than 3m. No soakaways of SUDS discharge shall be constructed in contaminated ground or where there is a risk of contamination. This is to prevent the pollution of groundwater.

Surface water from hardstanding should discharge via deep seal trapped gullies incorporating a minimum water seal of 85mm or similar.

Roof water downpipes should be connected to the drainage system either directly, or by the means of back inlet gullies provided with sealing plates instead of open gratings.

Cont/d..

Drainage from covered car parking floors should not discharge to the surface water system. Where roof car parking is proposed surface water should pass through an approved oil separator before connecting to the surface water system.

For further guidance please refer to the following information and advice when dealing with land affected by contamination, especially with respect to protection of the groundwater beneath the site:

From www.gov.uk:

- Groundwater Protection: Principles and Practice (August 2013) (commonly referred to as GP3).
- Our Technical Guidance Pages, which includes links to CLR11 (Model Procedures for the Management of Land Contamination) and GPLC (Environment Agency's Guiding Principles for Land Contamination) in the 'overarching documents' section

If you have any questions please contact me on 0203 263 8054 or email me at northlondonplanning@environment-agency.gov.uk, quoting the reference at the beginning of this letter.

Yours sincerely

[redacted]

Telephone: [redacted]
E-mail: northlondonplanning@environment-agency.gov.uk
Address: Environment Agency, Ergon House, Horseferry Road, London SW1P 2AL

Appendix C: Preliminary Drainage Strategy

North London Waste Authority

North London Heat and Power Project

Preliminary Surface Water Drainage Strategy

AD05.14 Appendix C

The Planning Act 2008 The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5 (2)(q)

Issue | October 2015

Amec Foster Wheeler E&I UK Ltd

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Executive summary

i.i.i This report is the Preliminary Surface Water Drainage Strategy which forms an Appendix to the Flood Risk Assessment (FRA) for the North London Heat and Power Project (the Project). It has been prepared to support North London Waste Authority's (the Applicant's) application (the Application) for a Development Consent Order (DCO) made pursuant to the Planning Act 2008 (as amended).

i.i.ii The Strategy has been prepared with due consideration of all relevant policies and has been prepared in consultation with the Environment Agency (EA) and London Borough of Enfield (LB Enfield). Discharge rates have been determined and attenuation storage volumes calculated. A preliminary Sustainable Drainage Systems (SuDS) selection assessment has been undertaken to assess the suitability of various SuDS with respect to the Application Site constraints, as well as quality, quantity, ecological and amenity benefits and the opportunity to combine various SuDS techniques to produce a recognised management/treatment train solution. Finally, a preliminary SuDS drainage strategy for the Application Site has been determined, which can subsequently be used as the basis for detailed drainage design at the appropriate time.

i.i.iii The proposed strategy is set out below:

i.i.iv Rainwater harvesting would be installed and used for all or some of the following uses: toilet flushing in the administrative offices; vehicle washing; and for dust and fire suppression.

i.i.v The Project would include brown and/or green roofs covering a total area of approximately 7,845m^2 including on the Energy Recovery Facility (ERF) and EcoPark House.

i.i.vi Lined permeable paving in appropriate areas, such as general car parking areas and roads which would be frequented by light traffic.

i.i.vii Lined filter trenches have been identified as an effective upstream treatment to remove sediment and fine silts. They would form part of the three stage SuDS train to treat surface water from hardstanding areas.

i.i.viii Three separate attenuation tanks (serving the three distinct areas of the Application Site) to provide the storage necessary to limit peak discharges to greenfield runoff rates. The use of a sealed pipe network and tanks has the benefit of being able to contain any contamination if necessary (during a pollution incident or spillage for example), which could then be pumped and either treated at the on-site waste water treatment works, or tankered for off-site disposal if necessary.

i.i.ix Peak discharges would be limited to greenfield runoff rates for all events up to and including the 1 in 100 year with climate change storm event.

i.i.x Surface water would be discharged to a nearby watercourse. This method would avoid both discharge to the sewer network (the least sustainable discharge option) and minimise the risk of impacting the highly sensitive

principal aquifer that underlies the Application Site, which is used for public water supply.

i.i.xi It is proposed to discharge the attenuated flows to Enfield Ditch. This is the preferred option because of the current lack of flow in Enfield Ditch and the existing frequent high flow levels in the Salmons Brook.

i.i.xii Because of the relatively flat topography, the drainage solution may require some degree of pumping to discharge the runoff from the Application Site. Pumping would be kept to a minimum and used only when necessary.

i.i.xiii Where appropriate, oil separators would be used, at locations to be determined as part of the detailed design. Trapped gullies would also provide a treatment train component.

i.i.xiv Surface water drainage from Deephams Farm Road access, will be treated and conveyed to the attenuation tank serving sub-catchment 1. This would likely be via filter drains and a piped network.

i.i.xv Surface water drainage from the new section of Lee Park Way from the Edmonton EcoPark to the access bridge over Enfield Ditch will drain towards the attenuation tank serving sub-catchment 3 where it will be discharged to Enfield Ditch.

i.i.xvi Surface water drainage from Ardra Road and the Edmonton EcoPark pump station will remain as per the existing drainage system.

i.i.xvii The Temporary Laydown Area would utilise SuDS, in the form of swales, filter strips, and a retention pond or below ground tanks to attenuate flows and limit discharge to greenfield runoff rate.

i.i.xviii The piped network would be designed in accordance with Sewers for Adoption[1], i.e. capable of conveying the 1 in 30 year event. For events in excess of the capacity of the drainage network, i.e. exceedance events up to the 1 in 100 year event, surface water would be conveyed as overland flow via the road network to the on-site car parks. Slight raising around the edges of the site may be necessary to ensure this. As described in the FRA (AD05.14), only very small portions of the site are located within the 1 per cent Annual Exceedance Probability plus climate change extent, for which compensation storage is already proposed, and therefore it should be possible to achieve this without impacting the conclusions of the FRA.

[1] Water UK (2012) Sewers for Adoption 7th Edition - A Design & Construction Guide for Developer.

1 Introduction

1.1 Purpose of the report

1.1.1 This report presents the Preliminary Surface Water Drainage Strategy for the proposed North London Heat and Power Project (the Project).

1.1.2 This report forms an appendix to the Flood Risk Assessment (FRA) (AD05.14) which has been prepared to support the North London Waste Authority's (the Applicant's) application (the Application) for a Development Consent Order (DCO) made pursuant to the Planning Act 2008 (as amended). The FRA is Application Document AD05.14 and also Vol 2 Appendix 11.2 to the Environmental Statement (ES) (AD06.02).

1.1.3 This report sets out the relevant policy relating to surface water drainage and details how this would be met, including discharge rates and attenuation storage volumes.

1.1.4 This report also includes a high level Sustainable Drainage Systems (SuDS) selection assessment which considers the different SuDS techniques and solutions which would be appropriate for accommodating the surface runoff from the new buildings and the roads/car park areas proposed as part of the Project. The assessment addresses the quality, quantity and amenity impact on the Project as well as the opportunity to combine various SuDS techniques to produce a recognised management/treatment train solution.

1.1.5 This preliminary assessment of the suitability of potential SuDS solutions does not constitute a final SuDS design, the development of which will occur at the detailed design stage.

2 Planning policy context and consultation

2.1.1 This section provides a summary of the planning context in respect of management of surface water at the Application Site, including relevant national, regional and local legislation. It also summaries engagement with stakeholders which has informed the strategy. Further details on the relevant policies associated with surface water management are included in Appendix A.

2.2 Relevant planning policy

National policy

2.2.1 The Overarching National Policy Statement for Energy (NPS EN-1)[2] sets out government policy on planning applications for nationally significant energy infrastructure. It will provide the primary policy guidance for the Secretary of State in determining this DCO application.

2.2.2 The National Planning Policy Framework (NPPF)[3] requires that the development will be safe from flood risk and that flood risk will not be increased elsewhere as a result of the development, and this includes surface water runoff from rainfall.

Regional policy

2.2.3 Regional policy includes the London Plan[4], the Mayor's Supplementary Planning Guidance (SPG) and Environment Agency (EA) policy.

2.2.4 London Plan Policy 5.13 covers sustainable drainage. It states that developers should utilise SuDS unless there are practical reasons for not doing so, aim for a greenfield runoff rate from developments, and ensure that surface water runoff is managed as close to its source as possible in line with the following drainage hierarchy:

a. store rainwater for later use;
b. use infiltration techniques, such as porous surfaces in non-clay areas;
c. attenuate rainwater in ponds or open water features for gradual release;
d. attenuate rainwater by storing in tanks or sealed water features for gradual release;
e. discharge rainwater direct to a watercourse;
f. discharge rainwater to a surface water sewer/ drain; and
g. discharge rainwater to the combined sewer.

[2] Department of Energy and Climate Change (2011) Overarching National Policy Statement for Energy (EN-1), July 2011.
[3] Department for Communities and Local Government (2012) National Planning Policy Framework, March 2012.
[4] Greater London Authority (GLA) (2015) The London Plan, the Spatial Development Strategy for London Consolidated with Alterations since 2015, March 2015.

2.2.5 The Mayor's Sustainable Design and Construction SPG[5] provides guidance on to how to achieve the London Plan objectives effectively, supporting the Mayor's aims for growth, including the delivery of housing and infrastructure. Further detail is included in Appendix A.

2.2.6 The EA Flood Risk Fact Sheet for sites in Hertfordshire and North London states that *"Peak discharge rates from site will not increase as a result of the proposed development, up to a 1 in 100 chance in any year including an allowance for climate change storm event. We expect all applicants to strive to achieve greenfield run-off rates to reduce the impact of the development on the surface water drainage infrastructure, unless it is demonstrated that this is not practicable".* The factsheet is included in Appendix B.

Local policy

2.2.7 The London Borough of Enfield (LB Enfield) are the Lead Local Flood Authority. Collectively, LB Enfield's Core Strategy[6], Development Management Document (DMD)[7] and Area Action Plans form Enfield's Local Plan. The DMD states that a drainage strategy will be required for all developments to demonstrate how proposed measures manage surface water as close to its source as possible and follow the drainage hierarchy in the London Plan

2.2.8 All developments must maximise the use of and, where possible, retrofit SuDS. Further details into the requirements and hierarchy of SuDS are included in Section 4.2.

2.3 Consultation and meetings

2.3.1 The EA was consulted during the preparation of the FRA which included this Preliminary Drainage Strategy. The EA provided the following guidance for the Application Site:

- *"the site is within Zone 1 of a groundwater Source Protection Zone (SPZ) and no infiltration based SuDS should be constructed on land that is affected by contamination as contaminants can remobilise and cause groundwater pollution";*
- *"any soakaway would need to be constructed, such that its base is at least 1m above the highest seasonal water table and the SuDS should not be constructed in contaminated ground";*
- *"roof water downpipes should be connected to the drainage system either directly, or by the means of back inlet gullies provided with sealing plates instead of open gratings"; and*

[5] GLA (2014) Sustainable design and construction, supplementary planning guidance. London Plan (2011), Implementation framework, April 2014.
[6] LB Enfield (2010) The Enfield Plan Core Strategy 2010 – 2025, Adopted November 2010.
[7] LB Enfield (2014) Development Management Document, Adopted November 2014.

- *"as it is a waste site and contamination of surface water falling on the site's hard standing is likely, only clean roof water from sealed piped systems should be discharged to watercourses".*

2.3.2 The EA confirmed that discharges to Enfield Ditch, the Salmon's Brook and part of the River Lee Navigation must be limited to a maximum of three times the calculated Greenfield runoff rate, as set out in the Sustainable Design and Construction SPG.

2.3.3 Consultation responses from the EA are included in Appendix B of the FRA.

2.3.4 LB Enfield were consulted in May 2015 to obtain their views and expectations with respect to surface water management. LB Enfield advised that they expect the Applicant to aim to achieve greenfield runoff rates, and submit a Sustainable Drainage Strategy with the Application. This report addresses their suggestions and comments. Key notes from this meeting are included in Appendix C.

3 Attenuation storage requirements

3.1.1 The section sets out the requirements with respect to attenuation storage volumes and the rates to which discharge would be limited.

3.2 Existing runoff rates

3.2.1 The NPPF requires no increase in flood risk downstream as a result of the development. As a minimum, peak runoff rates from development must be no greater than existing, and allowing for the anticipated effects of climate change over the lifetime of the development. The Sustainable Design and Construction SPG goes further in stating that, as a minimum, discharge from pre-developed sites should not exceed 50 per cent of the existing rate.

3.2.2 The existing peak rate of surface water runoff from the Edmonton EcoPark has been estimated using the modified rational method to be approximately 2,433 l/s. This is the peak runoff rate for the entire existing Edmonton EcoPark, which discharges to the Chingford Sewer and Enfield Ditch via the combined sewer system and a surface water system respectively, and overland flow discharging to Salmon's Brook and Enfield Ditch. As set out later in this strategy, the intention is to direct all surface water runoff to Enfield Ditch in future, meaning that the flood risk to the other watercourses/networks (Salmon's Brook and the Chingford Sewer) would be reduced once the Edmonton EcoPark has been redeveloped.

3.2.3 Therefore, in order to ensure no local increase in flood risk as a result of increasing the discharge to any single location, the existing discharge rate to Enfield Ditch was also calculated. A number of conservative assumptions (such as that the pipe network to the Chingford Sewer would convey the 1 in 30 year event) were taken so as to ensure that the lower limit of the existing peak rate to this watercourse was identified, i.e. to ensure that it has not been overestimated.

3.2.4 The peak runoff rate to Enfield Ditch during the 1 per cent AEP plus climate change storm event (an event which would on average occur once every 100 years) was estimated to be at least 634 l/s. 50 per cent of this rate is 317 l/s, which provides the upper value to which discharge to Enfield Ditch should be limited.

3.2.5 The calculations of the peak runoff rate for the existing site and to Enfield Ditch are included in Appendix D1.

3.3 Greenfield runoff rates

3.3.1 Greenfield runoff rates at the site were calculated using the Institute of Hydrology 124 method[8]. The results are shown in Table 3.1 below, with the calculations shown in Appendix D2.

[8] IOH (1994) Flood Estimation for Small Catchments, Report 124, Marshall, D and Bayliss, A, June 1994.

Table 3.1 Greenfield Rates - Results

Storm event	Q (l/s/ha)	Q (l/s)
$Q_{BARrural}$	4.0	16.8
$Q_{100\ rural}$	12.8	164
$Q_{30\ rural}$	9.0	115.3
$Q_{10\ rural}$	6.5	83.3

3.3.2 The Sustainable Design and Construction SPG indicates that three times the greenfield rate is the maximum allowable for previously development sites, which is a rate of 38.4 l/s/ha during the 1 per cent AEP plus climate change rainfall event, or 507 l/s for the Edmonton EcoPark.

3.4 Storage volumes

3.4.1 Industry standard software WinDes was used to estimate the storage volumes required. This was undertaken for each of the separate zones of the staged development to ensure that each stage could be implemented independently, i.e. without causing any increase in flood risk elsewhere if any were undertaken in isolation. Constructed areas were grouped together where they are to be located nearby to each other and due to be constructed in the same phase, so that an efficient drainage layout can be designed. A 20 per cent climate change factor was applied to allow for a building lifetime of 60 years.

3.4.2 Figure 3.1 shows how the construction areas in each stage were grouped to determine attenuation storage requirements. Figure 3.2 shows the temporary construction areas. Table 3.2 sets out the results of the calculation of attenuation volumes for Edmonton EcoPark. Table 3.3 sets out the results for the temporary construction areas. WinDes summary outputs are included in Appendix E.

3.4.3 The Temporary Laydown Area would be re-instated to soft landscaping after construction; the areas within the Edmonton EcoPark used for temporary parking, storage and support building areas during construction would be incorporated into the permanent design layout by the end of construction.

Key	Description
1	RRF
2	EcoPark House
3	ERF
4	Existing EfW facility

Figure 3.1: Schematic showing indicative impermeable areas of the final Edmonton EcoPark layout.

Key	Description
5a	temporary construction area within Edmonton EcoPark
5b	Land to the east

Figure 3.2: Schematic showing the location of the temporary laydown area and the temporary construction area. Please note this is the final Edmonton EcoPark layout.

Table 3.2 Attenuation storage requirements for staged development

Stage	Construction component	Note (attenuation requirements)	Area label	Note	Building reference	Component	Maximum area (m^2)	Area (ha)	3 x Greenfield runoff rate			Greenfield runoff rate		
									Limiting discharge (l/s)	Maximum attenuation volume (m^3)	Windes file ref (Appendix E1)	Limiting discharge (l/s)	Maximum attenuation volume (m^3)	Windes file ref (Appendix E2)
Stage 1b	Construction of RRF, EcoPark House, use of Temporary Laydown Area		1		RRF	Roof	15,200	1.52	58.4	744	4	19.5	970	4a
						hardstanding	560	0.06	2.2	-	-	-	-	-
			2		EcoPark House	Roof	630	0.06	2.4	42	5	0.8	56	5a
						Hardstanding	280	0.03	1.1	-	-	-	-	-
Stage 1d	Construction of ERF		3		All buildings in north part of site	Roofs (ERF)	18,275	1.83	70.2	864	6	23.4	1125	6a
						Roof (northwest part of site)	2,483	0.25	9.5	116	7	3.2	154	7a
						Hardstanding	7,254	0.73	27.9	341	8	9.3	450	8a
Stage 3	Demolition of existing EfW facility		4		Area of demolished EfW facility	Hardstanding	36,750	3.67	138.6	1,759	9	47	2266	9a
					5 small buildings located on central former EfW facility area	Roof	650	0.07	2.5	-	9	-	-	-

Stage	Construction component	Note (attenuation requirements)	Area label	Note	Building reference	Component	Maximum area (m^2)	Area (ha)	3 x Greenfield runoff rate			Greenfield runoff rate		
									Limiting discharge (l/s)	Maximum attenuation volume (m^3)	Windes file ref (Appendix E1)	Limiting discharge (l/s)	Maximum attenuation volume (m^3)	Windes file ref (Appendix E2)
	Other areas of hardstanding						3,545	0.35	13.6	162	10	4.5	214	10a
	Roads						47,034	4.70	180.6	2,256	11	60.2	2893	11a
	Deephams Farm Road access						1,467	0.15	5.7	76	12	1.9	101	12a
	Total						**133,478**	**13.3**		**6360**		**169.8**	**8229**	
	Soft landscaping						35,814	3.58	-	-	-	-	-	-

Note:

Stage 1c (operation of RRF and demolition and clearance of north part of site) – attenuation for this stage is provided in Stage 1d, therefore no attenuation required at this stage and has not been included in the table above.

Stage 2 (Operation of all new buildings alongside the existing EfW facility) - attenuation for this stage is provided in Stage 1d, therefore no attenuation required at this stage and has not been included in the table above.

Table 3.3 Attenuation volumes required for the temporary areas during construction

Stage	**Construction component**	**Note (attenuation requirements)**	**Area label**	**Note**	**Building reference**	**Component**	**Area (m2)**	**Area (ha)**	**3 x Greenfield runoff rate**			**Greenfield runoff rate**		
									Limiting discharge (l/s)	**Attenuation volume (m^3)**	**Windes file ref (Appendix E1)**	**Limiting discharge (l/s)**	**Attenuation volume (m3)**	**Windes file ref (Appendix E2)**
Stage 1a	Site preparation and enabling works	Infill of pond and clearance of landscaped area to form Edmonton EcoPark temporary storage and parking area	5a	temporary	Storage and parking area	hardstanding and temporary building	16,083	1.61	61.8	760	1	20.6	986	1a
		Establish Temporary Laydown Area to south of William Girling Reservoir	5c	temporary	Temporary Laydown Area	hardstanding and temporary buildings	32,500	3.25	124.8	1547	3	41.6	2000	3a
	Total (temporary areas)						**48,583**	**4.86**	**186.6**	**1623**		**62.2**	**2986**	

3.4.4 As the discharge rates are relatively low in comparison to the site runoff for a 1 in 100 year storm event plus climate change, the attenuation difference between 3 times greenfield runoff rate and greenfield runoff rate is less than expected. Figures 3.3 and 3.4 show the discharge rates in comparison to the inflow.

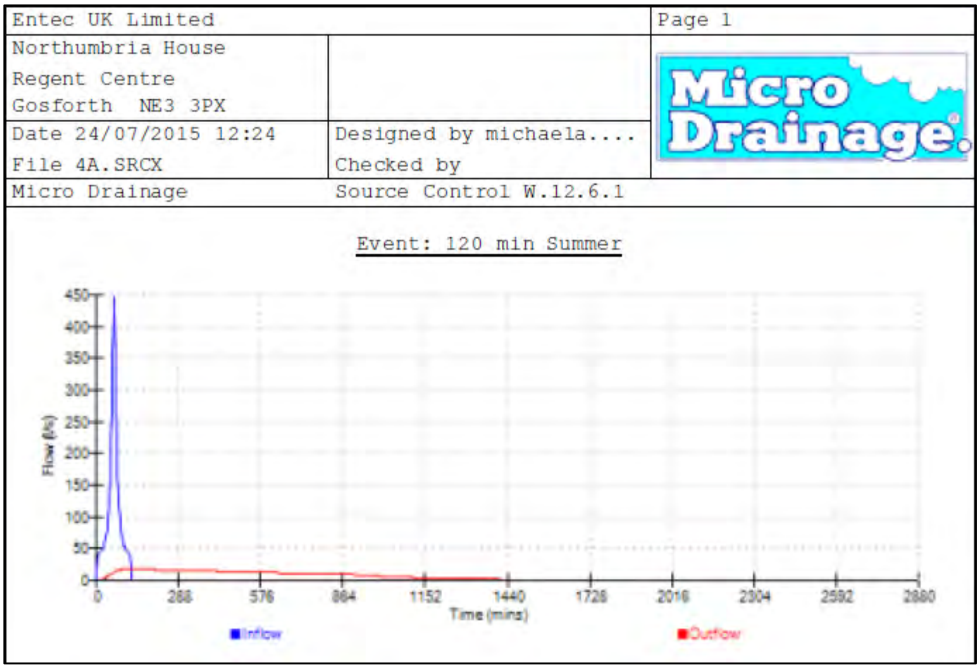

Figure 3.3: Graph showing inflow vs greenfield runoff rate for Area 4 (RRF Roof)

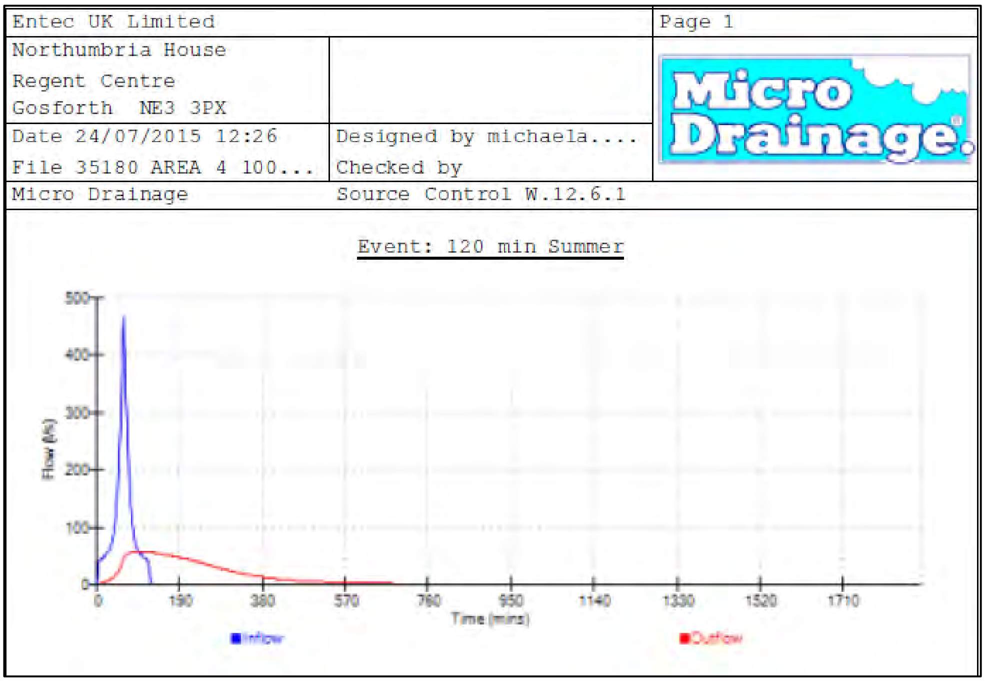

Figure 3.3: Graph showing inflow vs 3x greenfield runoff rate for Area 4 (RRF Roof)

4 SuDS selection assessment for the Edmonton EcoPark

4.1.1 This assessment has been completed for the Edmonton EcoPark by understanding key parameters of the site conditions so that the most appropriate techniques can be selected. The key assessment parameters are shown in Table 4.1.

Table 4.1: Assessment Parameters

Parameter	Comments
Land use	High density Industrial. An Energy Recovery Facility and Recycling Refuse Facility are proposed. Heavy lorry traffic expected on the roads. Phased development proposed, therefore full consideration of construction site runoff management is required.
Topography	Ground elevations at Edmonton EcoPark range from around 10.0m AOD to 13.5m AOD, with some isolated areas at higher levels than this. Elevations are highest across the north part of the site, and at the landscaped area in the north-east where the existing pond is located. Elevations fall generally from north towards the south. There is a localised high point in the southern section, at the grass landscaped area, where the elevations are in the range 11m AOD to 13m AOD, but this mound would be removed as part of the development resulting in ground levels in the region of 11m AOD in this area
Area of catchment	Edmonton EcoPark covers an area of approximately 16.8 ha (approximately 5.1ha of the 22.8ha is required for the Temporary Laydown Area located on the eastern side of the River Lee Navigation).
Soil type	London Clay overlying the Lambeth Group (comprising mottled clay with sand and pebble beds), and in turn, the Thanet Sand Formation and the chalk. Superficial deposits, which lie over the clay, are Alluvium (clay, silt, sand and gravel) overlying the Kempton Park Gravels. The thickness of the London Clay ranges between 2m and 19m across the site with the thinnest in the south of the site. This clay layer is expected to act as an aquiclude, which can protect the chalk aquifer below from risk of any contamination as a consequence of activities at the surface.
Permeability	Laboratory permeability testing on samples of the silty clay underlying the site found low hydraulic conductivity with a mean 9.02×10^{-11} m/s, similar to the London Clay.
Depth to water table	Groundwater levels have been monitored at the application site since 2011, including over winter periods. Groundwater elevations have been measured between 7.12m and 9.45m AOD, which equates to between approximately 2.5m and 8.5m below ground level (bgl). Further information on groundwater is provided in the

Parameter	Comments
	Hydrogeological Risk Assessment, Vol 2 Appendix 7.2 of the Environmental Statement.
Receiving water sensitivity	Most of the Application Site is located within the inner zone (Zone 1) of a groundwater Source Protection Zone (SPZ) relating to public water supply sourced from the chalk and superficial aquifers. This is considered highly sensitive. Surface water sensitivity is based upon the surface water features in the vicinity of the site, which include Enfield Ditch, Salmons Brook and River Lee Navigation. Enfield Ditch and Salmons Brook currently have poor ecological and biological quality. The site currently drains toward these watercourses via the general topography and a piped network. These watercourses are considered to be low to medium sensitivity.
Environmental sensitivity of site	The site has no ecological designations (SSSI, SACs, SPA, etc).
Available space for SuDS	Low. The majority of Edmonton EcoPark is already developed and the proposals are for similar intensive industrial development. Limited amount of suitable green space is available for SuDS. The only green space that could potentially be available for surface SuDS is located in the eastern section of the site. However, this would not be suitable for the majority of larger above ground SuDS devices as there is the possibility that this area may be used in the future during redevelopment of the EfW. This area is proposed to be a grassy meadow. The green strip on the western corridor has been allocated for the utilities, which may need to be accessed from time to time, and is therefore unsuitable for any SuDS.
Runoff catchments characteristics	Industrial site. Roof runoff with hardstanding areas including roads used for operational and light vehicle use, and parking areas.

4.2 SuDS hierarchy

4.2.1 The hierarchy of preferred SuDS techniques has been considered in the design of the SuDS strategy. This is set out in Table 4.2 taken from the Sustainable Design and Construction SPG, the Enfield DMD and the EA factsheet. The Sustainable Design and Construction SPG and DMD are detailed in Appendix A, and the EA factsheet is shown in Appendix B.

Table 4.2: SuDS Hierarchy

	SuDS technique
Most sustainable	Store rainwater for later use.
	Living roofs and walls.
	Use infiltration techniques, such as porous surfaces in no-clay areas.
	Attenuate rainwater in ponds or open water features for gradual release to a watercourse.

	SuDS technique
	Attenuate rainwater in ponds or open water features for gradual release to a watercourse.
	Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse.
	Discharge rainwater to a surface water drain.
Least sustainable	Discharge rainwater to the combined sewer.

4.3 Treatment train component

4.3.1 The design of a SuDS scheme would normally require the use of two or more techniques that are linked together. Each technique would perform uniquely with regard to water quality treatment and storm water attenuation. To achieve the best results, treatment trains should be combined to form a SuDS management train. The number of treatment trains needed for the runoff catchment characteristic of any particular site is provided in Table 4.3.

Table 4.3 Number of treatment train components required[9]

Runoff catchment characteristics	Receiving water sensitivity		
	Low	Medium	High
Roofs only	1	1	1
Residential roads, parking areas	2	2	3
Refuse collection/industrial areas/loading bays/lorry parks/highways	3	3	4

4.3.2 Runoff from roofs requires only one simple treatment stage before discharge. Areas frequented only by normal road traffic would require two treatment stages before discharge to a watercourse or three stages before infiltration to the highly sensitive underlying aquifer. In the waste loading areas and vehicle storage areas three SuDS components would be required before discharge to a watercourse.

4.3.3 It is proposed that runoff from designated vehicle washing bays would be discharged to the on-site wastewater treatment plant. It is recommended that these areas should be covered if possible to prevent rainwater entering the system.

4.4 Identification of possible SuDS techniques

4.4.1 A preliminary assessment of the possible SuDS techniques that could be employed at Edmonton Ecopark has been carried out as shown in Table 4.4, based on the key assessment parameters identified in Table 4.1 above.

[9] CIRIA C697 (2007) The SUDS Manual 2007, Table 5.6. Note that the table included in the SuDS manual itself has been acknowledge to include errors, the corrected version is show.

Table 4.4 Site characteristics selection matrix [10]

SuDS Group	Technique	SuDS selection criteria								AmecFW assessment
		Soils	Area draining to a single SuDS component		Minimum depth to water table		Site slope	Available head	Available space	Suitability of SuDS
		Impermeable	0 - 2 ha	>2ha	0-1m	> 1m	0-5 %	0 to 1m	Low	Suitable or unsuitable
Retention	Retention pond	Yes (1)	Yes	Yes (5)	Yes	Yes	Yes	Yes	No	Unsuitable due to limited space available and ground elevations
	Subsurface storage	Yes	Yes	Yes (5)	Yes	Yes	Yes	Yes	Yes	Suitable
Wetland	Shallow wetland	Yes (2)	Yes (4)	Yes (6)	Yes (2)	Yes (2)	Yes	Yes	No	Unsuitable due to limited space available
	Extended detention wetland	Yes (2)	Yes (4)	Yes (6)	Yes (2)	Yes (2)	Yes	Yes	No	Unsuitable due to limited space available
	Pond / wetland	Yes (2)	Yes (4)	Yes (6)	Yes (2)	Yes (2)	Yes	Yes	No	Unsuitable due to limited space available
	Pocket wetland	Yes (2)	Yes (4)	No	Yes (2)	Yes (2)	Yes	Yes	Yes	Unsuitable due to limited space available
	Submerged gravel wetland	Yes (2)	Yes (4)	Yes (6)	Yes (2)	Yes (2)	Yes	Yes	No	Unsuitable due to limited space available
	Wetland channel	Yes (2)	Yes (4)	Yes (6)	Yes (2)	Yes (2)	Yes	Yes	No	Unsuitable due to depth of water table and the site will unlikely have a continuous surface base flow
Infiltration	Infiltration trench	No	Yes	No	No	Yes	Yes	Yes	Yes	Unsuitable due to SPZ 1, brownfield site (potential existing contaminated or disturbed ground), low permeability of the underlying ground
	Infiltration basin	No	Yes	Yes (5)	No	Yes	Yes	Yes	No	Unsuitable due to SPZ 1, brownfield site (potential existing contaminated or

[10] CIRIA C697 (2007) The SUDS Manual 2007, Table 5.4.

SuDS Group	Technique	SuDS selection criteria								AmecFW assessment
		Soils	Area draining to a single SuDS component		Minimum depth to water table		Site slope	Available head	Available space	Suitability of SuDS
		Impermeable	0 - 2 ha	>2ha	0-1m	> 1m	0-5 %	0 to 1m	Low	Suitable or unsuitable
										disturbed ground), low permeability of the underlying ground
	Soakaway	No	Yes	No	No	Yes	Yes	Yes	Yes	Unsuitable due to SPZ 1, brownfield site (potential existing contaminated or disturbed ground), low permeability of the underlying ground
Filtration	Surface sand filter	Yes	Yes	Yes (5)	No	Yes	Yes	No	No	Unsuitable due to limited space available
	Sub surface sand filter	Yes	Yes	No	No	Yes	Yes	No	Yes	Potentially suitable
	Perimeter sand filter	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Potentially suitable
	Bio-retention / filter strip	Yes	Yes	No	No	Yes	Yes	Yes	No	Unsuitable due to limited space available
	Filter trench	Yes(1)	Yes	No	No	Yes	Yes	Yes	Yes	Potentially suitable for runoff from the EfW if lined
Detention	Detention basin	Yes(1)	Yes	Yes (5)	No	Yes	Yes	No	No	Unsuitable due to limited space available
Open channels	Conveyance swale	Yes	Yes	No	No	Yes	Yes	Yes	No	Unsuitable due to limited space available
	Enhanced dry swale	Yes	Yes	No	No	Yes	Yes	Yes	No	Unsuitable due to limited space available
	Enhanced wet swale	Yes (4)	Yes	No	Yes	Yes	Yes	Yes	No	Unsuitable due to limited space available
Source control	Green roof	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Suitable
	Rain water harvesting	Yes	Yes	No	Yes	Yes	Yes	Yes		Suitable

SuDS Group	Technique	SuDS selection criteria								AmecFW assessment
		Soils	Area draining to a single SuDS component		Minimum depth to water table		Site slope	Available head	Available space	Suitability of SuDS
		Impermeable	0 - 2 ha	>2ha	0-1m	> 1m	0-5 %	0 to 1m	Low	Suitable or unsuitable
	Permeable pavements	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Potentially suitable under car parks if lined, not suitable in areas frequented by heavy industrial traffic and subject to pollution prevention control (alternative methods more appropriate in these areas)

Notes
(1) with liner
(2) with surface base flow
(3) unless follows contours
(4) with linear and constant base flow or high ground water table
(5) possible but not recommended (implies appropriate management train not in place)
(6) where high flows are diverted around SuDS component
(7) further on site investigation may be needed to prove soakaways will work

4.4.2 Infiltration would not be implemented due to relatively high groundwater levels, the limited presence of natural (undisturbed) ground underlying the Application Site, the low permeability soil and clay layer at a relatively shallow depth, and because the site is a waste site within an inner groundwater Source Protection Zone (SPZ). Infiltration of surface water within this zone is restricted by the EA to avoid groundwater pollution.

4.4.3 Space constraints at the Edmonton EcoPark would mean there is minimal space for significant amounts of surface based SuDS features such as swales and ponds. The Edmonton EcoPark is designated for intensive development as a waste site, and the area where the existing EfW facility is to be demolished would remain clear for future development and therefore is not suitable for surface based SuDS.

4.4.4 Blue roofs are not suitable due to the architectural design of the roofs (sloping angles, glass to provide light, Photovoltaic Panels etc.), and green and brown roofs have been proposed where suitable.

4.5 Possible SuDS solutions

Table 4.5 Possible SuDS Solutions

SuDS group	**SuDS technique**	**Suitability and benefits**	**Incorporated into outline drainage strategy solution**
Retention	Subsurface storage	Good. Suitable but provide no habitat creation or water quality treatment benefits. The subsurface storage could be used as tanks or geocellular.	Yes
Filtration	Filter trench	Good. Lined filter trenches with granular fill provide high water quality treatment and are suitable for contaminated sites. Filter trenches provide a quiescent zone for removal of fine silts and also encourage filtration, adsorption and biodegradation. Sediment/debris traps should be installed upstream to ensure minimal maintenance required.	Yes
Source Control	Green roofs and brown Roofs	Good. Green roofs can be used to reduce the volume and rate of runoff, together with creating biodiversity. Green roofs and brown roofs are suitable where the slope of the roof is less than 1 in 3.	Yes
	Rainwater harvesting	Good. Rainwater harvesting is easy to install and requires minimal space. For example a water butt can be installed adjacent to the building or underground. Water collected can be reused for irrigation for surrounding green areas. It is also possible that a grey water system can be installed where rainwater is reused within the building for toilet flushing etc. It should be noted however, that, rainwater harvesting cannot be included in the stormwater storage assessment because they wouldn’t necessarily have capacity to store water at the required time.	Yes

SuDS group	SuDS technique	Suitability and benefits	Incorporated into outline drainage strategy solution
	Permeable paving	Good. Permeable pavement with no infiltration. The quality of the runoff is improved due to filtration, adsorption, biodegradation and sedimentation throughout the sub-base and permeable paving. The permeable paving should only be proposed in general car park areas and where light traffic is proposed.	Yes

5 Preliminary Drainage Strategy

5.1 SuDS components

The following SuDS components are proposed for the Application Site.

Pre-treatment

5.1.1 Sediment sumps or manholes would be proposed as the primary pre-treatment for surface water runoff from hardstanding areas such as the roads and Refuse Collection Vehicles parking areas. Sediment sumps remove sediment by provided a permanent water pool to promote settling of solids.

Green and brown roofs

5.1.2 A green roof is proposed to be installed on approximately 3,000m^2 on the ERF roof, with either brown or green roofs proposed on approximately 4,845m^2 on the ERF roof and EcoPark House roof. Green roofs would provide attenuation close to source, for lower return period rainfall events and they improve water quality of the rainwater as it filters through the substrate. Green and brown roofs also provide biodiversity value, which would be important at the Edmonton EcoPark where there is to be little soft landscaped area at ground level. Green and brown roofs cannot provide attenuation for extreme events for example rainfall events with a return period of more than 10 years. Nevertheless they do provide some additional contribution to storage for the design storm i.e. the 100 year (1 per cent AEP) event.

Rainwater harvesting

5.1.3 It is proposed to use rainwater harvesting at the Application Site. This helps to minimise water demand from the public water supply and it can also be used to manage surface water runoff. Rainfall is diverted from roofs to tanks, where it is stored for later use. This reduces the volume of water running off the Application Site, particularly for more frequent (less extreme) storms. The design of the tank must ensure sufficient volume is available to accommodate the design storm. Rainwater with minimal filtration treatment can be used for toilet flushing as well as landscape watering, and for example clothes washing.

5.1.4 At the Application Site it is proposed that rainwater is used some of all of the following:

h. in the administrative office and visitor centre building, for toilet flushing;

i. for vehicle washing (lorries);

j. for dust suppression; and

k. for fire suppression.

5.1.5 It is not intended that the rainwater harvesting system is included as part of the stormwater control, as there may be concerns by regulators that the demand rainwater stored is not continuous and stable. This would be necessary so that the tank is drawn down at a constant rate and the stormwater storage volume is always available. Alternatively levels in the tank could be monitored and when necessary the tank could be drawn down and excess water discharged at a low rate to a watercourse. In this case the rainwater harvesting storage would be separate to, and in addition to, the stormwater attenuation requirements.

5.1.6 Provision of rainwater harvesting is in line with the requirements of London Plan Policy 5.13 to store rainwater for later use and the Enfield DMD to make use of rainwater collection. See Appendix A for further details regarding relevant policy.

Permeable paving

5.1.7 Permeable paving is not considered a suitable approach in the areas of the Application Site which would be subject to heavy and frequent use by heavy waste vehicles. It is of utmost importance that the drainage strategy serves the purpose of the Edmonton EcoPark in the first instance and does not impinge upon the ability of the site to process waste, which could be impacted if frequent maintenance of permeable paving is required. The greatest risk would be that it would not be possible to keep up the required level of maintenance to ensure that the paving functions as designed, meaning that the Edmonton EcoPark's drainage system could be compromised. For this reason an approach that does not require such frequent maintenance at the point of operation has been identified.

5.1.8 General car parking on the Edmonton EcoPark and areas frequented for light traffic is a suitable location for permeable paving. The areas suitable are shown in Figure 5.1. Permeable paving with lining would be required to prevent infiltration.

Figure 5.1: Light traffic (staff, visitors and RRF)

5.1.9 Permeable paving provides storage capacity, as well as water quality treatment as runoff percolates through the sub base material, and would be designed so that additional areas of impermeable land can also drain to it.

5.1.10 The permeable paving would be installed during the final stages of construction to prevent silt and sediment clogging the pavement.

Filter trenches

5.1.11 Filter trenches are an effective upstream treatment to remove sediment and fine silts. They would form part of the three stage SuDS train to treat surface water from hardstanding areas. Filter trenches don't require large amounts of space and can be easily incorporated into the Edmonton EcoPark landscaping.

5.1.12 Similar to permeable paving, filter trenches are suitable where not frequented by heavy vehicles, therefore areas which are suitable include the staff car parking and roads used by the light vehicles.

5.1.13 Filter trenches would require a lining to prevent infiltration to the ground.

Green space

5.1.14 Parts of the Application Site have been set aside as open space, to provide ecological habitat and amenity value. Due to the location of these spaces within the development, for example located up gradient or on sloping surfaces, incorporation of these spaces into the drainage strategy is not possible, but this does not detract from the habitat they would provide.

Oil separators

5.1.15 Where appropriate, oil separators would be used, at locations to be determined as part of the detailed design. Surface water from carparks, hardstanding areas and the roofs would be treated via the oil separators.

Summary of SuDS components

5.1.16 The SuDS components selected are summarised in Table 5.1 below. It can be seen that the two most sustainable techniques have been applied at the Application Site. In addition, lined permeable paving would be utilised in areas frequented by light/non-operational traffic. Of the six potential options for discharge, the third most sustainable out of the six has been selected, which is considered the most appropriate given the location of the site in the inner zone of an SPZ and the space constraints on the Edmonton EcoPark.

Table 5.1: Summary of SuDS selected

Table header	SuDS technique	Selected in this strategy
Most sustainable	Store rainwater for later use	✓
	Living roofs and walls	✓
	Use infiltration techniques, such as porous surfaces in non-clay areas	✓ (infiltration and permeable paving)

Table header	SuDS technique	Selected in this strategy
	Attenuate rainwater in ponds or open water features for gradual release to a watercourse	
	Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse	✓
	Discharge rainwater direct to a watercourse	
	Discharge rainwater to a surface water drain	
Least sustainable	Discharge rainwater to the combined sewer.	

5.2 Drainage Strategy for the Edmonton EcoPark

5.2.1 The peak discharge from the 1 per cent AEP with climate change event to Enfield Ditch would be limited to the greenfield runoff rate of 170 l/s.

5.2.2 As a result of the discharge restricted to greenfield runoff rates, attenuation is required. From the volumes identified in Table 3.2, a total of 8,229m^3 of attenuation is required to cater for the 1 in 100 year storm event plus climate change. The attenuation would be provided by underground storage tanks or cellular storage. It is proposed that the attenuation would be divided into three sub-catchments:

a. northern area including the proposed ERF and Deephams Farm Road access;

b. central area including where the existing EFW facility would be demolished; and

c. southern area including the RRF and EcoPark house.

5.2.3 These areas are shown in Figure 5.2.

5.2.4 It is anticipated that the attenuated flows would be discharged to Enfield Ditch. This is the preferred option because of existing frequent high flow levels in Salmon's Brook.

5.2.5 Because of the relatively flat topography the drainage solution may require some degree of pumping to discharge the runoff from the Application Site. Pumping would be kept to a minimum and used only when necessary.

5.2.6 Drainage from roofs (other than that used for rainwater harvesting) would be collected separately, and discharged direct to the watercourse after attenuation. The roof drainage would be through a sealed system to avoid potential contamination from surface runoff at ground level.

5.2.7 Currently the surface water drainage for Deephams Farm Road access discharges via three outlets to Salmons Brook. It is proposed that the drainage design would be in accordance with the Design Manual for

Roads and Bridges, Volume 4[11] and treatment would be in the form of filter drains before being conveyed to the attenuation tank located in sub-catchment 1.

5.2.8 Surface water drainage for the section of Lee Park Way from the Edmonton EcoPark to the access bridge over Enfield Ditch will drain towards the attenuation tank located in the sub-catchment 3, for eventual discharge to Enfield Ditch.

5.2.9 Drainage from Ardra Road and the pump station will continue to utilise the existing surface water system. The existing drainage system on Ardra Road comprises of gullies and a piped system. Surface water from the Edmonton EcoPark pumping station roof and yard area drains to Deephams STW outflow channel.

5.2.10 Routing of drainage and positioning of tanks would need to consider the phasing of the development i.e. to ensure that it is routed/located around existing buildings before they are demolished. Attenuation tanks would need to be shallow to maximise drainage by gravity and to ensure the clay layer is not penetrated, since this layer provides protection from contamination to the underlying aquifer.

Figure 5.2: Sub-catchment zones

5.2.11 Penstock valves would be installed downstream of the storage tanks to ensure containment of any pollution incident on-site, i.e. to prevent any contamination of the receiving watercourse. In the event of a hazardous spill, runoff from the site (from a design rain event) would be stored in the tank before being treated (perhaps at the on-site waste water treatment

[11] Design Manual for Roads and Bridges, Geotechnics and Drainage, Volume 4

works) and discharged from the Application Site (either to the Chingford combined trunk sewer, or tinkered off-site if necessary).

Overland flow

5.2.12 Surface water runoff which may mobilise as overland flows during peak rainfall events would be conveyed via the roads to the on-site car parks. Levels associated with the on-site car parks and roads would be designed accordingly as part of the detailed design.

5.2.13 The piped network would be designed in accordance with Sewers for Adoption[12], i.e. capable of conveying the 1 in 30 year event. For events in excess of this, i.e. exceedance events up to the 1 in 100 year event, surface water would be conveyed as overland flow via the road network to the on-site car parks. Slight raising around the edges of the Edmonton EcoPark may be necessary to ensure this, i.e. to amend the existing surface water flow routes which run off directly into Enfield Ditch and Salmon's Brook at the edges of the Edmonton EcoPark. Provided this does not impinge upon the 1 per cent AEP plus climate change defended flood extent then this is acceptable from the flood risk perspective. As described in the FRA, only very small portions of the Edmonton EcoPark are located within the 1 per cent AEP plus climate change extent, for which compensation storage is already proposed and therefore it should be possible to achieve this without impacting the conclusions of the FRA.

Construction stages

5.2.14 During construction, the existing drainage system (discharging to Enfield Ditch and the combined system) would be utilised with a sediment and pollution control plan in place prior to construction. The proposed SuDS would be installed for each sub-catchment with the landscaping and permeable pavement installed in the final stages. The SuDS would only be used once construction of that specific stage is complete as during construction the runoff is heavily laden with silt which can build up in storage systems and pollute the receiving waters.

5.3 Temporary Laydown Area

5.3.1 The Temporary Laydown Area is located to the south of William Girling Reservoir and east of the River Lee Navigation. The purpose of the Temporary Laydown Area is to provide for:

a. site offices;

b. storage of construction materials, plant and machinery;

c. fabrication/ sub-assembly; and

d. construction staff and contractor vehicle parking.

5.3.2 Currently the topography of this area is sloping both towards the River Lee Navigation on the western side of the Temporary Laydown Area and the

[12] Water UK (2012) Sewers for Adoption 7th Edition - A Design & Construction Guide for Developer.

River Lea on the eastern side of the Temporary Laydown Area. There is currently bunding on the northern and eastern edge.

5.3.3 If the total site was to be hard standing area, a total of 2,000m^3 is required to be stored on-site to limit the discharge rate to greenfield runoff rate. It would be proposed that the Temporary Laydown Area would be contoured to route the flows towards the River Lee Navigation. The impermeable areas would be further refined during detailed design together with consultation with the Canal and River Trust, with the potential for this storage volume to be decreased.

5.3.4 The attenuation and treatment for this area could be provided by SuDS, in the form of swales, filter strips, below ground tanks or a retention pond.

5.3.5 Due to the level of water in the River Lee Navigation, it is likely that the drainage would require pumping.

5.3.6 After completion of the Project, the Temporary Laydown Area would be reinstated as existing unless otherwise agreed with LB Enfield.

Appendix A: Policy context for surface water systems

A1 National policy

A1.1.1 The Overarching National Policy Statement for Energy[13] (NPS EN-1) sets out government policy on planning applications for nationally significant energy infrastructure. It will provide the primary policy guidance for the Secretary of State in determining this planning application.

A1.1.2 The NPS EN-1 states at Paragraph 4.5.3*") the IPC needs to be satisfied that energy infrastructure developments are sustainable and, having regard to regulatory and other constraints, are as attractive, durable and adaptable (including taking account of natural hazards such as flooding) as they can be."*

A1.1.3 Section 5.7 explains the requirements for flood risk assessment and mitigation in detail, referring to Planning Policy Statement 25[14] (which preceded NPPF Planning Policy Guidance: Flood Risk and Coastal Change) or successor documents. The National Planning Policy Framework[15] (NPPF) requires that *") 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."* Whilst these fundamental principles of managing flood risk on-site whilst not increasing flood risk elsewhere underpin the approach to the drainage strategy, there are no drainage specific policies in the national policy documents.

A2 Regional policy

A2.1.1 Regional policy includes the London Plan, its supporting documents and Environment Agency (EA) policy.

A2.2 London Plan

A2.2.1 The following policy excerpts from the London Plan[16] are relevant to this Drainage Strategy.

Sustainable Drainage (Policy 5.13)

A2.2.2 *"Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to*

[13] DECC (2011)Overarching National Policy Statement for Energy (EN1): Planning for New Energy Infrastructure, Department of Energy and Climate Change, July 2011.
[14] DCLG (2009) Planning Policy Statement 25: Development and Flood Risk Practice Guidance, Updated December 2009.
[15] DCLG, 2012 Department for Communities and Local Government, 2012. National Planning Policy Framework, March 2012.
[16] GLA, 2011 London Plan: Spatial Development Strategy for Greater London (as amended), Mayor of London, July 2011.

achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. *Store rainwater for later use;*
2. *Use infiltration techniques, such as porous surfaces in non-clay areas;*
3. *Attenuate rainwater in ponds or open water features for gradual release to a watercourse;*
4. *Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse;*
5. *Discharge rainwater direct to a watercourse;*
6. *Discharge rainwater to a surface water drain;*
7. *Discharge rainwater to the combined sewer."*

The use of sustainable urban drainage systems should be promoted for development unless there are practical reasons for not doing so. Such reasons may include the local ground conditions or density of development. In such cases, the developer should seek to manage as much run-off as possible on site and explore sustainable methods of managing the remainder as close as possible to the site."

Sustainable Design and Construction Supplementary Planning Document

A2.2.3 The Mayor's Sustainable Design and Construction Supplementary Planning Guidance (SPG)[17] provides guidance on to how to achieve the London Plan objectives effectively, supporting the Mayor's aims for growth, including the delivery of housing and infrastructure. Section 3.4.10 states:

"All developments on greenfield sites must maintain greenfield run-off rates. On previously developed sites, run-off rates should not be more than three times the calculated greenfield rate. The only exceptions to this, where greater discharge rates may be acceptable, are where a pumped discharge would be required to meet the standards or where surface water drainage is to tidal waters and therefore would be able to discharge at unrestricted rates provided unacceptable scour would not result."

A2.2.4 The requirement from the Sustainable Design and Construction SPD to manage discharge rates at previously developed sites at three times greenfield was published after the Enfield Development Management Document (DMD) (discussed under local policy below).

[17] GLA, 2014 Sustainable Design and Construction Supplementary Planning Guidance, Mayor of London, 2014.

A2.2.5 Relevant guidance is provided include Sections 3.4.5 to 3.4.19. These are repeated below for ease of reference:

"Greenfield runoff rates

London Plan Policy 5.13[16] states *"that developers should aim for a greenfield runoff rate from their developments. Greenfield runoff rates are defined as the runoff rates from a site, in its natural state, prior to any development. Typically this is between 2 and 8 litres per second per hectare. The CIRIA SuDS Manual generally recommends the institute of Hydrology Report 124 methodology for calculating greenfield runoff rates.*

Achieving a greenfield runoff rate is of particular importance where the development is located in a catchment that contributes to combined sewers with known and/or modelled capacity or flooding issues. Information to determine whether capacity/flooding issues exist is available from borough SWMPs and Strategic Flood Risk Assessments (SFRAs) as well as other historic data.

If greenfield runoff rates are not proposed, developers will be expected to clearly demonstrate how all opportunities to minimise final site runoff, as close to greenfield rate as practical, have been taken. This should be done using calculations and drawings appropriate to the scale of the application. In order to achieve this, applicants should:

1. *consider the permeability of all existing and proposed surfaces on the application site;*
2. *assess the existing surface water and foul drainage networks and their discharges; and*
3. *assess a range of return periods (the probability of a rainfall event of a particular size occurring and resulting in flooding) up to and including the 1 in 100 year plus climate change critical storms (an additional 20-30%).*

Most developments referred to the Mayor have been able to achieve at least 50% attenuation of the site's (prior to re-development) surface water runoff at peak times. This is the minimum expectation from development proposals.

There may be situations where it is not appropriate to discharge at greenfield runoff rates. These include, for example, sites where the calculated greenfield runoff rate is extremely low and the final outfall of a piped system required to achieve this would be prone to blockage. An appropriate minimum discharge rate would be 5 litres per second per outfall.

The drainage hierarchy

The drainage hierarchy set out in London Plan policy 5.13 comprises two elements:

- *managing and storing surface water on-site before it is finally discharged, if required (Numbers 1 to 4); and*

- *disposal of surface water from a piped drainage system (Numbers 5, 6 and 7).*

The capture and storage of rainwater for later use is always the priority in order to also meet the objective of making efficient use of water resources. See section 2.5 for more details on water reuse. Where there are no opportunities to collect and reuse rainwater, the site, where practical should drain to the ground to recharge groundwater resources. Where infiltration is not possible, surface water should be stored on-site in open water features such as ponds and wetlands and then released at a controlled rate. The final option is to store surface water in tanks or cellular storage before it is released at a controlled rate. This is the least preferable storage option as it does not provide wider sustainability benefits such as habitat provision or water quality improvements.

Multi-functional benefits of SuDS

Development should utilise SuDS unless there are practical reasons for not doing so. The aspiration is to deliver SuDS schemes that provide multiple benefits, in addition to reducing flood risk. The most beneficial schemes will successfully contribute to the delivery of the Water Framework Directive by reducing water pollution and providing additional valuable habitat to improve the status of our water bodies. SuDS schemes should also aim to improve amenity, and therefore the quality of life of Londoners, as well as contribute to the wider goals relating to green infrastructure, biodiversity, water efficiency and recreation.

SuDS should be fully justified by adopting techniques in a hierarchical manner, maximising the use of those techniques higher up the hierarchy and those that deliver multi-functional benefits before considering others further down the hierarchy. A London SuDS Guidance Pack from the London Drainage Engineers Group will be available in 2014.

Site conditions to consider when assessing the suitability of different SuDS include:

- *the contaminants present in runoff;*
- *the catchment area;*
- *local hydrology; and*
- *the type of development.*
- *Infiltration methods need to consider:*
- *soil permeability;*
- *ground stability;*
- *depth to water table;*
- *soil attenuation, both flow and quality;*
- *contaminants present in ground; and*
- *local hydrogeology and risk of groundwater contamination.*

Management of SuDS and contributions

Drainage designs incorporating SuDS measures should include details of how each SuDS feature, and the scheme as a whole, will be managed and maintained throughout its lifetime. When published the National Standards for sustainable drainage systems should be followed with additional consideration given to the issues associated with the *constrained nature and abundance of below ground services on London sites. These SuDS will be reviewed by, and require permission from SuDS Approval Bodies administered by the boroughs.*

Some borough SWMPs may include actions to deliver SuDS schemes to help alleviate existing surface water flooding issues. Developers should consider these proposals and investigate ways to implement or contribute towards such schemes."

A2.3 Environment Agency

A2.3.1 The EA Flood Risk Fact Sheet for sites in Hertfordshire and North London[18] states:

"Peak discharge rates from site will not increase as a result of the proposed development, up to a 1 in 100 chance in any year including an allowance for climate change storm event. We expect all applicants to strive to achieve greenfield run-off rates to reduce the impact of the development on the surface water drainage infrastructure, unless it is demonstrated that this is not practicable."

A2.3.2 The factsheet also provides a SuDS Hierarchy which indicates that 'living roofs and walls' are the most sustainable SuDS technique, providing flood reduction, pollution reduction and landscape wildlife benefit.

A2.3.3 The EA was consulted during the preparation of the FRA this Preliminary Drainage Strategy. Correspondence is in Appendix B of the FRA (AD05.15). Their response on 21 November 2014 addressed the following specific queries:

a. the required limiting discharge rates for run-off from the site;

Response: "Discharges to Enfield Ditch, the Salmons Brook and this part of the River Lee must be limited to a maximum of three times the calculated Greenfield run-off rate. This is in accordance with the London Plan (July 2011) Policy 5.13 and the Supplementary Planning Guidance (SPG) on Sustainable Design and Construction - section 3.4.10." The response also included the fact sheet for Hertfordshire noted above.

b. the required treatment for surface run-off at waste sites;

Response: "As it is a waste site and contamination of surface water falling on the sites hard standing is likely, only clean roof water from sealed piped systems should be discharged to the watercourse."

A2.3.4 Their response on 13 July 2015 included details relating to infiltration and the protection of controlled waters:

"The site lies within Zone 1 of a groundwater source protection zone (SPZ). Groundwater protection zones protect water that is abstracted for

[18] Environment Agency (2013) Sites over 1 hectare factsheet Hertfordshire and North London Area, Environment Agency, October 2013.

public supply and so they are vulnerable to pollution with regards to site drainage entering the ground.

No infiltration based sustainable drainage systems should be constructed on land that is affected by contamination as contaminants can remobilise and cause groundwater pollution.

Any soakaway would need to be constructed in natural ground, such that it's base is at least 1m above the highest seasonal water table and in any case no deeper than 3m. No soakaways of SUDS discharge shall be constructed in contaminated ground or where there is a risk of contamination. This is to prevent the pollution of groundwater.

Surface water from hardstanding should discharge via deep seal trapped gullies incorporating a minimum water seal of 85mm or similar.

Roof water downpipes should be connected to the drainage system either directly, or by the means of back inlet gullies provided with sealing plates instead of open gratings.

Drainage from covered car parking floors should not discharge to the surface water system. Where roof car parking is proposed surface water should pass through an approved oil separator before connecting to the surface water system."

A3 Local Policy

A3.1 London Borough of Enfield

A3.1.1 LB Enfield are the Lead Local Flood Authority. The key policy document of relevance to this Preliminary Drainage Strategy is the Enfield Development Management Document[19] (DMD). LB Enfield have been consulted during the preparation of this strategy.

Enfield Development Management Document

A3.1.2 Collectively, LB Enfield's Core Strategy, DMD and Area Action Plans form Enfield's Local Plan. The DMD provides detailed land use and criteria/standard based policies by which planning applications (Town and Country Planning Applications) will be determined and will be a key vehicle in delivering the vision and objectives for Enfield as set out in the Core Strategy. Of relevance to this drainage strategy are sections on Water Efficiency and Managing Surface Water:

"Policy *DMD 61 - Managing Surface Water*

A Drainage Strategy will be required for all developments to demonstrate how proposed measures manage surface water as close to its source as possible and follow the drainage hierarchy in the London Plan. All

[19] LB Enfield, 2014 Development Management Document, London Borough of Enfield, November 2014

developments must maximise the use of and, where possible, retrofit Sustainable Drainage Systems (SuDS) which meet the following requirements:

1. *Suitability*

SuDS measure(s) should be appropriate having regard to the proposed use of site, site conditions/context (including proximity to Source Protection Zones and potential for contamination) and geology.

2. *Quantity*

All major developments must achieve greenfield run off rates (for 1 in 1 year and 1 in 100 year events).

All other development should seek to achieve greenfield run off and must maximise the use of SuDS, including at least one 'at source' SuDS measure resulting in a net improvement in water quantity or quality discharging to sewer in-line with any SuDS guidance or requirements.

3. *Quality*

Major developments must have regard to best practice and where appropriate follow the SuDS management train by providing a number of treatment phases corresponding to their pollution potential and the environmental sensitivities of the locality.

Measures should be incorporated to maximise opportunities for sustainable development, improve water quality, biodiversity, local amenity and recreation value.

4. *Functionality*

The system must be designed to allow for flows that exceed the design capacity to be stored on site or conveyed off-site with minimum impact.

Clear ownership, management and maintenance arrangements must be established.

5. *Other*

Where appropriate, developments must incorporate relevant measures identified in the Surface Water Management Plan.

The criteria above must be demonstrated through the submission of a site specific FRA, where one is required, or a Sustainable Design and Construction Statement.

Justification and guidance on implementation

Effective management of surface water will reduce the risk of flooding, pollution and other environmental damage.

Any development has the potential to increase the risk of flooding further down the catchment. Even minor developments, such as modifications to individual properties, contribute significantly to the overall run-off characteristics of a given catchment area when their cumulative effect is considered. Consequently, the Core Strategy and this policy require all developments to maximise the use of SuDS. All developments must also make every effort to retain permeable surfaces, flood storage and flow *routes to mitigate possible increases in flood risks elsewhere. SuDS should be provided on site so that they are managed as part of that development unless there are practical reasons for not doing so in accordance with the following London Plan drainage hierarchy:*

1. *store rainwater for later use.*
2. *use infiltration techniques, such as porous surfaces in non-clay areas.*
3. *attenuate rainwater in ponds or open water features for gradual release.*
4. *attenuate rainwater by storing in tanks or sealed water features for gradual release.*
5. *discharge rainwater direct to a watercourse.*
6. *discharge rainwater to a surface water sewer/drain.*
7. *discharge rainwater to the combined sewer.*

The selection of SuDS measures must be appropriate to the site and the nature of the proposed development and/or operations. Local geology, areas of sensitive groundwater supplies (such as Source Protection Zones), and the pollution potential of certain uses may constrain the types of SuDS that can be employed on particular sites. However, this does not mean that SuDS should not be implemented. Developers must use information on local conditions, including the SFRA, SWMP and the information held by other organisations, to inform/justify their selection of SuDs measures.

SuDS schemes can contribute towards meeting a number of wider sustainability policy objectives. Water quality can be improved if the SuDs include treatment phases, and in line with best practice, the number of treatment stages should correspond with the run-off pollution potential. SuDS measures can also provide opportunities to enhance local biodiversity and amenity, such as the use of green roofs, basins and ponds.

To be effective, SuDS need to be properly maintained. Maintenance issues can be simplified by keeping SuDS above ground. Examples of above ground SuDS features include basins and ponds, green roofs, permeable surfaces, water butts and swales. By keeping such features above ground, when problems do occur they are generally obvious and can be remedied simply using standard landscaping practice."

Policy DMD 58 - Water Efficiency

A3.1.3 Major non-residential development will be required, from 2019 onwards "to move towards a 65% improvement in water efficiency over a notional baseline". In addition the Council *"will seek to encourage the inclusion of rainwater collection and greywater recycling. All new major developments with a floor-space over 1,000m^2 or residential dwellings either numbering 10 or more or being developed on a site having an area of 0.5 hectares or more, should undertake a rainwater and greywater use feasibility study.*

Where collecting and reusing water is feasible, it should be included in the proposed development."

Appendix B: Environment Agency Flood Risk Fact Sheet

Sites over 1 hectare factsheet

Hertfordshire and North London area

Produced October 2013 v.2

This factsheet provides information on the requirements for Flood Risk Assessments (FRA) on sites over 1 hectare within Hertfordshire and North London area, to assist you with producing a satisfactory FRA for your development. It should be read alongside the Environment Agency's general FRA advice (FRA Guidance note 1).

It covers matters relating to flood risk assessments only, and does not outline other considerations we may take into account, (e.g. proximity to a watercourse, contaminated land, biodiversity requirements).

The Environment Agency will assess Flood Risk Assessments for all planning applications over a hectare in size. A local exception to this is when the actual development footprint is 250 square metres or less, when we will pass the assessment over to the Local Planning Authority (LPA).

A surface water strategy should be carried out to demonstrate that the proposed development will not create an increased risk of flooding from surface water. It should be carried out in accordance with the National Planning Policy Framework and the Practice Guide, giving preference to infiltration over discharge to a watercourse, which in turn is preferable to discharge to surface water sewer. Guidance on the preparation of surface water strategies can be found in the Defra/Environment Agency R&D Technical Report W5-074/A/TR/1 Revision E "Preliminary rainfall runoff management for developments".

We recommend that the FRA demonstrates the following (1-4) as a minimum:

1. Runoff rates

Peak discharge rates from site will not increase as a result of the proposed development, up to a 1 in 100 chance in any year including an allowance for climate change storm event. We expect all applicants to strive to achieve greenfield runoff rates to reduce the impact of the development on the surface water drainage infrastructure, unless it is demonstrated that this is not practicable

2. Storage volumes

Storage volumes for all events up to a 1 in 100 chance in any year including an allowance for climate change storm event can be provided on site.

The site will not flood from surface water up to a 1 in 100 year chance in any year including an allowance for climate change event, OR surface water flooding will be safely contained on site up to this event, ensuring that surface water runoff will not increase flood risk to the development or third parties.

3. Sustainable drainage techniques

Sustainable Drainage Systems (SuDS) such as green roofs, ponds, swales and permeable pavements will be used.

SuDS are an approach to managing surface water run-off which seeks to mimic natural drainage systems and retain water on or near the site as opposed to traditional drainage approaches which involve piping water off site as quickly as possible.SuDS offer significant advantages over conventional piped drainage systems in reducing flood risk by attenuating the rate and quantity of surface water run-off from a site, promoting groundwater recharge and biodiversity benefits, as well as improving water quality and amenity value.

The SuDS hierarchy should be followed as you design the site. The methods at the top of the hierarchy are preferred because they are beneficial in terms of sustainability and biodiversity. The hierarchy should be used in descending order, with any obstacles to the use of SuDS methods clearly justified.

SuDS Hierarchy

	SuDS technique	Flood reduction	Pollution reduction	Landscape and wildlife benefit
Most Sustainable	Living roofs and walls	✓	✓	✓
	Basins and ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices	✓	✓	✓
	Permeable surfaces and filter drains	✓	✓	
	Tanked and piped systems	✓		
Least sustainable				

A site's drainage design can be made up of a range of SUDS techniques. The variety of SuDS techniques available means that any development should be able to include a scheme based around these principles. These should be explored early on in the design of any development, to ensure they are an integral part of the site layout. Further information on SuDS can be found in:

- CIRIA C522 Sustainable Drainage Systems – design manual for England and Wales
- CIRIA C697 SuDS manual
- CIRIA C609 SuDS management train
- The Interim Code of Practice for Sustainable Drainage Systems.

4. Residual Risk

The residual risk of flooding can be managed and contained safely on site should any drainage features fail (e.g. pumps or hydrobrakes) OR during an extreme storm event. The location and depth and flow routes of any overground flooding should be clearly shown on a plan.

5. Climate change allowances

Guidance on climate change allowances can be found within the National Planning Policy Framework Technical Guidance.

6. Infiltration rates

Infiltration rates should be worked out in accordance with BRE 365. If it is not feasible to access the site to carry out soakage tests before planning approval is granted, a desktop study could be undertaken looking at the underlying geology of the area and assuming a worst-case infiltration rate for that site.

Local policies and recommendations

You should, as part of the surface water strategy, demonstrate to the LPA that the requirements of any local surface water drainage planning policies have been met and the recommendations of the relevant Strategic Flood Risk Assessment and Surface Water Management Plan have been considered, including an assessment of the risk of flooding from other sources (e.g. groundwater).

Further Information

We cannot prepare or provide FRAs. Our Customers and Engagement Team can provide any relevant flooding information that we have available for you to use. There may be a charge for this information. Please email: HNLenquiries@environment-agency.gov.uk, or telephone 03708 506 506 and ask for the Hertfordshire and North London Customers and Engagement team. For further information on our flood map products please visit our website at: www.environment-agency.gov.uk/research/planning/93498.aspx

Appendix C: Meeting Notes from LB Enfield

Sent: 03 June 2015 14:52

Subject: RE: Redevelopment of North London Waste Site [SEC=UNCLASSIFIED]

Thanks very much for the bullet points summarising our meeting yesterday, and the surface water map (we have addressed surface water flooding in the draft FRA).
I had forwarded the letter from the EA which set out their drainage requirement, in line with the London Plan, and I've attached that again (your sixth bullet point refers).
Please note that here will now take over finalising the FRA report, and in particular the SuDS strategy. will be in touch with you in the next few weeks on this.
Regards

From: @Enfield.gov.uk]
Sent: 03 June 2015 13:50

Subject: Redevelopment of North London Waste Site [SEC=UNCLASSIFIED]

Classification: UNCLASSIFIED

Hi

Below are our notes from yesterday's meeting, as promised.

- We agreed that infiltration not appropriate due to SPZ/waste site issues

- However, we must still aim to use above ground features (such as permeable paving, swales, rain gardens) as long as they are isolated from aquifer below

- Permeable paving can manage silt on the surface before discharge into tanks, and are favourable in terms of maintenance regimes

- The triangular area of land on the east side of the site could potentially be re-landscaped as a wetland feature or detention basin

- Green/blue roofs should also be considered as they can provide a significant amount of storage

- Controlled discharge rate should be restricted to greenfield runoff rate (for 1:1 and 1:100 year return periods) in line with Enfield's DMD policies. We did discuss that the EA recommended 3 x the greenfield runoff rate. I believe I discussed this with beforehand and suggested that they may be referring to 3 x the greenfield runoff rate for a 1:1 year event (which is roughly the 1:100 year greenfield runoff rate). Could you provide evidence that the EA have requested this and confirm whether they mean it is for the 1:1 year or 1:100 year event?

- London Plan also requires developments to "aim to achieve" greenfield rate

- In accordance with London Plan, above ground SuDS measures should be considered first before utilising below ground tanks, etc.

- If using below ground features and/or increasing discharge rate it is essential to justify why this is considered necessary and demonstrate that preferred options have been explored

- Temporary (~5 year car park) on east side of Lee Navigation should be constructed using permeable materials – this would remove the need to provide additional attenuation measures

Attached is our map of Surface Water Flooding (1 in 100 year) for the site, which may be useful.

As mentioned, the information we request for Sustainable Drainage Strategies can be found following this link and is set out in bullet points:
http://www.enfield.gov.uk/info/1000000622/waterways_and_drainage/3792/sustainable_drainage_systems

The proforma is not yet available, but we are more than happy to discuss any of these points further.

Best

SuDS Officer
Enfield Council

Classification: UNCLASSIFIED

Appendix D: Calculations

D1 Existing Peak Runoff Rate

Technical note:
Peak runoff calculations

Peak flow rates

The modified rational method was used to determine the existing peak runoff rates. The modified rational method as set out in the Wallingford Procedures Volume 4[20], is of the form

Q = 3.61 x Cv x i x A Equation 1

where

Q = peak run-off (l/s)

Cv = volumetric run-off coefficient

i = rainfall intensity for the design storm (mm/hr)

A = the impermeable area being drained (ha)

The parameter values used are shown in Table 1. The time to concentration of the storm (TOC), i.e. the time from the start of rainfall for all of the area to be contributing to runoff at the outlet point, is estimated based on

	Total Site	**Draining to Enfield Ditch**
Area	11.5Ha	4.5Ha
Drainage path length (√area)	342m	212m
Flow Velocity across the area	0.5m/s	0.5m/s
ToC (path length/velocity)	11min	7min

This confirms that all of the drained area does contribute to runoff within the storm duration i.e. the peak rate is reached within 15 minutes. Shorter storm durations give greater rainfall intensities and hence runoff, so a 15 minute rainstorm has been assumed for this calculation.

[20] *Design and analysis of urban storm drainage* - WALLINGFORD PROCEDURE Volume 4, *The Modified Rational Method, HR Wallingord, .*

Table 5.2 Parameter values used for estimating peak flow

	Value	Comment
i	96 mm/hr assumed for the 15 minute 100 year storm 62 mm/hr assumed for the 15 minute 30 year storm	From the Flood Estimation Handbook (FEH) CD Rom. Peak flow is given by the most intense storm; rainfall estimates from the FEH ddf model are not reliable for storm durations less than 30 minutes however. For a conservative estimate the 30 minute rainfall intensity was assumed for the 15 minute storm. Rainfall depth for 15 minute 100 year storm from FEH CD Rom = 41 mm Rainfall depth for 30 minute 100 year storm from FEH CD Rom = 48 mm Rainfall depth for 60 minute 100 year storm from FEH CD Rom = 55 mm Point rainfall data taken from CD Rom for 1 km grid square TQ 3693. Rainfall depth for 15 minute 30 year storm from FEH CD Rom = 27 mm Rainfall depth for 30 minute 30 year storm from FEH CD Rom = 31 mm
A_{total}	11.7	Existing impermeable area of the total site
$A_{Enfield\ Ditch}$	2.25 ha	Assumed that less than half of the 4.5 ha area identified drains to the Chingford and/or Angel Sewer, and a 2.25 ha area has been assumed for a conservative estimate of flows to Enfield Ditch
Cv	0.60	A runoff coefficient which is dependent on the nature of the underlying soil type (since it is assumed that some runoff will permeate through cracks in the impermeable surface) and is found to vary from 0.6 on rapidly draining soils to 0.9 on impervious ones, with an average value of 0.75. For a conservative assessment a value of 0.60 has been assumed in this case.

Table 5.3 Peak flow runoff

	Total Site	Draining to Enfield Ditch
Q30 (l/s)	1,571	302
Q100 (l/s)	2,433	936

- Peak flow into Enfield Ditch = 100 year 15 minute rate across 4.5 ha less 30 year 15 minute rate from 2.25 ha
- = 3.61 x 0.6 x (96 x 4.5 – 62 x 2.25) = 936 – 302 = **634 l/s.**

D2 Greenfield Peak Runoff Rate

Technical note:
Greenfield run-off calculation rates

5.3.7 Greenfield run-off rates at the site were calculated using the Institute of Hydrology 124 method (IH, 1994). The method determines the mean annual peak flow using equation 1 below.

$Q_{BAR\ rural} = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$ (m^3/s) Eq 1

Where

Area = the permeable catchment area (km^2)

SAAR = standard average annual rainfall (mm/yr)

SOIL = Soil index (from the Flood Studies report (FSR, 1975)

5.3.8 For areas smaller than 50ha, the flow rates are pro-rated from the result for 50 ha result based on area. The Flood Studies Report regional growth curve for the southeast is then applied to the mean flow to determine a flood frequency curve. The input parameters and results are provided in Table 7.1. The greenfield rate for the mean annual flood is 4.0 l/s/ha and for the 1% AEP (100 year) event is 12.8 l/s/ha.

Table 1-4 Greenfield rates - input parameters and results

Parameter	
Long term average rainfall SAAR (mm/yr)1	648
Soil type (from Wallingford Winter Rainfall Acceptance Potential (WRAP) map3	4
SOIL index (from soil type)2	0.45
Hydrological Region3	6
QBARrural (l/s/ha)	4.0
Q100 rural (l/s/ha)	12.8
Q30 rural (l/s/ha)	9.0
Q10 rural (l/s/ha)	6.5
Q2.33 rural (l/s/ha)	4.0

[1] See Section 2.3 of the FRA

[2] See Section 2.5 of the FRA.

[3] Flood Studies Supplementary Report hydrological growth region.

Appendix E: WinDes Results

E1 3 x Greenfield Rates

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.734	0.734	53.6	0.0	53.6	565.3	Flood Risk
30 min Summer	0.813	0.813	56.2	0.0	56.2	625.7	Flood Risk
60 min Summer	0.865	0.865	57.7	0.0	57.7	666.4	Flood Risk
120 min Summer	0.872	0.872	57.9	0.0	57.9	671.1	Flood Risk
180 min Summer	0.862	0.862	57.7	0.0	57.7	664.0	Flood Risk
240 min Summer	0.846	0.846	57.2	0.0	57.2	651.4	Flood Risk
360 min Summer	0.803	0.803	55.9	0.0	55.9	618.4	Flood Risk
480 min Summer	0.756	0.756	54.4	0.0	54.4	582.4	Flood Risk
600 min Summer	0.711	0.711	52.9	0.0	52.9	547.5	Flood Risk
720 min Summer	0.669	0.669	51.4	0.0	51.4	514.9	O K
960 min Summer	0.581	0.581	48.0	0.0	48.0	447.4	O K
1440 min Summer	0.462	0.462	42.0	0.0	42.0	355.9	O K
2160 min Summer	0.360	0.360	34.4	0.0	34.4	277.3	O K
2880 min Summer	0.299	0.299	29.0	0.0	29.0	230.4	O K
4320 min Summer	0.230	0.230	22.2	0.0	22.2	176.9	O K
5760 min Summer	0.189	0.189	18.0	0.0	18.0	145.5	O K
7200 min Summer	0.163	0.163	15.3	0.0	15.3	125.5	O K
8640 min Summer	0.144	0.144	13.3	0.0	13.3	110.9	O K
10080 min Summer	0.129	0.129	11.8	0.0	11.8	99.7	O K
15 min Winter	0.825	0.825	56.5	0.0	56.5	635.0	Flood Risk
30 min Winter	0.916	0.916	59.2	0.0	59.2	705.2	Flood Risk
60 min Winter	0.981	0.981	61.0	0.0	61.0	755.5	Flood Risk
120 min Winter	0.986	0.986	61.1	0.0	61.1	759.2	Flood Risk
180 min Winter	0.968	0.968	60.6	0.0	60.6	745.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	598.7	0.0	18
30 min Summer	114.035	0.0	687.5	0.0	32
60 min Summer	65.469	0.0	790.2	0.0	60
120 min Summer	37.586	0.0	907.3	0.0	98
180 min Summer	27.167	0.0	983.8	0.0	130
240 min Summer	21.579	0.0	1041.9	0.0	164
360 min Summer	15.597	0.0	1129.6	0.0	232
480 min Summer	12.388	0.0	1196.3	0.0	300
600 min Summer	10.362	0.0	1250.8	0.0	366
720 min Summer	8.954	0.0	1297.1	0.0	430
960 min Summer	6.975	0.0	1347.1	0.0	556
1440 min Summer	4.904	0.0	1420.8	0.0	796
2160 min Summer	3.448	0.0	1498.6	0.0	1164
2880 min Summer	2.686	0.0	1556.3	0.0	1528
4320 min Summer	1.901	0.0	1652.2	0.0	2248
5760 min Summer	1.487	0.0	1723.8	0.0	2944
7200 min Summer	1.230	0.0	1781.5	0.0	3680
8640 min Summer	1.053	0.0	1830.0	0.0	4408
10080 min Summer	0.923	0.0	1872.0	0.0	5144
15 min Winter	198.630	0.0	670.6	0.0	18
30 min Winter	114.035	0.0	770.1	0.0	32
60 min Winter	65.469	0.0	885.0	0.0	60
120 min Winter	37.586	0.0	1016.2	0.0	110
180 min Winter	27.167	0.0	1101.9	0.0	138

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.939	0.939	59.9	0.0	59.9	723.1	Flood Risk
360 min Winter	0.869	0.869	57.9	0.0	57.9	669.4	Flood Risk
480 min Winter	0.798	0.798	55.7	0.0	55.7	614.3	Flood Risk
600 min Winter	0.731	0.731	53.5	0.0	53.5	562.9	Flood Risk
720 min Winter	0.671	0.671	51.4	0.0	51.4	516.4	O K
960 min Winter	0.556	0.556	47.0	0.0	47.0	428.2	O K
1440 min Winter	0.416	0.416	38.8	0.0	38.8	320.0	O K
2160 min Winter	0.308	0.308	29.8	0.0	29.8	236.9	O K
2880 min Winter	0.248	0.248	24.0	0.0	24.0	191.0	O K
4320 min Winter	0.184	0.184	17.5	0.0	17.5	141.8	O K
5760 min Winter	0.149	0.149	13.8	0.0	13.8	115.1	O K
7200 min Winter	0.127	0.127	11.5	0.0	11.5	97.8	O K
8640 min Winter	0.112	0.112	9.9	0.0	9.9	85.9	O K
10080 min Winter	0.100	0.100	8.7	0.0	8.7	76.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	1166.9	0.0	176
360 min Winter	15.597	0.0	1265.2	0.0	250
480 min Winter	12.388	0.0	1339.9	0.0	322
600 min Winter	10.362	0.0	1400.9	0.0	390
720 min Winter	8.954	0.0	1452.8	0.0	456
960 min Winter	6.975	0.0	1508.8	0.0	580
1440 min Winter	4.904	0.0	1591.3	0.0	824
2160 min Winter	3.448	0.0	1678.5	0.0	1188
2880 min Winter	2.686	0.0	1743.2	0.0	1556
4320 min Winter	1.901	0.0	1850.5	0.0	2252
5760 min Winter	1.487	0.0	1930.7	0.0	3000
7200 min Winter	1.230	0.0	1995.3	0.0	3680
8640 min Winter	1.053	0.0	2049.6	0.0	4416
10080 min Winter	0.923	0.0	2096.7	0.0	5144

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.612	0.612	7.9	0.0	7.9	91.8	O K
30 min Summer	0.676	0.676	8.3	0.0	8.3	101.5	O K
60 min Summer	0.721	0.721	8.5	0.0	8.5	108.1	Flood Risk
120 min Summer	0.723	0.723	8.5	0.0	8.5	108.5	Flood Risk
180 min Summer	0.711	0.711	8.5	0.0	8.5	106.7	Flood Risk
240 min Summer	0.695	0.695	8.4	0.0	8.4	104.3	O K
360 min Summer	0.656	0.656	8.1	0.0	8.1	98.4	O K
480 min Summer	0.616	0.616	7.9	0.0	7.9	92.4	O K
600 min Summer	0.578	0.578	7.6	0.0	7.6	86.6	O K
720 min Summer	0.542	0.542	7.4	0.0	7.4	81.3	O K
960 min Summer	0.467	0.467	6.9	0.0	6.9	70.1	O K
1440 min Summer	0.357	0.357	6.0	0.0	6.0	53.5	O K
2160 min Summer	0.248	0.248	5.0	0.0	5.0	37.3	O K
2880 min Summer	0.167	0.167	4.9	0.0	4.9	25.1	O K
4320 min Summer	0.121	0.121	3.8	0.0	3.8	18.2	O K
5760 min Summer	0.101	0.101	3.1	0.0	3.1	15.2	O K
7200 min Summer	0.089	0.089	2.6	0.0	2.6	13.3	O K
8640 min Summer	0.080	0.080	2.2	0.0	2.2	12.0	O K
10080 min Summer	0.074	0.074	1.9	0.0	1.9	11.1	O K
15 min Winter	0.687	0.687	8.3	0.0	8.3	103.1	O K
30 min Winter	0.762	0.762	8.8	0.0	8.8	114.4	Flood Risk
60 min Winter	0.818	0.818	9.1	0.0	9.1	122.6	Flood Risk
120 min Winter	0.824	0.824	9.1	0.0	9.1	123.6	Flood Risk
180 min Winter	0.805	0.805	9.0	0.0	9.0	120.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	96.2	0.0	18
30 min Summer	114.035	0.0	110.5	0.0	32
60 min Summer	65.469	0.0	127.3	0.0	62
120 min Summer	37.586	0.0	146.3	0.0	102
180 min Summer	27.167	0.0	158.6	0.0	134
240 min Summer	21.579	0.0	168.0	0.0	166
360 min Summer	15.597	0.0	182.1	0.0	236
480 min Summer	12.388	0.0	192.9	0.0	304
600 min Summer	10.362	0.0	201.7	0.0	370
720 min Summer	8.954	0.0	209.2	0.0	436
960 min Summer	6.975	0.0	217.2	0.0	568
1440 min Summer	4.904	0.0	229.0	0.0	820
2160 min Summer	3.448	0.0	241.9	0.0	1188
2880 min Summer	2.686	0.0	251.1	0.0	1500
4320 min Summer	1.901	0.0	266.4	0.0	2204
5760 min Summer	1.487	0.0	278.3	0.0	2936
7200 min Summer	1.230	0.0	287.6	0.0	3672
8640 min Summer	1.053	0.0	295.3	0.0	4400
10080 min Summer	0.923	0.0	301.9	0.0	5136
15 min Winter	198.630	0.0	107.8	0.0	18
30 min Winter	114.035	0.0	123.8	0.0	32
60 min Winter	65.469	0.0	142.7	0.0	60
120 min Winter	37.586	0.0	163.8	0.0	114
180 min Winter	27.167	0.0	177.7	0.0	140

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.781	0.781	8.9	0.0	8.9	117.2	Flood Risk
360 min Winter	0.724	0.724	8.5	0.0	8.5	108.5	Flood Risk
480 min Winter	0.664	0.664	8.2	0.0	8.2	99.7	O K
600 min Winter	0.609	0.609	7.8	0.0	7.8	91.4	O K
720 min Winter	0.558	0.558	7.5	0.0	7.5	83.8	O K
960 min Winter	0.459	0.459	6.8	0.0	6.8	68.8	O K
1440 min Winter	0.318	0.318	5.7	0.0	5.7	47.7	O K
2160 min Winter	0.168	0.168	4.9	0.0	4.9	25.2	O K
2880 min Winter	0.127	0.127	4.0	0.0	4.0	19.0	O K
4320 min Winter	0.096	0.096	2.9	0.0	2.9	14.5	O K
5760 min Winter	0.082	0.082	2.3	0.0	2.3	12.2	O K
7200 min Winter	0.072	0.072	1.9	0.0	1.9	10.8	O K
8640 min Winter	0.066	0.066	1.6	0.0	1.6	9.8	O K
10080 min Winter	0.061	0.061	1.4	0.0	1.4	9.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	188.2	0.0	180
360 min Winter	15.597	0.0	204.0	0.0	254
480 min Winter	12.388	0.0	216.1	0.0	328
600 min Winter	10.362	0.0	225.9	0.0	398
720 min Winter	8.954	0.0	234.3	0.0	468
960 min Winter	6.975	0.0	243.3	0.0	598
1440 min Winter	4.904	0.0	256.5	0.0	852
2160 min Winter	3.448	0.0	270.9	0.0	1172
2880 min Winter	2.686	0.0	281.3	0.0	1500
4320 min Winter	1.901	0.0	298.4	0.0	2208
5760 min Winter	1.487	0.0	311.7	0.0	2936
7200 min Winter	1.230	0.0	322.1	0.0	3672
8640 min Winter	1.053	0.0	330.8	0.0	4328
10080 min Winter	0.923	0.0	338.2	0.0	5016

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.733	0.733	107.1	0.0	107.1	1136.6	Flood Risk
30 min Summer	0.814	0.814	113.0	0.0	113.0	1262.4	Flood Risk
60 min Summer	0.873	0.873	116.9	0.0	116.9	1352.4	Flood Risk
120 min Summer	0.884	0.884	117.6	0.0	117.6	1369.9	Flood Risk
180 min Summer	0.879	0.879	117.3	0.0	117.3	1362.1	Flood Risk
240 min Summer	0.866	0.866	116.5	0.0	116.5	1342.4	Flood Risk
360 min Summer	0.829	0.829	114.0	0.0	114.0	1285.4	Flood Risk
480 min Summer	0.788	0.788	111.2	0.0	111.2	1220.7	Flood Risk
600 min Summer	0.746	0.746	108.1	0.0	108.1	1156.9	Flood Risk
720 min Summer	0.708	0.708	104.8	0.0	104.8	1097.1	Flood Risk
960 min Summer	0.628	0.628	96.6	0.0	96.6	972.8	O K
1440 min Summer	0.516	0.516	82.4	0.0	82.4	799.2	O K
2160 min Summer	0.413	0.413	67.1	0.0	67.1	640.5	O K
2880 min Summer	0.349	0.349	56.6	0.0	56.6	540.7	O K
4320 min Summer	0.273	0.273	43.6	0.0	43.6	422.4	O K
5760 min Summer	0.227	0.227	35.6	0.0	35.6	351.6	O K
7200 min Summer	0.196	0.196	30.2	0.0	30.2	304.0	O K
8640 min Summer	0.174	0.174	26.4	0.0	26.4	270.0	O K
10080 min Summer	0.157	0.157	23.4	0.0	23.4	244.0	O K
15 min Winter	0.823	0.823	113.6	0.0	113.6	1276.1	Flood Risk
30 min Winter	0.917	0.917	119.7	0.0	119.7	1421.0	Flood Risk
60 min Winter	0.987	0.987	123.9	0.0	123.9	1529.8	Flood Risk
120 min Winter	0.998	0.998	124.6	0.0	124.6	1547.3	Flood Risk
180 min Winter	0.984	0.984	123.8	0.0	123.8	1525.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	1206.5	0.0	20
30 min Summer	114.035	0.0	1385.5	0.0	34
60 min Summer	65.469	0.0	1595.0	0.0	62
120 min Summer	37.586	0.0	1831.5	0.0	100
180 min Summer	27.167	0.0	1985.8	0.0	130
240 min Summer	21.579	0.0	2103.1	0.0	164
360 min Summer	15.597	0.0	2280.3	0.0	232
480 min Summer	12.388	0.0	2415.0	0.0	300
600 min Summer	10.362	0.0	2524.9	0.0	366
720 min Summer	8.954	0.0	2618.4	0.0	430
960 min Summer	6.975	0.0	2719.0	0.0	558
1440 min Summer	4.904	0.0	2866.9	0.0	806
2160 min Summer	3.448	0.0	3025.1	0.0	1168
2880 min Summer	2.686	0.0	3141.7	0.0	1532
4320 min Summer	1.901	0.0	3334.6	0.0	2252
5760 min Summer	1.487	0.0	3479.7	0.0	2992
7200 min Summer	1.230	0.0	3596.1	0.0	3680
8640 min Summer	1.053	0.0	3694.1	0.0	4416
10080 min Summer	0.923	0.0	3778.7	0.0	5144
15 min Winter	198.630	0.0	1351.5	0.0	20
30 min Winter	114.035	0.0	1552.1	0.0	33
60 min Winter	65.469	0.0	1786.5	0.0	60
120 min Winter	37.586	0.0	2051.4	0.0	110
180 min Winter	27.167	0.0	2224.2	0.0	140

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.959	0.959	122.3	0.0	122.3	1487.1	Flood Risk
360 min Winter	0.896	0.896	118.4	0.0	118.4	1389.0	Flood Risk
480 min Winter	0.830	0.830	114.1	0.0	114.1	1286.6	Flood Risk
600 min Winter	0.768	0.768	109.8	0.0	109.8	1190.7	Flood Risk
720 min Winter	0.713	0.713	105.3	0.0	105.3	1105.2	Flood Risk
960 min Winter	0.609	0.609	94.5	0.0	94.5	944.7	O K
1440 min Winter	0.475	0.475	76.6	0.0	76.6	736.5	O K
2160 min Winter	0.362	0.362	58.8	0.0	58.8	561.6	O K
2880 min Winter	0.297	0.297	47.8	0.0	47.8	459.6	O K
4320 min Winter	0.223	0.223	34.9	0.0	34.9	346.4	O K
5760 min Winter	0.182	0.182	27.8	0.0	27.8	282.8	O K
7200 min Winter	0.156	0.156	23.1	0.0	23.1	241.5	O K
8640 min Winter	0.137	0.137	20.0	0.0	20.0	212.3	O K
10080 min Winter	0.123	0.123	17.5	0.0	17.5	190.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	2355.6	0.0	178
360 min Winter	15.597	0.0	2554.0	0.0	252
480 min Winter	12.388	0.0	2704.9	0.0	322
600 min Winter	10.362	0.0	2828.0	0.0	390
720 min Winter	8.954	0.0	2932.7	0.0	456
960 min Winter	6.975	0.0	3045.4	0.0	584
1440 min Winter	4.904	0.0	3211.2	0.0	836
2160 min Winter	3.448	0.0	3388.2	0.0	1196
2880 min Winter	2.686	0.0	3518.8	0.0	1560
4320 min Winter	1.901	0.0	3735.0	0.0	2292
5760 min Winter	1.487	0.0	3897.4	0.0	3000
7200 min Winter	1.230	0.0	4027.7	0.0	3744
8640 min Winter	1.053	0.0	4137.5	0.0	4472
10080 min Winter	0.923	0.0	4232.5	0.0	5152

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.746	0.746	53.0	0.0	53.0	555.6	Flood Risk
30 min Summer	0.824	0.824	55.4	0.0	55.4	614.1	Flood Risk
60 min Summer	0.877	0.877	56.9	0.0	56.9	653.3	Flood Risk
120 min Summer	0.882	0.882	57.1	0.0	57.1	657.3	Flood Risk
180 min Summer	0.872	0.872	56.8	0.0	56.8	650.0	Flood Risk
240 min Summer	0.855	0.855	56.3	0.0	56.3	637.3	Flood Risk
360 min Summer	0.811	0.811	55.0	0.0	55.0	604.4	Flood Risk
480 min Summer	0.763	0.763	53.5	0.0	53.5	568.7	Flood Risk
600 min Summer	0.717	0.717	52.0	0.0	52.0	534.2	Flood Risk
720 min Summer	0.674	0.674	50.5	0.0	50.5	502.0	O K
960 min Summer	0.585	0.585	47.2	0.0	47.2	435.6	O K
1440 min Summer	0.464	0.464	41.4	0.0	41.4	345.5	O K
2160 min Summer	0.360	0.360	33.9	0.0	33.9	268.4	O K
2880 min Summer	0.299	0.299	28.5	0.0	28.5	222.7	O K
4320 min Summer	0.229	0.229	21.8	0.0	21.8	170.7	O K
5760 min Summer	0.189	0.189	17.7	0.0	17.7	140.4	O K
7200 min Summer	0.162	0.162	15.0	0.0	15.0	121.0	O K
8640 min Summer	0.143	0.143	13.0	0.0	13.0	106.8	O K
10080 min Summer	0.129	0.129	11.6	0.0	11.6	96.1	O K
15 min Winter	0.838	0.838	55.8	0.0	55.8	624.2	Flood Risk
30 min Winter	0.929	0.929	58.4	0.0	58.4	692.2	Flood Risk
60 min Winter	0.994	0.994	60.1	0.0	60.1	740.8	Flood Risk
120 min Winter	0.998	0.998	60.3	0.0	60.3	743.6	Flood Risk
180 min Winter	0.979	0.979	59.7	0.0	59.7	729.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	587.7	0.0	18
30 min Summer	114.035	0.0	674.8	0.0	32
60 min Summer	65.469	0.0	775.4	0.0	60
120 min Summer	37.586	0.0	890.4	0.0	98
180 min Summer	27.167	0.0	965.4	0.0	130
240 min Summer	21.579	0.0	1022.5	0.0	164
360 min Summer	15.597	0.0	1108.6	0.0	232
480 min Summer	12.388	0.0	1174.1	0.0	300
600 min Summer	10.362	0.0	1227.5	0.0	364
720 min Summer	8.954	0.0	1272.9	0.0	430
960 min Summer	6.975	0.0	1322.0	0.0	556
1440 min Summer	4.904	0.0	1394.4	0.0	794
2160 min Summer	3.448	0.0	1470.7	0.0	1164
2880 min Summer	2.686	0.0	1527.4	0.0	1524
4320 min Summer	1.901	0.0	1621.4	0.0	2248
5760 min Summer	1.487	0.0	1691.7	0.0	2944
7200 min Summer	1.230	0.0	1748.3	0.0	3680
8640 min Summer	1.053	0.0	1795.9	0.0	4408
10080 min Summer	0.923	0.0	1837.2	0.0	5144
15 min Winter	198.630	0.0	658.2	0.0	18
30 min Winter	114.035	0.0	755.8	0.0	32
60 min Winter	65.469	0.0	868.5	0.0	60
120 min Winter	37.586	0.0	997.3	0.0	110
180 min Winter	27.167	0.0	1081.3	0.0	138

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.950	0.950	59.0	0.0	59.0	707.4	Flood Risk
360 min Winter	0.878	0.878	57.0	0.0	57.0	654.2	Flood Risk
480 min Winter	0.805	0.805	54.8	0.0	54.8	599.6	Flood Risk
600 min Winter	0.737	0.737	52.7	0.0	52.7	548.8	Flood Risk
720 min Winter	0.675	0.675	50.6	0.0	50.6	503.0	O K
960 min Winter	0.559	0.559	46.2	0.0	46.2	416.1	O K
1440 min Winter	0.416	0.416	38.2	0.0	38.2	309.7	O K
2160 min Winter	0.307	0.307	29.3	0.0	29.3	228.7	O K
2880 min Winter	0.247	0.247	23.6	0.0	23.6	184.2	O K
4320 min Winter	0.183	0.183	17.2	0.0	17.2	136.7	O K
5760 min Winter	0.149	0.149	13.6	0.0	13.6	110.8	O K
7200 min Winter	0.127	0.127	11.3	0.0	11.3	94.2	O K
8640 min Winter	0.111	0.111	9.8	0.0	9.8	82.7	O K
10080 min Winter	0.099	0.099	8.5	0.0	8.5	74.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	1145.2	0.0	176
360 min Winter	15.597	0.0	1241.7	0.0	250
480 min Winter	12.388	0.0	1315.0	0.0	322
600 min Winter	10.362	0.0	1374.8	0.0	390
720 min Winter	8.954	0.0	1425.7	0.0	456
960 min Winter	6.975	0.0	1480.7	0.0	580
1440 min Winter	4.904	0.0	1561.7	0.0	822
2160 min Winter	3.448	0.0	1647.2	0.0	1188
2880 min Winter	2.686	0.0	1710.7	0.0	1552
4320 min Winter	1.901	0.0	1816.1	0.0	2252
5760 min Winter	1.487	0.0	1894.7	0.0	2992
7200 min Winter	1.230	0.0	1958.1	0.0	3736
8640 min Winter	1.053	0.0	2011.4	0.0	4416
10080 min Winter	0.923	0.0	2057.7	0.0	5144

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.701	0.701	2.9	0.0	2.9	31.5	Flood Risk
30 min Summer	0.771	0.771	3.1	0.0	3.1	34.7	Flood Risk
60 min Summer	0.814	0.814	3.1	0.0	3.1	36.6	Flood Risk
120 min Summer	0.806	0.806	3.1	0.0	3.1	36.3	Flood Risk
180 min Summer	0.786	0.786	3.1	0.0	3.1	35.4	Flood Risk
240 min Summer	0.761	0.761	3.0	0.0	3.0	34.3	Flood Risk
360 min Summer	0.708	0.708	2.9	0.0	2.9	31.9	Flood Risk
480 min Summer	0.659	0.659	2.8	0.0	2.8	29.6	O K
600 min Summer	0.614	0.614	2.7	0.0	2.7	27.6	O K
720 min Summer	0.573	0.573	2.6	0.0	2.6	25.8	O K
960 min Summer	0.489	0.489	2.4	0.0	2.4	22.0	O K
1440 min Summer	0.366	0.366	2.1	0.0	2.1	16.5	O K
2160 min Summer	0.248	0.248	1.7	0.0	1.7	11.2	O K
2880 min Summer	0.166	0.166	1.5	0.0	1.5	7.5	O K
4320 min Summer	0.080	0.080	1.4	0.0	1.4	3.6	O K
5760 min Summer	0.063	0.063	1.1	0.0	1.1	2.8	O K
7200 min Summer	0.054	0.054	0.9	0.0	0.9	2.4	O K
8640 min Summer	0.049	0.049	0.8	0.0	0.8	2.2	O K
10080 min Summer	0.045	0.045	0.7	0.0	0.7	2.0	O K
15 min Winter	0.788	0.788	3.1	0.0	3.1	35.5	Flood Risk
30 min Winter	0.871	0.871	3.3	0.0	3.3	39.2	Flood Risk
60 min Winter	0.926	0.926	3.4	0.0	3.4	41.7	Flood Risk
120 min Winter	0.921	0.921	3.3	0.0	3.3	41.4	Flood Risk
180 min Winter	0.894	0.894	3.3	0.0	3.3	40.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	33.4	0.0	18
30 min Summer	114.035	0.0	38.4	0.0	32
60 min Summer	65.469	0.0	44.2	0.0	60
120 min Summer	37.586	0.0	50.7	0.0	100
180 min Summer	27.167	0.0	55.0	0.0	130
240 min Summer	21.579	0.0	58.2	0.0	166
360 min Summer	15.597	0.0	63.1	0.0	234
480 min Summer	12.388	0.0	66.9	0.0	302
600 min Summer	10.362	0.0	69.9	0.0	368
720 min Summer	8.954	0.0	72.5	0.0	434
960 min Summer	6.975	0.0	75.3	0.0	566
1440 min Summer	4.904	0.0	79.4	0.0	810
2160 min Summer	3.448	0.0	83.8	0.0	1188
2880 min Summer	2.686	0.0	87.0	0.0	1556
4320 min Summer	1.901	0.0	92.3	0.0	2204
5760 min Summer	1.487	0.0	96.4	0.0	2936
7200 min Summer	1.230	0.0	99.6	0.0	3640
8640 min Summer	1.053	0.0	102.3	0.0	4352
10080 min Summer	0.923	0.0	104.6	0.0	5104
15 min Winter	198.630	0.0	37.5	0.0	18
30 min Winter	114.035	0.0	43.0	0.0	32
60 min Winter	65.469	0.0	49.5	0.0	60
120 min Winter	37.586	0.0	56.8	0.0	112
180 min Winter	27.167	0.0	61.6	0.0	140

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.860	0.860	3.2	0.0	3.2	38.7	Flood Risk
360 min Winter	0.785	0.785	3.1	0.0	3.1	35.3	Flood Risk
480 min Winter	0.712	0.712	2.9	0.0	2.9	32.1	Flood Risk
600 min Winter	0.647	0.647	2.8	0.0	2.8	29.1	O K
720 min Winter	0.590	0.590	2.7	0.0	2.7	26.5	O K
960 min Winter	0.478	0.478	2.4	0.0	2.4	21.5	O K
1440 min Winter	0.325	0.325	2.0	0.0	2.0	14.6	O K
2160 min Winter	0.184	0.184	1.5	0.0	1.5	8.3	O K
2880 min Winter	0.084	0.084	1.4	0.0	1.4	3.8	O K
4320 min Winter	0.059	0.059	1.0	0.0	1.0	2.6	O K
5760 min Winter	0.049	0.049	0.8	0.0	0.8	2.2	O K
7200 min Winter	0.043	0.043	0.7	0.0	0.7	2.0	O K
8640 min Winter	0.040	0.040	0.6	0.0	0.6	1.8	O K
10080 min Winter	0.037	0.037	0.5	0.0	0.5	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	65.2	0.0	178
360 min Winter	15.597	0.0	70.7	0.0	252
480 min Winter	12.388	0.0	74.9	0.0	324
600 min Winter	10.362	0.0	78.3	0.0	396
720 min Winter	8.954	0.0	81.2	0.0	464
960 min Winter	6.975	0.0	84.3	0.0	596
1440 min Winter	4.904	0.0	88.9	0.0	852
2160 min Winter	3.448	0.0	93.8	0.0	1236
2880 min Winter	2.686	0.0	97.4	0.0	1500
4320 min Winter	1.901	0.0	103.4	0.0	2204
5760 min Winter	1.487	0.0	107.9	0.0	2880
7200 min Winter	1.230	0.0	111.5	0.0	3672
8640 min Winter	1.053	0.0	114.6	0.0	4384
10080 min Winter	0.923	0.0	117.2	0.0	5080

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.737	0.737	61.0	0.0	61.0	640.8	Flood Risk
30 min Summer	0.817	0.817	63.9	0.0	63.9	710.6	Flood Risk
60 min Summer	0.871	0.871	65.8	0.0	65.8	757.6	Flood Risk
120 min Summer	0.878	0.878	66.0	0.0	66.0	763.7	Flood Risk
180 min Summer	0.869	0.869	65.7	0.0	65.7	756.1	Flood Risk
240 min Summer	0.853	0.853	65.2	0.0	65.2	742.3	Flood Risk
360 min Summer	0.811	0.811	63.7	0.0	63.7	705.4	Flood Risk
480 min Summer	0.765	0.765	62.1	0.0	62.1	665.1	Flood Risk
600 min Summer	0.719	0.719	60.3	0.0	60.3	625.9	Flood Risk
720 min Summer	0.677	0.677	58.6	0.0	58.6	589.2	O K
960 min Summer	0.590	0.590	54.8	0.0	54.8	513.3	O K
1440 min Summer	0.472	0.472	47.7	0.0	47.7	410.8	O K
2160 min Summer	0.370	0.370	39.0	0.0	39.0	321.8	O K
2880 min Summer	0.308	0.308	32.8	0.0	32.8	268.1	O K
4320 min Summer	0.237	0.237	25.1	0.0	25.1	206.5	O K
5760 min Summer	0.195	0.195	20.4	0.0	20.4	170.1	O K
7200 min Summer	0.169	0.169	17.3	0.0	17.3	146.8	O K
8640 min Summer	0.149	0.149	15.1	0.0	15.1	129.8	O K
10080 min Summer	0.134	0.134	13.4	0.0	13.4	116.9	O K
15 min Winter	0.827	0.827	64.3	0.0	64.3	719.5	Flood Risk
30 min Winter	0.920	0.920	67.4	0.0	67.4	800.5	Flood Risk
60 min Winter	0.987	0.987	69.5	0.0	69.5	858.7	Flood Risk
120 min Winter	0.993	0.993	69.7	0.0	69.7	863.7	Flood Risk
180 min Winter	0.975	0.975	69.2	0.0	69.2	848.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	680.4	0.0	19
30 min Summer	114.035	0.0	781.3	0.0	33
60 min Summer	65.469	0.0	898.1	0.0	60
120 min Summer	37.586	0.0	1031.3	0.0	98
180 min Summer	27.167	0.0	1118.2	0.0	130
240 min Summer	21.579	0.0	1184.2	0.0	164
360 min Summer	15.597	0.0	1284.0	0.0	232
480 min Summer	12.388	0.0	1359.8	0.0	300
600 min Summer	10.362	0.0	1421.7	0.0	366
720 min Summer	8.954	0.0	1474.4	0.0	430
960 min Summer	6.975	0.0	1531.2	0.0	556
1440 min Summer	4.904	0.0	1614.9	0.0	796
2160 min Summer	3.448	0.0	1703.4	0.0	1164
2880 min Summer	2.686	0.0	1769.0	0.0	1528
4320 min Summer	1.901	0.0	1878.0	0.0	2248
5760 min Summer	1.487	0.0	1959.4	0.0	2952
7200 min Summer	1.230	0.0	2024.9	0.0	3680
8640 min Summer	1.053	0.0	2080.1	0.0	4408
10080 min Summer	0.923	0.0	2127.9	0.0	5144
15 min Winter	198.630	0.0	762.1	0.0	19
30 min Winter	114.035	0.0	875.2	0.0	32
60 min Winter	65.469	0.0	1005.9	0.0	60
120 min Winter	37.586	0.0	1155.1	0.0	110
180 min Winter	27.167	0.0	1252.4	0.0	138

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.947	0.947	68.3	0.0	68.3	823.5	Flood Risk
360 min Winter	0.877	0.877	66.0	0.0	66.0	763.2	Flood Risk
480 min Winter	0.806	0.806	63.6	0.0	63.6	701.2	Flood Risk
600 min Winter	0.739	0.739	61.1	0.0	61.1	643.3	Flood Risk
720 min Winter	0.679	0.679	58.7	0.0	58.7	591.0	O K
960 min Winter	0.566	0.566	53.6	0.0	53.6	492.0	O K
1440 min Winter	0.426	0.426	44.0	0.0	44.0	370.8	O K
2160 min Winter	0.317	0.317	33.7	0.0	33.7	276.1	O K
2880 min Winter	0.257	0.257	27.3	0.0	27.3	223.2	O K
4320 min Winter	0.191	0.191	19.8	0.0	19.8	166.2	O K
5760 min Winter	0.155	0.155	15.8	0.0	15.8	134.9	O K
7200 min Winter	0.132	0.132	13.1	0.0	13.1	114.8	O K
8640 min Winter	0.116	0.116	11.2	0.0	11.2	100.8	O K
10080 min Winter	0.104	0.104	9.9	0.0	9.9	90.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	1326.4	0.0	178
360 min Winter	15.597	0.0	1438.1	0.0	250
480 min Winter	12.388	0.0	1523.0	0.0	322
600 min Winter	10.362	0.0	1592.4	0.0	390
720 min Winter	8.954	0.0	1651.3	0.0	456
960 min Winter	6.975	0.0	1715.0	0.0	580
1440 min Winter	4.904	0.0	1808.7	0.0	824
2160 min Winter	3.448	0.0	1907.8	0.0	1188
2880 min Winter	2.686	0.0	1981.8	0.0	1556
4320 min Winter	1.901	0.0	2103.4	0.0	2288
5760 min Winter	1.487	0.0	2194.5	0.0	2992
7200 min Winter	1.230	0.0	2267.9	0.0	3744
8640 min Winter	1.053	0.0	2329.7	0.0	4416
10080 min Winter	0.923	0.0	2383.3	0.0	5144

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.731	0.731	8.1	0.0	8.1	87.7	Flood Risk
30 min Summer	0.805	0.805	8.5	0.0	8.5	96.6	Flood Risk
60 min Summer	0.850	0.850	8.7	0.0	8.7	102.0	Flood Risk
120 min Summer	0.843	0.843	8.7	0.0	8.7	101.2	Flood Risk
180 min Summer	0.823	0.823	8.5	0.0	8.5	98.7	Flood Risk
240 min Summer	0.798	0.798	8.4	0.0	8.4	95.7	Flood Risk
360 min Summer	0.743	0.743	8.1	0.0	8.1	89.2	Flood Risk
480 min Summer	0.691	0.691	7.8	0.0	7.8	82.9	O K
600 min Summer	0.643	0.643	7.6	0.0	7.6	77.1	O K
720 min Summer	0.599	0.599	7.3	0.0	7.3	71.9	O K
960 min Summer	0.508	0.508	6.7	0.0	6.7	60.9	O K
1440 min Summer	0.373	0.373	5.8	0.0	5.8	44.8	O K
2160 min Summer	0.224	0.224	5.2	0.0	5.2	26.9	O K
2880 min Summer	0.145	0.145	4.9	0.0	4.9	17.4	O K
4320 min Summer	0.104	0.104	3.8	0.0	3.8	12.5	O K
5760 min Summer	0.087	0.087	3.0	0.0	3.0	10.4	O K
7200 min Summer	0.076	0.076	2.5	0.0	2.5	9.1	O K
8640 min Summer	0.069	0.069	2.2	0.0	2.2	8.3	O K
10080 min Summer	0.064	0.064	1.9	0.0	1.9	7.6	O K
15 min Winter	0.822	0.822	8.5	0.0	8.5	98.6	Flood Risk
30 min Winter	0.908	0.908	9.0	0.0	9.0	109.0	Flood Risk
60 min Winter	0.967	0.967	9.3	0.0	9.3	116.0	Flood Risk
120 min Winter	0.962	0.962	9.2	0.0	9.2	115.5	Flood Risk
180 min Winter	0.934	0.934	9.1	0.0	9.1	112.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	92.7	0.0	18
30 min Summer	114.035	0.0	106.5	0.0	32
60 min Summer	65.469	0.0	122.6	0.0	60
120 min Summer	37.586	0.0	140.7	0.0	100
180 min Summer	27.167	0.0	152.6	0.0	132
240 min Summer	21.579	0.0	161.6	0.0	166
360 min Summer	15.597	0.0	175.3	0.0	234
480 min Summer	12.388	0.0	185.6	0.0	302
600 min Summer	10.362	0.0	194.1	0.0	370
720 min Summer	8.954	0.0	201.2	0.0	436
960 min Summer	6.975	0.0	209.0	0.0	566
1440 min Summer	4.904	0.0	220.4	0.0	820
2160 min Summer	3.448	0.0	232.6	0.0	1188
2880 min Summer	2.686	0.0	241.6	0.0	1496
4320 min Summer	1.901	0.0	256.3	0.0	2204
5760 min Summer	1.487	0.0	267.6	0.0	2936
7200 min Summer	1.230	0.0	276.6	0.0	3672
8640 min Summer	1.053	0.0	284.0	0.0	4400
10080 min Summer	0.923	0.0	290.5	0.0	5088
15 min Winter	198.630	0.0	103.9	0.0	18
30 min Winter	114.035	0.0	119.3	0.0	32
60 min Winter	65.469	0.0	137.3	0.0	60
120 min Winter	37.586	0.0	157.7	0.0	112
180 min Winter	27.167	0.0	170.9	0.0	140

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.899	0.899	8.9	0.0	8.9	107.9	Flood Risk
360 min Winter	0.821	0.821	8.5	0.0	8.5	98.5	Flood Risk
480 min Winter	0.745	0.745	8.1	0.0	8.1	89.4	Flood Risk
600 min Winter	0.676	0.676	7.7	0.0	7.7	81.1	O K
720 min Winter	0.614	0.614	7.4	0.0	7.4	73.6	O K
960 min Winter	0.493	0.493	6.6	0.0	6.6	59.1	O K
1440 min Winter	0.319	0.319	5.3	0.0	5.3	38.2	O K
2160 min Winter	0.140	0.140	4.9	0.0	4.9	16.8	O K
2880 min Winter	0.107	0.107	3.9	0.0	3.9	12.8	O K
4320 min Winter	0.082	0.082	2.8	0.0	2.8	9.8	O K
5760 min Winter	0.070	0.070	2.2	0.0	2.2	8.4	O K
7200 min Winter	0.062	0.062	1.8	0.0	1.8	7.4	O K
8640 min Winter	0.057	0.057	1.6	0.0	1.6	6.8	O K
10080 min Winter	0.053	0.053	1.4	0.0	1.4	6.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	181.0	0.0	178
360 min Winter	15.597	0.0	196.3	0.0	254
480 min Winter	12.388	0.0	207.9	0.0	326
600 min Winter	10.362	0.0	217.4	0.0	396
720 min Winter	8.954	0.0	225.4	0.0	464
960 min Winter	6.975	0.0	234.1	0.0	598
1440 min Winter	4.904	0.0	246.8	0.0	864
2160 min Winter	3.448	0.0	260.5	0.0	1148
2880 min Winter	2.686	0.0	270.6	0.0	1476
4320 min Winter	1.901	0.0	287.1	0.0	2200
5760 min Winter	1.487	0.0	299.8	0.0	2936
7200 min Winter	1.230	0.0	309.8	0.0	3616
8640 min Winter	1.053	0.0	318.2	0.0	4368
10080 min Winter	0.923	0.0	325.4	0.0	5120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.744	0.744	24.0	0.0	24.0	256.8	Flood Risk
30 min Summer	0.821	0.821	25.2	0.0	25.2	283.2	Flood Risk
60 min Summer	0.870	0.870	25.9	0.0	25.9	300.3	Flood Risk
120 min Summer	0.870	0.870	25.9	0.0	25.9	300.1	Flood Risk
180 min Summer	0.855	0.855	25.7	0.0	25.7	294.9	Flood Risk
240 min Summer	0.833	0.833	25.4	0.0	25.4	287.5	Flood Risk
360 min Summer	0.783	0.783	24.6	0.0	24.6	270.0	Flood Risk
480 min Summer	0.730	0.730	23.8	0.0	23.8	252.0	Flood Risk
600 min Summer	0.681	0.681	23.0	0.0	23.0	235.0	O K
720 min Summer	0.635	0.635	22.2	0.0	22.2	219.2	O K
960 min Summer	0.541	0.541	20.5	0.0	20.5	186.7	O K
1440 min Summer	0.403	0.403	17.7	0.0	17.7	139.0	O K
2160 min Summer	0.262	0.262	17.0	0.0	17.0	90.4	O K
2880 min Summer	0.212	0.212	14.5	0.0	14.5	73.2	O K
4320 min Summer	0.166	0.166	10.8	0.0	10.8	57.3	O K
5760 min Summer	0.142	0.142	8.7	0.0	8.7	48.9	O K
7200 min Summer	0.126	0.126	7.2	0.0	7.2	43.4	O K
8640 min Summer	0.114	0.114	6.2	0.0	6.2	39.5	O K
10080 min Summer	0.106	0.106	5.5	0.0	5.5	36.5	O K
15 min Winter	0.836	0.836	25.4	0.0	25.4	288.5	Flood Risk
30 min Winter	0.925	0.925	26.8	0.0	26.8	319.2	Flood Risk
60 min Winter	0.987	0.987	27.6	0.0	27.6	340.6	Flood Risk
120 min Winter	0.986	0.986	27.6	0.0	27.6	340.2	Flood Risk
180 min Winter	0.962	0.962	27.3	0.0	27.3	332.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	269.3	0.0	18
30 min Summer	114.035	0.0	309.5	0.0	32
60 min Summer	65.469	0.0	357.2	0.0	60
120 min Summer	37.586	0.0	410.3	0.0	98
180 min Summer	27.167	0.0	444.9	0.0	130
240 min Summer	21.579	0.0	471.2	0.0	164
360 min Summer	15.597	0.0	511.0	0.0	232
480 min Summer	12.388	0.0	541.2	0.0	300
600 min Summer	10.362	0.0	565.8	0.0	368
720 min Summer	8.954	0.0	586.8	0.0	434
960 min Summer	6.975	0.0	609.3	0.0	560
1440 min Summer	4.904	0.0	642.3	0.0	808
2160 min Summer	3.448	0.0	678.8	0.0	1144
2880 min Summer	2.686	0.0	704.7	0.0	1496
4320 min Summer	1.901	0.0	747.3	0.0	2204
5760 min Summer	1.487	0.0	781.2	0.0	2936
7200 min Summer	1.230	0.0	807.2	0.0	3672
8640 min Summer	1.053	0.0	828.9	0.0	4408
10080 min Summer	0.923	0.0	847.1	0.0	5136
15 min Winter	198.630	0.0	301.8	0.0	18
30 min Winter	114.035	0.0	346.9	0.0	32
60 min Winter	65.469	0.0	400.2	0.0	60
120 min Winter	37.586	0.0	459.6	0.0	112
180 min Winter	27.167	0.0	498.4	0.0	138

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.929	0.929	26.8	0.0	26.8	320.6	Flood Risk
360 min Winter	0.853	0.853	25.7	0.0	25.7	294.2	Flood Risk
480 min Winter	0.776	0.776	24.5	0.0	24.5	267.7	Flood Risk
600 min Winter	0.705	0.705	23.3	0.0	23.3	243.2	Flood Risk
720 min Winter	0.641	0.641	22.3	0.0	22.3	221.0	O K
960 min Winter	0.515	0.515	20.0	0.0	20.0	177.8	O K
1440 min Winter	0.317	0.317	17.5	0.0	17.5	109.4	O K
2160 min Winter	0.209	0.209	14.2	0.0	14.2	72.2	O K
2880 min Winter	0.172	0.172	11.3	0.0	11.3	59.3	O K
4320 min Winter	0.136	0.136	8.1	0.0	8.1	46.8	O K
5760 min Winter	0.116	0.116	6.4	0.0	6.4	40.1	O K
7200 min Winter	0.104	0.104	5.3	0.0	5.3	35.7	O K
8640 min Winter	0.095	0.095	4.5	0.0	4.5	32.6	O K
10080 min Winter	0.088	0.088	4.0	0.0	4.0	30.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	527.9	0.0	178
360 min Winter	15.597	0.0	572.4	0.0	252
480 min Winter	12.388	0.0	606.3	0.0	324
600 min Winter	10.362	0.0	633.9	0.0	392
720 min Winter	8.954	0.0	657.4	0.0	462
960 min Winter	6.975	0.0	682.6	0.0	590
1440 min Winter	4.904	0.0	719.6	0.0	836
2160 min Winter	3.448	0.0	760.3	0.0	1144
2880 min Winter	2.686	0.0	789.5	0.0	1500
4320 min Winter	1.901	0.0	837.3	0.0	2208
5760 min Winter	1.487	0.0	875.0	0.0	2944
7200 min Winter	1.230	0.0	904.1	0.0	3672
8640 min Winter	1.053	0.0	928.5	0.0	4400
10080 min Winter	0.923	0.0	949.1	0.0	5136

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.732	0.732	119.7	0.0	119.7	1288.8	Flood Risk
30 min Summer	0.813	0.813	127.3	0.0	127.3	1431.5	Flood Risk
60 min Summer	0.872	0.872	131.8	0.0	131.8	1534.8	Flood Risk
120 min Summer	0.885	0.885	132.7	0.0	132.7	1556.7	Flood Risk
180 min Summer	0.880	0.880	132.4	0.0	132.4	1549.5	Flood Risk
240 min Summer	0.869	0.869	131.5	0.0	131.5	1528.8	Flood Risk
360 min Summer	0.834	0.834	128.9	0.0	128.9	1467.0	Flood Risk
480 min Summer	0.793	0.793	125.6	0.0	125.6	1396.3	Flood Risk
600 min Summer	0.754	0.754	121.9	0.0	121.9	1326.4	Flood Risk
720 min Summer	0.716	0.716	118.0	0.0	118.0	1260.6	Flood Risk
960 min Summer	0.637	0.637	108.4	0.0	108.4	1122.0	O K
1440 min Summer	0.526	0.526	92.4	0.0	92.4	926.5	O K
2160 min Summer	0.424	0.424	75.3	0.0	75.3	745.7	O K
2880 min Summer	0.359	0.359	63.6	0.0	63.6	631.1	O K
4320 min Summer	0.281	0.281	49.0	0.0	49.0	494.7	O K
5760 min Summer	0.234	0.234	40.0	0.0	40.0	412.6	O K
7200 min Summer	0.203	0.203	34.0	0.0	34.0	357.0	O K
8640 min Summer	0.180	0.180	29.7	0.0	29.7	317.5	O K
10080 min Summer	0.163	0.163	26.5	0.0	26.5	287.0	O K
15 min Winter	0.822	0.822	128.0	0.0	128.0	1446.8	Flood Risk
30 min Winter	0.915	0.915	134.9	0.0	134.9	1611.0	Flood Risk
60 min Winter	0.986	0.986	139.8	0.0	139.8	1735.3	Flood Risk
120 min Winter	0.999	0.999	140.7	0.0	140.7	1758.1	Flood Risk
180 min Winter	0.986	0.986	139.8	0.0	139.8	1735.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	1365.3	0.0	21
30 min Summer	114.035	0.0	1568.0	0.0	34
60 min Summer	65.469	0.0	1806.1	0.0	62
120 min Summer	37.586	0.0	2073.9	0.0	100
180 min Summer	27.167	0.0	2248.6	0.0	130
240 min Summer	21.579	0.0	2381.4	0.0	164
360 min Summer	15.597	0.0	2582.0	0.0	232
480 min Summer	12.388	0.0	2734.5	0.0	300
600 min Summer	10.362	0.0	2858.9	0.0	366
720 min Summer	8.954	0.0	2964.6	0.0	432
960 min Summer	6.975	0.0	3078.5	0.0	558
1440 min Summer	4.904	0.0	3245.9	0.0	808
2160 min Summer	3.448	0.0	3425.4	0.0	1172
2880 min Summer	2.686	0.0	3557.4	0.0	1532
4320 min Summer	1.901	0.0	3775.6	0.0	2252
5760 min Summer	1.487	0.0	3940.1	0.0	2992
7200 min Summer	1.230	0.0	4071.9	0.0	3680
8640 min Summer	1.053	0.0	4182.8	0.0	4416
10080 min Summer	0.923	0.0	4278.4	0.0	5144
15 min Winter	198.630	0.0	1529.5	0.0	21
30 min Winter	114.035	0.0	1756.6	0.0	34
60 min Winter	65.469	0.0	2022.9	0.0	60
120 min Winter	37.586	0.0	2322.8	0.0	112
180 min Winter	27.167	0.0	2518.5	0.0	140

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.962	0.962	138.2	0.0	138.2	1693.6	Flood Risk
360 min Winter	0.901	0.901	133.9	0.0	133.9	1585.7	Flood Risk
480 min Winter	0.837	0.837	129.1	0.0	129.1	1472.5	Flood Risk
600 min Winter	0.777	0.777	124.1	0.0	124.1	1366.8	Flood Risk
720 min Winter	0.723	0.723	118.8	0.0	118.8	1272.6	Flood Risk
960 min Winter	0.621	0.621	106.3	0.0	106.3	1093.4	O K
1440 min Winter	0.487	0.487	86.1	0.0	86.1	857.9	O K
2160 min Winter	0.373	0.373	66.2	0.0	66.2	657.3	O K
2880 min Winter	0.306	0.306	53.8	0.0	53.8	539.2	O K
4320 min Winter	0.232	0.232	39.6	0.0	39.6	407.5	O K
5760 min Winter	0.189	0.189	31.4	0.0	31.4	333.0	O K
7200 min Winter	0.162	0.162	26.2	0.0	26.2	284.6	O K
8640 min Winter	0.142	0.142	22.5	0.0	22.5	250.2	O K
10080 min Winter	0.128	0.128	19.8	0.0	19.8	224.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	2667.3	0.0	178
360 min Winter	15.597	0.0	2891.9	0.0	252
480 min Winter	12.388	0.0	3062.7	0.0	322
600 min Winter	10.362	0.0	3202.1	0.0	390
720 min Winter	8.954	0.0	3320.5	0.0	456
960 min Winter	6.975	0.0	3448.1	0.0	586
1440 min Winter	4.904	0.0	3635.7	0.0	836
2160 min Winter	3.448	0.0	3836.5	0.0	1208
2880 min Winter	2.686	0.0	3984.3	0.0	1560
4320 min Winter	1.901	0.0	4229.0	0.0	2292
5760 min Winter	1.487	0.0	4413.0	0.0	3000
7200 min Winter	1.230	0.0	4560.6	0.0	3744
8640 min Winter	1.053	0.0	4684.9	0.0	4488
10080 min Winter	0.923	0.0	4792.3	0.0	5152

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.743	0.743	11.6	0.0	11.6	122.7	Flood Risk
30 min Summer	0.817	0.817	12.2	0.0	12.2	134.9	Flood Risk
60 min Summer	0.862	0.862	12.5	0.0	12.5	142.2	Flood Risk
120 min Summer	0.853	0.853	12.4	0.0	12.4	140.8	Flood Risk
180 min Summer	0.832	0.832	12.3	0.0	12.3	137.2	Flood Risk
240 min Summer	0.805	0.805	12.1	0.0	12.1	132.9	Flood Risk
360 min Summer	0.748	0.748	11.7	0.0	11.7	123.5	Flood Risk
480 min Summer	0.693	0.693	11.2	0.0	11.2	114.4	O K
600 min Summer	0.643	0.643	10.8	0.0	10.8	106.1	O K
720 min Summer	0.597	0.597	10.4	0.0	10.4	98.5	O K
960 min Summer	0.502	0.502	9.5	0.0	9.5	82.8	O K
1440 min Summer	0.360	0.360	8.2	0.0	8.2	59.4	O K
2160 min Summer	0.200	0.200	8.2	0.0	8.2	33.0	O K
2880 min Summer	0.150	0.150	7.1	0.0	7.1	24.8	O K
4320 min Summer	0.113	0.113	5.3	0.0	5.3	18.7	O K
5760 min Summer	0.096	0.096	4.2	0.0	4.2	15.8	O K
7200 min Summer	0.085	0.085	3.5	0.0	3.5	14.0	O K
8640 min Summer	0.077	0.077	3.0	0.0	3.0	12.7	O K
10080 min Summer	0.071	0.071	2.6	0.0	2.6	11.7	O K
15 min Winter	0.836	0.836	12.3	0.0	12.3	137.9	Flood Risk
30 min Winter	0.922	0.922	12.9	0.0	12.9	152.2	Flood Risk
60 min Winter	0.980	0.980	13.3	0.0	13.3	161.7	Flood Risk
120 min Winter	0.972	0.972	13.3	0.0	13.3	160.4	Flood Risk
180 min Winter	0.943	0.943	13.1	0.0	13.1	155.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	129.7	0.0	18
30 min Summer	114.035	0.0	149.0	0.0	32
60 min Summer	65.469	0.0	171.5	0.0	60
120 min Summer	37.586	0.0	197.0	0.0	98
180 min Summer	27.167	0.0	213.6	0.0	130
240 min Summer	21.579	0.0	226.2	0.0	164
360 min Summer	15.597	0.0	245.3	0.0	234
480 min Summer	12.388	0.0	259.8	0.0	302
600 min Summer	10.362	0.0	271.6	0.0	368
720 min Summer	8.954	0.0	281.7	0.0	434
960 min Summer	6.975	0.0	292.5	0.0	566
1440 min Summer	4.904	0.0	308.4	0.0	820
2160 min Summer	3.448	0.0	325.6	0.0	1144
2880 min Summer	2.686	0.0	338.1	0.0	1472
4320 min Summer	1.901	0.0	358.7	0.0	2204
5760 min Summer	1.487	0.0	374.7	0.0	2936
7200 min Summer	1.230	0.0	387.1	0.0	3672
8640 min Summer	1.053	0.0	397.6	0.0	4400
10080 min Summer	0.923	0.0	406.5	0.0	5104
15 min Winter	198.630	0.0	145.3	0.0	18
30 min Winter	114.035	0.0	166.9	0.0	32
60 min Winter	65.469	0.0	192.1	0.0	60
120 min Winter	37.586	0.0	220.7	0.0	110
180 min Winter	27.167	0.0	239.3	0.0	138

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.905	0.905	12.8	0.0	12.8	149.4	Flood Risk
360 min Winter	0.823	0.823	12.2	0.0	12.2	135.8	Flood Risk
480 min Winter	0.743	0.743	11.6	0.0	11.6	122.6	Flood Risk
600 min Winter	0.671	0.671	11.0	0.0	11.0	110.6	O K
720 min Winter	0.606	0.606	10.5	0.0	10.5	100.0	O K
960 min Winter	0.480	0.480	9.3	0.0	9.3	79.1	O K
1440 min Winter	0.274	0.274	8.2	0.0	8.2	45.2	O K
2160 min Winter	0.145	0.145	6.9	0.0	6.9	23.9	O K
2880 min Winter	0.116	0.116	5.5	0.0	5.5	19.2	O K
4320 min Winter	0.091	0.091	3.9	0.0	3.9	15.0	O K
5760 min Winter	0.078	0.078	3.1	0.0	3.1	12.9	O K
7200 min Winter	0.070	0.070	2.5	0.0	2.5	11.5	O K
8640 min Winter	0.064	0.064	2.2	0.0	2.2	10.5	O K
10080 min Winter	0.059	0.059	1.9	0.0	1.9	9.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	253.4	0.0	178
360 min Winter	15.597	0.0	274.8	0.0	252
480 min Winter	12.388	0.0	291.0	0.0	324
600 min Winter	10.362	0.0	304.2	0.0	394
720 min Winter	8.954	0.0	315.5	0.0	462
960 min Winter	6.975	0.0	327.6	0.0	596
1440 min Winter	4.904	0.0	345.5	0.0	852
2160 min Winter	3.448	0.0	364.7	0.0	1128
2880 min Winter	2.686	0.0	378.7	0.0	1472
4320 min Winter	1.901	0.0	401.9	0.0	2200
5760 min Winter	1.487	0.0	419.6	0.0	2920
7200 min Winter	1.230	0.0	433.6	0.0	3608
8640 min Winter	1.053	0.0	445.4	0.0	4336
10080 min Winter	0.923	0.0	455.4	0.0	5072

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.731	0.731	149.0	0.0	149.0	1651.5	Flood Risk
30 min Summer	0.811	0.811	160.6	0.0	160.6	1833.1	Flood Risk
60 min Summer	0.870	0.870	167.8	0.0	167.8	1967.2	Flood Risk
120 min Summer	0.885	0.885	169.4	0.0	169.4	1999.6	Flood Risk
180 min Summer	0.882	0.882	169.1	0.0	169.1	1994.2	Flood Risk
240 min Summer	0.872	0.872	168.0	0.0	168.0	1971.7	Flood Risk
360 min Summer	0.841	0.841	164.3	0.0	164.3	1900.1	Flood Risk
480 min Summer	0.804	0.804	159.6	0.0	159.6	1816.1	Flood Risk
600 min Summer	0.766	0.766	154.3	0.0	154.3	1732.0	Flood Risk
720 min Summer	0.731	0.731	149.0	0.0	149.0	1652.0	Flood Risk
960 min Summer	0.655	0.655	136.4	0.0	136.4	1480.0	O K
1440 min Summer	0.546	0.546	116.0	0.0	116.0	1233.2	O K
2160 min Summer	0.443	0.443	94.6	0.0	94.6	1000.5	O K
2880 min Summer	0.376	0.376	79.9	0.0	79.9	850.7	O K
4320 min Summer	0.297	0.297	61.8	0.0	61.8	670.7	O K
5760 min Summer	0.249	0.249	50.7	0.0	50.7	562.2	O K
7200 min Summer	0.216	0.216	43.1	0.0	43.1	487.0	O K
8640 min Summer	0.192	0.192	37.6	0.0	37.6	433.8	O K
10080 min Summer	0.174	0.174	33.5	0.0	33.5	392.7	O K
15 min Winter	0.820	0.820	161.7	0.0	161.7	1853.0	Flood Risk
30 min Winter	0.912	0.912	172.3	0.0	172.3	2061.8	Flood Risk
60 min Winter	0.983	0.983	178.8	0.0	178.8	2222.6	Flood Risk
120 min Winter	0.998	0.998	180.2	0.0	180.2	2256.0	Flood Risk
180 min Winter	0.987	0.987	179.2	0.0	179.2	2231.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	1741.6	0.0	21
30 min Summer	114.035	0.0	2000.3	0.0	34
60 min Summer	65.469	0.0	2306.6	0.0	62
120 min Summer	37.586	0.0	2648.7	0.0	100
180 min Summer	27.167	0.0	2871.8	0.0	132
240 min Summer	21.579	0.0	3041.4	0.0	166
360 min Summer	15.597	0.0	3297.5	0.0	234
480 min Summer	12.388	0.0	3492.0	0.0	300
600 min Summer	10.362	0.0	3650.8	0.0	366
720 min Summer	8.954	0.0	3785.8	0.0	432
960 min Summer	6.975	0.0	3931.3	0.0	560
1440 min Summer	4.904	0.0	4144.4	0.0	810
2160 min Summer	3.448	0.0	4374.8	0.0	1172
2880 min Summer	2.686	0.0	4543.4	0.0	1532
4320 min Summer	1.901	0.0	4821.4	0.0	2256
5760 min Summer	1.487	0.0	5032.2	0.0	3000
7200 min Summer	1.230	0.0	5200.5	0.0	3736
8640 min Summer	1.053	0.0	5342.2	0.0	4416
10080 min Summer	0.923	0.0	5463.9	0.0	5144
15 min Winter	198.630	0.0	1951.2	0.0	21
30 min Winter	114.035	0.0	2241.0	0.0	34
60 min Winter	65.469	0.0	2583.6	0.0	62
120 min Winter	37.586	0.0	2966.7	0.0	112
180 min Winter	27.167	0.0	3216.6	0.0	140

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	0.966	0.966	177.3	0.0	177.3	2182.3	Flood Risk
360 min Winter	0.908	0.908	171.9	0.0	171.9	2052.4	Flood Risk
480 min Winter	0.848	0.848	165.2	0.0	165.2	1916.1	Flood Risk
600 min Winter	0.791	0.791	157.9	0.0	157.9	1788.6	Flood Risk
720 min Winter	0.741	0.741	150.5	0.0	150.5	1673.6	Flood Risk
960 min Winter	0.642	0.642	134.1	0.0	134.1	1450.9	O K
1440 min Winter	0.509	0.509	108.6	0.0	108.6	1151.5	O K
2160 min Winter	0.394	0.394	83.8	0.0	83.8	890.4	O K
2880 min Winter	0.325	0.325	68.2	0.0	68.2	733.9	O K
4320 min Winter	0.247	0.247	50.2	0.0	50.2	557.4	O K
5760 min Winter	0.202	0.202	40.0	0.0	40.0	456.6	O K
7200 min Winter	0.173	0.173	33.4	0.0	33.4	391.1	O K
8640 min Winter	0.152	0.152	28.7	0.0	28.7	344.0	O K
10080 min Winter	0.137	0.137	25.3	0.0	25.3	308.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	21.579	0.0	3406.5	0.0	178
360 min Winter	15.597	0.0	3693.2	0.0	252
480 min Winter	12.388	0.0	3911.2	0.0	322
600 min Winter	10.362	0.0	4089.0	0.0	390
720 min Winter	8.954	0.0	4240.3	0.0	458
960 min Winter	6.975	0.0	4403.2	0.0	588
1440 min Winter	4.904	0.0	4642.2	0.0	840
2160 min Winter	3.448	0.0	4899.9	0.0	1212
2880 min Winter	2.686	0.0	5088.7	0.0	1584
4320 min Winter	1.901	0.0	5400.5	0.0	2296
5760 min Winter	1.487	0.0	5636.2	0.0	3008
7200 min Winter	1.230	0.0	5824.7	0.0	3744
8640 min Winter	1.053	0.0	5983.4	0.0	4488
10080 min Winter	0.923	0.0	6120.2	0.0	5152

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.696	0.696	3.3	0.0	3.3	53.6	O K
30 min Summer	1.776	0.776	3.5	0.0	3.5	59.8	Flood Risk
60 min Summer	1.842	0.842	3.7	0.0	3.7	64.8	Flood Risk
120 min Summer	1.867	0.867	3.7	0.0	3.7	66.8	Flood Risk
180 min Summer	1.856	0.856	3.7	0.0	3.7	65.9	Flood Risk
240 min Summer	1.843	0.843	3.7	0.0	3.7	64.9	Flood Risk
360 min Summer	1.810	0.810	3.6	0.0	3.6	62.4	Flood Risk
480 min Summer	1.774	0.774	3.5	0.0	3.5	59.6	Flood Risk
600 min Summer	1.738	0.738	3.4	0.0	3.4	56.8	Flood Risk
720 min Summer	1.704	0.704	3.4	0.0	3.4	54.2	Flood Risk
960 min Summer	1.625	0.625	3.2	0.0	3.2	48.2	O K
1440 min Summer	1.505	0.505	2.8	0.0	2.8	38.9	O K
2160 min Summer	1.378	0.378	2.5	0.0	2.5	29.1	O K
2880 min Summer	1.291	0.291	2.2	0.0	2.2	22.4	O K
4320 min Summer	1.172	0.172	1.8	0.0	1.8	13.3	O K
5760 min Summer	1.096	0.096	1.7	0.0	1.7	7.4	O K
7200 min Summer	1.077	0.077	1.5	0.0	1.5	5.9	O K
8640 min Summer	1.067	0.067	1.3	0.0	1.3	5.1	O K
10080 min Summer	1.060	0.060	1.1	0.0	1.1	4.6	O K
15 min Winter	1.782	0.782	3.5	0.0	3.5	60.2	Flood Risk
30 min Winter	1.874	0.874	3.7	0.0	3.7	67.3	Flood Risk
60 min Winter	1.952	0.952	3.9	0.0	3.9	73.3	Flood Risk
120 min Winter	1.991	0.991	4.0	0.0	4.0	76.3	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	18
30 min Summer	114.035	0.0	33
60 min Summer	65.469	0.0	62
120 min Summer	37.586	0.0	120
180 min Summer	27.167	0.0	150
240 min Summer	21.579	0.0	180
360 min Summer	15.597	0.0	248
480 min Summer	12.388	0.0	316
600 min Summer	10.362	0.0	386
720 min Summer	8.954	0.0	454
960 min Summer	6.975	0.0	588
1440 min Summer	4.904	0.0	850
2160 min Summer	3.448	0.0	1216
2880 min Summer	2.686	0.0	1588
4320 min Summer	1.901	0.0	2336
5760 min Summer	1.487	0.0	2944
7200 min Summer	1.230	0.0	3672
8640 min Summer	1.053	0.0	4400
10080 min Summer	0.923	0.0	5136
15 min Winter	198.630	0.0	18
30 min Winter	114.035	0.0	32
60 min Winter	65.469	0.0	60
120 min Winter	37.586	0.0	116

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	1.979	0.979	4.0	0.0	4.0	75.4	Flood Risk
240 min Winter	1.960	0.960	3.9	0.0	3.9	73.9	Flood Risk
360 min Winter	1.916	0.916	3.8	0.0	3.8	70.5	Flood Risk
480 min Winter	1.864	0.864	3.7	0.0	3.7	66.5	Flood Risk
600 min Winter	1.812	0.812	3.6	0.0	3.6	62.5	Flood Risk
720 min Winter	1.763	0.763	3.5	0.0	3.5	58.7	Flood Risk
960 min Winter	1.655	0.655	3.2	0.0	3.2	50.5	O K
1440 min Winter	1.494	0.494	2.8	0.0	2.8	38.1	O K
2160 min Winter	1.336	0.336	2.3	0.0	2.3	25.9	O K
2880 min Winter	1.232	0.232	1.9	0.0	1.9	17.9	O K
4320 min Winter	1.089	0.089	1.6	0.0	1.6	6.9	O K
5760 min Winter	1.068	0.068	1.3	0.0	1.3	5.2	O K
7200 min Winter	1.059	0.059	1.1	0.0	1.1	4.5	O K
8640 min Winter	1.053	0.053	0.9	0.0	0.9	4.0	O K
10080 min Winter	1.048	0.048	0.8	0.0	0.8	3.7	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	168
240 min Winter	21.579	0.0	190
360 min Winter	15.597	0.0	266
480 min Winter	12.388	0.0	342
600 min Winter	10.362	0.0	416
720 min Winter	8.954	0.0	488
960 min Winter	6.975	0.0	626
1440 min Winter	4.904	0.0	894
2160 min Winter	3.448	0.0	1276
2880 min Winter	2.686	0.0	1668
4320 min Winter	1.901	0.0	2248
5760 min Winter	1.487	0.0	2936
7200 min Winter	1.230	0.0	3640
8640 min Winter	1.053	0.0	4408
10080 min Winter	0.923	0.0	5088

E2 Greenfield Rates

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.587	0.587	15.8	0.0	15.8	587.4	O K
30 min Summer	0.667	0.667	16.8	0.0	16.8	667.2	O K
60 min Summer	0.749	0.749	17.8	0.0	17.8	748.5	Flood Risk
120 min Summer	0.822	0.822	18.7	0.0	18.7	821.9	Flood Risk
180 min Summer	0.853	0.853	19.0	0.0	19.0	852.8	Flood Risk
240 min Summer	0.865	0.865	19.1	0.0	19.1	864.8	Flood Risk
360 min Summer	0.863	0.863	19.1	0.0	19.1	862.6	Flood Risk
480 min Summer	0.855	0.855	19.0	0.0	19.0	854.9	Flood Risk
600 min Summer	0.845	0.845	18.9	0.0	18.9	845.0	Flood Risk
720 min Summer	0.834	0.834	18.8	0.0	18.8	833.6	Flood Risk
960 min Summer	0.789	0.789	18.3	0.0	18.3	789.3	Flood Risk
1440 min Summer	0.708	0.708	17.3	0.0	17.3	708.2	Flood Risk
2160 min Summer	0.605	0.605	16.0	0.0	16.0	605.4	O K
2880 min Summer	0.521	0.521	14.9	0.0	14.9	521.4	O K
4320 min Summer	0.390	0.390	13.9	0.0	13.9	389.9	O K
5760 min Summer	0.276	0.276	13.9	0.0	13.9	276.0	O K
7200 min Summer	0.220	0.220	13.3	0.0	13.3	220.3	O K
8640 min Summer	0.189	0.189	12.3	0.0	12.3	189.0	O K
10080 min Summer	0.169	0.169	11.1	0.0	11.1	168.6	O K
15 min Winter	0.658	0.658	16.7	0.0	16.7	658.5	O K
30 min Winter	0.749	0.749	17.8	0.0	17.8	748.5	Flood Risk
60 min Winter	0.841	0.841	18.9	0.0	18.9	841.3	Flood Risk
120 min Winter	0.927	0.927	19.8	0.0	19.8	926.7	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	19
30 min Summer	114.035	0.0	34
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	240
360 min Summer	15.597	0.0	330
480 min Summer	12.388	0.0	386
600 min Summer	10.362	0.0	448
720 min Summer	8.954	0.0	514
960 min Summer	6.975	0.0	648
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1324
2880 min Summer	2.686	0.0	1728
4320 min Summer	1.901	0.0	2504
5760 min Summer	1.487	0.0	3120
7200 min Summer	1.230	0.0	3816
8640 min Summer	1.053	0.0	4496
10080 min Summer	0.923	0.0	5152
15 min Winter	198.630	0.0	19
30 min Winter	114.035	0.0	33
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.965	0.965	20.2	0.0	20.2	964.9	Flood Risk
240 min Winter	0.982	0.982	20.4	0.0	20.4	982.3	Flood Risk
360 min Winter	0.987	0.987	20.5	0.0	20.5	986.6	Flood Risk
480 min Winter	0.972	0.972	20.3	0.0	20.3	971.6	Flood Risk
600 min Winter	0.958	0.958	20.2	0.0	20.2	958.1	Flood Risk
720 min Winter	0.942	0.942	20.0	0.0	20.0	942.4	Flood Risk
960 min Winter	0.884	0.884	19.4	0.0	19.4	883.5	Flood Risk
1440 min Winter	0.772	0.772	18.1	0.0	18.1	772.3	Flood Risk
2160 min Winter	0.630	0.630	16.3	0.0	16.3	630.4	O K
2880 min Winter	0.514	0.514	14.8	0.0	14.8	514.5	O K
4320 min Winter	0.315	0.315	13.9	0.0	13.9	314.9	O K
5760 min Winter	0.209	0.209	13.0	0.0	13.0	209.1	O K
7200 min Winter	0.171	0.171	11.3	0.0	11.3	170.5	O K
8640 min Winter	0.149	0.149	9.8	0.0	9.8	149.5	O K
10080 min Winter	0.135	0.135	8.6	0.0	8.6	135.3	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	234
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	438
600 min Winter	10.362	0.0	470
720 min Winter	8.954	0.0	548
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	996
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1844
4320 min Winter	1.901	0.0	2592
5760 min Winter	1.487	0.0	3120
7200 min Winter	1.230	0.0	3816
8640 min Winter	1.053	0.0	4496
10080 min Winter	0.923	0.0	5240

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.583	0.583	33.4	0.0	33.4	1183.3	O K
30 min Summer	0.662	0.662	33.8	0.0	33.8	1344.3	O K
60 min Summer	0.744	0.744	35.8	0.0	35.8	1510.2	Flood Risk
120 min Summer	0.819	0.819	37.5	0.0	37.5	1661.7	Flood Risk
180 min Summer	0.851	0.851	38.3	0.0	38.3	1727.1	Flood Risk
240 min Summer	0.864	0.864	38.5	0.0	38.5	1753.8	Flood Risk
360 min Summer	0.864	0.864	38.5	0.0	38.5	1753.1	Flood Risk
480 min Summer	0.857	0.857	38.4	0.0	38.4	1740.0	Flood Risk
600 min Summer	0.848	0.848	38.2	0.0	38.2	1722.1	Flood Risk
720 min Summer	0.838	0.838	38.0	0.0	38.0	1700.9	Flood Risk
960 min Summer	0.795	0.795	37.0	0.0	37.0	1613.1	Flood Risk
1440 min Summer	0.714	0.714	35.1	0.0	35.1	1448.6	Flood Risk
2160 min Summer	0.606	0.606	33.4	0.0	33.4	1230.3	O K
2880 min Summer	0.510	0.510	33.4	0.0	33.4	1035.3	O K
4320 min Summer	0.362	0.362	33.4	0.0	33.4	734.6	O K
5760 min Summer	0.291	0.291	30.8	0.0	30.8	590.4	O K
7200 min Summer	0.250	0.250	27.8	0.0	27.8	506.6	O K
8640 min Summer	0.223	0.223	24.9	0.0	24.9	452.9	O K
10080 min Summer	0.204	0.204	22.3	0.0	22.3	413.2	O K
15 min Winter	0.654	0.654	33.6	0.0	33.6	1327.5	O K
30 min Winter	0.743	0.743	35.8	0.0	35.8	1508.9	Flood Risk
60 min Winter	0.836	0.836	37.9	0.0	37.9	1697.2	Flood Risk
120 min Winter	0.922	0.922	39.8	0.0	39.8	1872.0	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	22
30 min Summer	114.035	0.0	36
60 min Summer	65.469	0.0	66
120 min Summer	37.586	0.0	124
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	242
360 min Summer	15.597	0.0	330
480 min Summer	12.388	0.0	386
600 min Summer	10.362	0.0	450
720 min Summer	8.954	0.0	514
960 min Summer	6.975	0.0	652
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1324
2880 min Summer	2.686	0.0	1708
4320 min Summer	1.901	0.0	2380
5760 min Summer	1.487	0.0	3064
7200 min Summer	1.230	0.0	3752
8640 min Summer	1.053	0.0	4496
10080 min Summer	0.923	0.0	5240
15 min Winter	198.630	0.0	22
30 min Winter	114.035	0.0	36
60 min Winter	65.469	0.0	64
120 min Winter	37.586	0.0	122

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.961	0.961	40.7	0.0	40.7	1951.2	Flood Risk
240 min Winter	0.979	0.979	41.0	0.0	41.0	1987.9	Flood Risk
360 min Winter	0.985	0.985	41.1	0.0	41.1	1999.0	Flood Risk
480 min Winter	0.971	0.971	40.9	0.0	40.9	1970.2	Flood Risk
600 min Winter	0.957	0.957	40.6	0.0	40.6	1943.6	Flood Risk
720 min Winter	0.942	0.942	40.3	0.0	40.3	1912.4	Flood Risk
960 min Winter	0.883	0.883	39.0	0.0	39.0	1793.3	Flood Risk
1440 min Winter	0.770	0.770	36.4	0.0	36.4	1563.6	Flood Risk
2160 min Winter	0.619	0.619	33.4	0.0	33.4	1256.3	O K
2880 min Winter	0.477	0.477	33.4	0.0	33.4	968.4	O K
4320 min Winter	0.303	0.303	31.5	0.0	31.5	615.7	O K
5760 min Winter	0.239	0.239	26.7	0.0	26.7	486.2	O K
7200 min Winter	0.206	0.206	22.7	0.0	22.7	418.6	O K
8640 min Winter	0.185	0.185	19.7	0.0	19.7	374.7	O K
10080 min Winter	0.169	0.169	17.4	0.0	17.4	343.1	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	236
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	440
600 min Winter	10.362	0.0	472
720 min Winter	8.954	0.0	550
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	998
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1816
4320 min Winter	1.901	0.0	2424
5760 min Winter	1.487	0.0	3112
7200 min Winter	1.230	0.0	3816
8640 min Winter	1.053	0.0	4496
10080 min Winter	0.923	0.0	5240

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.592	0.592	15.4	0.0	15.4	577.4	O K
30 min Summer	0.672	0.672	16.4	0.0	16.4	655.3	O K
60 min Summer	0.754	0.754	17.4	0.0	17.4	734.9	Flood Risk
120 min Summer	0.828	0.828	18.2	0.0	18.2	807.2	Flood Risk
180 min Summer	0.859	0.859	18.5	0.0	18.5	837.7	Flood Risk
240 min Summer	0.872	0.872	18.7	0.0	18.7	849.7	Flood Risk
360 min Summer	0.870	0.870	18.6	0.0	18.6	847.9	Flood Risk
480 min Summer	0.862	0.862	18.6	0.0	18.6	840.3	Flood Risk
600 min Summer	0.852	0.852	18.4	0.0	18.4	830.7	Flood Risk
720 min Summer	0.841	0.841	18.3	0.0	18.3	819.7	Flood Risk
960 min Summer	0.796	0.796	17.8	0.0	17.8	776.3	Flood Risk
1440 min Summer	0.715	0.715	16.9	0.0	16.9	697.1	Flood Risk
2160 min Summer	0.612	0.612	15.6	0.0	15.6	596.7	O K
2880 min Summer	0.528	0.528	14.5	0.0	14.5	514.8	O K
4320 min Summer	0.398	0.398	13.4	0.0	13.4	387.7	O K
5760 min Summer	0.283	0.283	13.4	0.0	13.4	276.0	O K
7200 min Summer	0.223	0.223	13.0	0.0	13.0	217.0	O K
8640 min Summer	0.190	0.190	12.0	0.0	12.0	185.4	O K
10080 min Summer	0.169	0.169	10.9	0.0	10.9	164.7	O K
15 min Winter	0.664	0.664	16.3	0.0	16.3	647.2	O K
30 min Winter	0.754	0.754	17.4	0.0	17.4	735.3	Flood Risk
60 min Winter	0.847	0.847	18.4	0.0	18.4	826.2	Flood Risk
120 min Winter	0.933	0.933	19.3	0.0	19.3	910.1	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	19
30 min Summer	114.035	0.0	34
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	240
360 min Summer	15.597	0.0	330
480 min Summer	12.388	0.0	386
600 min Summer	10.362	0.0	448
720 min Summer	8.954	0.0	514
960 min Summer	6.975	0.0	652
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1324
2880 min Summer	2.686	0.0	1728
4320 min Summer	1.901	0.0	2504
5760 min Summer	1.487	0.0	3168
7200 min Summer	1.230	0.0	3816
8640 min Summer	1.053	0.0	4496
10080 min Summer	0.923	0.0	5152
15 min Winter	198.630	0.0	19
30 min Winter	114.035	0.0	33
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.972	0.972	19.7	0.0	19.7	947.8	Flood Risk
240 min Winter	0.990	0.990	19.9	0.0	19.9	965.1	Flood Risk
360 min Winter	0.995	0.995	19.9	0.0	19.9	969.9	Flood Risk
480 min Winter	0.980	0.980	19.8	0.0	19.8	955.5	Flood Risk
600 min Winter	0.966	0.966	19.6	0.0	19.6	942.3	Flood Risk
720 min Winter	0.951	0.951	19.5	0.0	19.5	927.1	Flood Risk
960 min Winter	0.892	0.892	18.9	0.0	18.9	869.6	Flood Risk
1440 min Winter	0.781	0.781	17.7	0.0	17.7	761.1	Flood Risk
2160 min Winter	0.639	0.639	16.0	0.0	16.0	622.6	O K
2880 min Winter	0.523	0.523	14.5	0.0	14.5	509.8	O K
4320 min Winter	0.328	0.328	13.4	0.0	13.4	320.1	O K
5760 min Winter	0.212	0.212	12.7	0.0	12.7	206.2	O K
7200 min Winter	0.171	0.171	11.0	0.0	11.0	166.8	O K
8640 min Winter	0.150	0.150	9.6	0.0	9.6	145.8	O K
10080 min Winter	0.135	0.135	8.5	0.0	8.5	131.7	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	234
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	440
600 min Winter	10.362	0.0	472
720 min Winter	8.954	0.0	548
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	996
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1844
4320 min Winter	1.901	0.0	2596
5760 min Winter	1.487	0.0	3168
7200 min Winter	1.230	0.0	3816
8640 min Winter	1.053	0.0	4496
10080 min Winter	0.923	0.0	5240

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.549	0.549	0.8	0.0	0.8	32.9	O K
30 min Summer	0.622	0.622	0.9	0.0	0.9	37.3	O K
60 min Summer	0.698	0.698	1.0	0.0	1.0	41.9	O K
120 min Summer	0.767	0.767	1.0	0.0	1.0	46.0	Flood Risk
180 min Summer	0.797	0.797	1.0	0.0	1.0	47.8	Flood Risk
240 min Summer	0.810	0.810	1.0	0.0	1.0	48.6	Flood Risk
360 min Summer	0.809	0.809	1.0	0.0	1.0	48.6	Flood Risk
480 min Summer	0.802	0.802	1.0	0.0	1.0	48.1	Flood Risk
600 min Summer	0.794	0.794	1.0	0.0	1.0	47.6	Flood Risk
720 min Summer	0.784	0.784	1.0	0.0	1.0	47.0	Flood Risk
960 min Summer	0.743	0.743	1.0	0.0	1.0	44.6	Flood Risk
1440 min Summer	0.668	0.668	0.9	0.0	0.9	40.1	O K
2160 min Summer	0.578	0.578	0.9	0.0	0.9	34.7	O K
2880 min Summer	0.507	0.507	0.8	0.0	0.8	30.4	O K
4320 min Summer	0.405	0.405	0.7	0.0	0.7	24.3	O K
5760 min Summer	0.331	0.331	0.7	0.0	0.7	19.9	O K
7200 min Summer	0.275	0.275	0.6	0.0	0.6	16.5	O K
8640 min Summer	0.231	0.231	0.5	0.0	0.5	13.9	O K
10080 min Summer	0.197	0.197	0.5	0.0	0.5	11.8	O K
15 min Winter	0.615	0.615	0.9	0.0	0.9	36.9	O K
30 min Winter	0.699	0.699	1.0	0.0	1.0	41.9	O K
60 min Winter	0.785	0.785	1.0	0.0	1.0	47.1	Flood Risk
120 min Winter	0.866	0.866	1.1	0.0	1.1	52.0	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	19
30 min Summer	114.035	0.0	33
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	240
360 min Summer	15.597	0.0	340
480 min Summer	12.388	0.0	394
600 min Summer	10.362	0.0	454
720 min Summer	8.954	0.0	520
960 min Summer	6.975	0.0	654
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1340
2880 min Summer	2.686	0.0	1728
4320 min Summer	1.901	0.0	2504
5760 min Summer	1.487	0.0	3232
7200 min Summer	1.230	0.0	3968
8640 min Summer	1.053	0.0	4672
10080 min Summer	0.923	0.0	5448
15 min Winter	198.630	0.0	19
30 min Winter	114.035	0.0	33
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.903	0.903	1.1	0.0	1.1	54.2	Flood Risk
240 min Winter	0.921	0.921	1.1	0.0	1.1	55.2	Flood Risk
360 min Winter	0.928	0.928	1.1	0.0	1.1	55.7	Flood Risk
480 min Winter	0.916	0.916	1.1	0.0	1.1	55.0	Flood Risk
600 min Winter	0.904	0.904	1.1	0.0	1.1	54.2	Flood Risk
720 min Winter	0.891	0.891	1.1	0.0	1.1	53.5	Flood Risk
960 min Winter	0.839	0.839	1.0	0.0	1.0	50.3	Flood Risk
1440 min Winter	0.740	0.740	1.0	0.0	1.0	44.4	Flood Risk
2160 min Winter	0.616	0.616	0.9	0.0	0.9	37.0	O K
2880 min Winter	0.520	0.520	0.8	0.0	0.8	31.2	O K
4320 min Winter	0.385	0.385	0.7	0.0	0.7	23.1	O K
5760 min Winter	0.294	0.294	0.6	0.0	0.6	17.6	O K
7200 min Winter	0.229	0.229	0.5	0.0	0.5	13.8	O K
8640 min Winter	0.182	0.182	0.5	0.0	0.5	10.9	O K
10080 min Winter	0.146	0.146	0.4	0.0	0.4	8.7	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	234
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	444
600 min Winter	10.362	0.0	476
720 min Winter	8.954	0.0	552
960 min Winter	6.975	0.0	704
1440 min Winter	4.904	0.0	1008
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1844
4320 min Winter	1.901	0.0	2632
5760 min Winter	1.487	0.0	3352
7200 min Winter	1.230	0.0	4104
8640 min Winter	1.053	0.0	4840
10080 min Winter	0.923	0.0	5552

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.588	0.588	17.7	0.0	17.7	666.9	O K
30 min Summer	0.668	0.668	18.9	0.0	18.9	757.9	O K
60 min Summer	0.750	0.750	20.0	0.0	20.0	851.2	Flood Risk
120 min Summer	0.824	0.824	21.0	0.0	21.0	935.4	Flood Risk
180 min Summer	0.856	0.856	21.4	0.0	21.4	971.5	Flood Risk
240 min Summer	0.869	0.869	21.5	0.0	21.5	985.9	Flood Risk
360 min Summer	0.867	0.867	21.5	0.0	21.5	984.4	Flood Risk
480 min Summer	0.860	0.860	21.4	0.0	21.4	976.0	Flood Risk
600 min Summer	0.850	0.850	21.3	0.0	21.3	965.1	Flood Risk
720 min Summer	0.839	0.839	21.1	0.0	21.1	952.6	Flood Risk
960 min Summer	0.795	0.795	20.6	0.0	20.6	902.8	Flood Risk
1440 min Summer	0.715	0.715	19.5	0.0	19.5	811.3	Flood Risk
2160 min Summer	0.612	0.612	18.1	0.0	18.1	694.4	O K
2880 min Summer	0.527	0.527	16.8	0.0	16.8	598.3	O K
4320 min Summer	0.392	0.392	16.1	0.0	16.1	444.5	O K
5760 min Summer	0.280	0.280	16.1	0.0	16.1	317.4	O K
7200 min Summer	0.227	0.227	15.2	0.0	15.2	257.5	O K
8640 min Summer	0.196	0.196	13.9	0.0	13.9	222.4	O K
10080 min Summer	0.175	0.175	12.6	0.0	12.6	199.1	O K
15 min Winter	0.659	0.659	18.7	0.0	18.7	747.8	O K
30 min Winter	0.749	0.749	20.0	0.0	20.0	850.3	Flood Risk
60 min Winter	0.843	0.843	21.2	0.0	21.2	956.3	Flood Risk
120 min Winter	0.929	0.929	22.3	0.0	22.3	1054.5	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	21
30 min Summer	114.035	0.0	34
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	240
360 min Summer	15.597	0.0	332
480 min Summer	12.388	0.0	388
600 min Summer	10.362	0.0	450
720 min Summer	8.954	0.0	514
960 min Summer	6.975	0.0	652
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1324
2880 min Summer	2.686	0.0	1728
4320 min Summer	1.901	0.0	2504
5760 min Summer	1.487	0.0	3120
7200 min Summer	1.230	0.0	3816
8640 min Summer	1.053	0.0	4496
10080 min Summer	0.923	0.0	5152
15 min Winter	198.630	0.0	21
30 min Winter	114.035	0.0	34
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.968	0.968	22.7	0.0	22.7	1098.8	Flood Risk
240 min Winter	0.986	0.986	22.9	0.0	22.9	1119.2	Flood Risk
360 min Winter	0.992	0.992	23.0	0.0	23.0	1125.5	Flood Risk
480 min Winter	0.977	0.977	22.8	0.0	22.8	1109.2	Flood Risk
600 min Winter	0.964	0.964	22.7	0.0	22.7	1093.9	Flood Risk
720 min Winter	0.948	0.948	22.5	0.0	22.5	1076.5	Flood Risk
960 min Winter	0.890	0.890	21.8	0.0	21.8	1010.3	Flood Risk
1440 min Winter	0.779	0.779	20.4	0.0	20.4	884.6	Flood Risk
2160 min Winter	0.637	0.637	18.4	0.0	18.4	723.0	O K
2880 min Winter	0.520	0.520	16.7	0.0	16.7	589.7	O K
4320 min Winter	0.312	0.312	16.1	0.0	16.1	354.3	O K
5760 min Winter	0.216	0.216	14.8	0.0	14.8	244.8	O K
7200 min Winter	0.178	0.178	12.8	0.0	12.8	201.5	O K
8640 min Winter	0.156	0.156	11.1	0.0	11.1	177.2	O K
10080 min Winter	0.142	0.142	9.8	0.0	9.8	160.6	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	234
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	440
600 min Winter	10.362	0.0	472
720 min Winter	8.954	0.0	550
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	998
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1844
4320 min Winter	1.901	0.0	2552
5760 min Winter	1.487	0.0	3120
7200 min Winter	1.230	0.0	3816
8640 min Winter	1.053	0.0	4496
10080 min Winter	0.923	0.0	5240

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.590	0.590	2.4	0.0	2.4	91.4	O K
30 min Summer	0.669	0.669	2.6	0.0	2.6	103.7	O K
60 min Summer	0.750	0.750	2.7	0.0	2.7	116.2	Flood Risk
120 min Summer	0.823	0.823	2.8	0.0	2.8	127.5	Flood Risk
180 min Summer	0.854	0.854	2.9	0.0	2.9	132.3	Flood Risk
240 min Summer	0.866	0.866	2.9	0.0	2.9	134.2	Flood Risk
360 min Summer	0.864	0.864	2.9	0.0	2.9	133.9	Flood Risk
480 min Summer	0.856	0.856	2.9	0.0	2.9	132.6	Flood Risk
600 min Summer	0.845	0.845	2.9	0.0	2.9	131.0	Flood Risk
720 min Summer	0.834	0.834	2.9	0.0	2.9	129.2	Flood Risk
960 min Summer	0.789	0.789	2.8	0.0	2.8	122.2	Flood Risk
1440 min Summer	0.708	0.708	2.6	0.0	2.6	109.7	Flood Risk
2160 min Summer	0.610	0.610	2.4	0.0	2.4	94.6	O K
2880 min Summer	0.534	0.534	2.3	0.0	2.3	82.8	O K
4320 min Summer	0.422	0.422	2.0	0.0	2.0	65.4	O K
5760 min Summer	0.341	0.341	1.8	0.0	1.8	52.8	O K
7200 min Summer	0.279	0.279	1.7	0.0	1.7	43.2	O K
8640 min Summer	0.230	0.230	1.5	0.0	1.5	35.6	O K
10080 min Summer	0.190	0.190	1.4	0.0	1.4	29.4	O K
15 min Winter	0.661	0.661	2.5	0.0	2.5	102.5	O K
30 min Winter	0.751	0.751	2.7	0.0	2.7	116.4	Flood Risk
60 min Winter	0.843	0.843	2.9	0.0	2.9	130.7	Flood Risk
120 min Winter	0.929	0.929	3.0	0.0	3.0	144.0	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	19
30 min Summer	114.035	0.0	33
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	240
360 min Summer	15.597	0.0	336
480 min Summer	12.388	0.0	390
600 min Summer	10.362	0.0	452
720 min Summer	8.954	0.0	516
960 min Summer	6.975	0.0	654
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1324
2880 min Summer	2.686	0.0	1728
4320 min Summer	1.901	0.0	2504
5760 min Summer	1.487	0.0	3232
7200 min Summer	1.230	0.0	3968
8640 min Summer	1.053	0.0	4752
10080 min Summer	0.923	0.0	5448
15 min Winter	198.630	0.0	19
30 min Winter	114.035	0.0	33
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.967	0.967	3.1	0.0	3.1	150.0	Flood Risk
240 min Winter	0.985	0.985	3.1	0.0	3.1	152.7	Flood Risk
360 min Winter	0.991	0.991	3.1	0.0	3.1	153.6	Flood Risk
480 min Winter	0.977	0.977	3.1	0.0	3.1	151.4	Flood Risk
600 min Winter	0.963	0.963	3.1	0.0	3.1	149.3	Flood Risk
720 min Winter	0.948	0.948	3.0	0.0	3.0	146.9	Flood Risk
960 min Winter	0.890	0.890	3.0	0.0	3.0	138.0	Flood Risk
1440 min Winter	0.782	0.782	2.8	0.0	2.8	121.2	Flood Risk
2160 min Winter	0.649	0.649	2.5	0.0	2.5	100.5	O K
2880 min Winter	0.544	0.544	2.3	0.0	2.3	84.4	O K
4320 min Winter	0.398	0.398	2.0	0.0	2.0	61.7	O K
5760 min Winter	0.298	0.298	1.7	0.0	1.7	46.2	O K
7200 min Winter	0.225	0.225	1.5	0.0	1.5	34.9	O K
8640 min Winter	0.164	0.164	1.3	0.0	1.3	25.4	O K
10080 min Winter	0.094	0.094	1.3	0.0	1.3	14.5	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	234
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	442
600 min Winter	10.362	0.0	474
720 min Winter	8.954	0.0	550
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	998
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1844
4320 min Winter	1.901	0.0	2632
5760 min Winter	1.487	0.0	3392
7200 min Winter	1.230	0.0	4112
8640 min Winter	1.053	0.0	4936
10080 min Winter	0.923	0.0	5344

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.594	0.594	7.1	0.0	7.1	267.1	O K
30 min Summer	0.673	0.673	7.6	0.0	7.6	303.0	O K
60 min Summer	0.755	0.755	8.0	0.0	8.0	339.8	Flood Risk
120 min Summer	0.830	0.830	8.4	0.0	8.4	373.4	Flood Risk
180 min Summer	0.862	0.862	8.6	0.0	8.6	387.7	Flood Risk
240 min Summer	0.874	0.874	8.6	0.0	8.6	393.5	Flood Risk
360 min Summer	0.874	0.874	8.6	0.0	8.6	393.2	Flood Risk
480 min Summer	0.867	0.867	8.6	0.0	8.6	390.2	Flood Risk
600 min Summer	0.858	0.858	8.6	0.0	8.6	386.3	Flood Risk
720 min Summer	0.848	0.848	8.5	0.0	8.5	381.7	Flood Risk
960 min Summer	0.805	0.805	8.3	0.0	8.3	362.5	Flood Risk
1440 min Summer	0.727	0.727	7.9	0.0	7.9	327.3	Flood Risk
2160 min Summer	0.629	0.629	7.3	0.0	7.3	283.0	O K
2880 min Summer	0.550	0.550	6.9	0.0	6.9	247.4	O K
4320 min Summer	0.434	0.434	6.1	0.0	6.1	195.5	O K
5760 min Summer	0.351	0.351	5.5	0.0	5.5	158.0	O K
7200 min Summer	0.288	0.288	5.0	0.0	5.0	129.7	O K
8640 min Summer	0.239	0.239	4.5	0.0	4.5	107.4	O K
10080 min Summer	0.191	0.191	4.4	0.0	4.4	86.0	O K
15 min Winter	0.665	0.665	7.5	0.0	7.5	299.5	O K
30 min Winter	0.756	0.756	8.0	0.0	8.0	340.1	Flood Risk
60 min Winter	0.849	0.849	8.5	0.0	8.5	382.1	Flood Risk
120 min Winter	0.936	0.936	8.9	0.0	8.9	421.1	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	19
30 min Summer	114.035	0.0	33
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	240
360 min Summer	15.597	0.0	330
480 min Summer	12.388	0.0	386
600 min Summer	10.362	0.0	448
720 min Summer	8.954	0.0	514
960 min Summer	6.975	0.0	648
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1320
2880 min Summer	2.686	0.0	1728
4320 min Summer	1.901	0.0	2468
5760 min Summer	1.487	0.0	3224
7200 min Summer	1.230	0.0	3960
8640 min Summer	1.053	0.0	4672
10080 min Summer	0.923	0.0	5352
15 min Winter	198.630	0.0	19
30 min Winter	114.035	0.0	33
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.975	0.975	9.1	0.0	9.1	438.8	Flood Risk
240 min Winter	0.993	0.993	9.2	0.0	9.2	447.0	Flood Risk
360 min Winter	1.000	1.000	9.2	0.0	9.2	449.8	Flood Risk
480 min Winter	0.986	0.986	9.2	0.0	9.2	443.7	Flood Risk
600 min Winter	0.974	0.974	9.1	0.0	9.1	438.2	Flood Risk
720 min Winter	0.960	0.960	9.1	0.0	9.1	431.8	Flood Risk
960 min Winter	0.903	0.903	8.8	0.0	8.8	406.3	Flood Risk
1440 min Winter	0.796	0.796	8.2	0.0	8.2	358.2	Flood Risk
2160 min Winter	0.661	0.661	7.5	0.0	7.5	297.4	O K
2880 min Winter	0.554	0.554	6.9	0.0	6.9	249.2	O K
4320 min Winter	0.404	0.404	5.9	0.0	5.9	181.6	O K
5760 min Winter	0.301	0.301	5.1	0.0	5.1	135.4	O K
7200 min Winter	0.223	0.223	4.4	0.0	4.4	100.4	O K
8640 min Winter	0.152	0.152	4.3	0.0	4.3	68.6	O K
10080 min Winter	0.131	0.131	3.9	0.0	3.9	58.8	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	234
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	438
600 min Winter	10.362	0.0	470
720 min Winter	8.954	0.0	548
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	996
2160 min Winter	3.448	0.0	1424
2880 min Winter	2.686	0.0	1820
4320 min Winter	1.901	0.0	2596
5760 min Winter	1.487	0.0	3352
7200 min Winter	1.230	0.0	4112
8640 min Winter	1.053	0.0	4584
10080 min Winter	0.923	0.0	5248

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.584	0.584	38.8	0.0	38.8	1339.7	O K
30 min Summer	0.663	0.663	38.8	0.0	38.8	1522.1	O K
60 min Summer	0.745	0.745	40.4	0.0	40.4	1710.5	Flood Risk
120 min Summer	0.820	0.820	42.4	0.0	42.4	1882.6	Flood Risk
180 min Summer	0.852	0.852	43.2	0.0	43.2	1957.3	Flood Risk
240 min Summer	0.866	0.866	43.5	0.0	43.5	1988.2	Flood Risk
360 min Summer	0.866	0.866	43.5	0.0	43.5	1988.3	Flood Risk
480 min Summer	0.860	0.860	43.4	0.0	43.4	1974.1	Flood Risk
600 min Summer	0.851	0.851	43.2	0.0	43.2	1954.5	Flood Risk
720 min Summer	0.841	0.841	42.9	0.0	42.9	1930.8	Flood Risk
960 min Summer	0.798	0.798	41.8	0.0	41.8	1832.0	Flood Risk
1440 min Summer	0.717	0.717	39.7	0.0	39.7	1645.3	Flood Risk
2160 min Summer	0.607	0.607	38.8	0.0	38.8	1393.9	O K
2880 min Summer	0.507	0.507	38.8	0.0	38.8	1164.7	O K
4320 min Summer	0.366	0.366	38.6	0.0	38.6	840.0	O K
5760 min Summer	0.298	0.298	35.2	0.0	35.2	683.2	O K
7200 min Summer	0.257	0.257	31.4	0.0	31.4	590.8	O K
8640 min Summer	0.231	0.231	28.0	0.0	28.0	530.3	O K
10080 min Summer	0.211	0.211	25.2	0.0	25.2	485.1	O K
15 min Winter	0.655	0.655	38.8	0.0	38.8	1503.1	O K
30 min Winter	0.744	0.744	40.4	0.0	40.4	1708.7	Flood Risk
60 min Winter	0.837	0.837	42.8	0.0	42.8	1922.0	Flood Risk
120 min Winter	0.924	0.924	45.0	0.0	45.0	2120.5	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	22
30 min Summer	114.035	0.0	37
60 min Summer	65.469	0.0	66
120 min Summer	37.586	0.0	124
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	242
360 min Summer	15.597	0.0	332
480 min Summer	12.388	0.0	386
600 min Summer	10.362	0.0	450
720 min Summer	8.954	0.0	514
960 min Summer	6.975	0.0	652
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1324
2880 min Summer	2.686	0.0	1704
4320 min Summer	1.901	0.0	2380
5760 min Summer	1.487	0.0	3064
7200 min Summer	1.230	0.0	3752
8640 min Summer	1.053	0.0	4496
10080 min Summer	0.923	0.0	5240
15 min Winter	198.630	0.0	22
30 min Winter	114.035	0.0	36
60 min Winter	65.469	0.0	64
120 min Winter	37.586	0.0	122

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.963	0.963	45.9	0.0	45.9	2210.6	Flood Risk
240 min Winter	0.981	0.981	46.3	0.0	46.3	2252.7	Flood Risk
360 min Winter	0.987	0.987	46.5	0.0	46.5	2266.0	Flood Risk
480 min Winter	0.973	0.973	46.1	0.0	46.1	2234.0	Flood Risk
600 min Winter	0.960	0.960	45.8	0.0	45.8	2204.0	Flood Risk
720 min Winter	0.945	0.945	45.5	0.0	45.5	2168.9	Flood Risk
960 min Winter	0.886	0.886	44.0	0.0	44.0	2034.0	Flood Risk
1440 min Winter	0.772	0.772	41.1	0.0	41.1	1772.6	Flood Risk
2160 min Winter	0.617	0.617	38.8	0.0	38.8	1416.9	O K
2880 min Winter	0.468	0.468	38.8	0.0	38.8	1075.5	O K
4320 min Winter	0.309	0.309	35.9	0.0	35.9	710.4	O K
5760 min Winter	0.248	0.248	30.3	0.0	30.3	568.4	O K
7200 min Winter	0.214	0.214	25.6	0.0	25.6	491.8	O K
8640 min Winter	0.192	0.192	22.2	0.0	22.2	441.1	O K
10080 min Winter	0.176	0.176	19.6	0.0	19.6	404.5	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	236
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	440
600 min Winter	10.362	0.0	474
720 min Winter	8.954	0.0	550
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	998
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1792
4320 min Winter	1.901	0.0	2424
5760 min Winter	1.487	0.0	3112
7200 min Winter	1.230	0.0	3816
8640 min Winter	1.053	0.0	4504
10080 min Winter	0.923	0.0	5240

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.595	0.595	3.4	0.0	3.4	128.0	O K
30 min Summer	0.675	0.675	3.6	0.0	3.6	145.1	O K
60 min Summer	0.756	0.756	3.8	0.0	3.8	162.5	Flood Risk
120 min Summer	0.829	0.829	4.0	0.0	4.0	178.3	Flood Risk
180 min Summer	0.860	0.860	4.1	0.0	4.1	184.9	Flood Risk
240 min Summer	0.872	0.872	4.1	0.0	4.1	187.4	Flood Risk
360 min Summer	0.869	0.869	4.1	0.0	4.1	186.8	Flood Risk
480 min Summer	0.860	0.860	4.1	0.0	4.1	184.9	Flood Risk
600 min Summer	0.849	0.849	4.1	0.0	4.1	182.6	Flood Risk
720 min Summer	0.837	0.837	4.0	0.0	4.0	180.1	Flood Risk
960 min Summer	0.792	0.792	3.9	0.0	3.9	170.2	Flood Risk
1440 min Summer	0.710	0.710	3.7	0.0	3.7	152.6	Flood Risk
2160 min Summer	0.611	0.611	3.5	0.0	3.5	131.4	O K
2880 min Summer	0.533	0.533	3.2	0.0	3.2	114.6	O K
4320 min Summer	0.419	0.419	2.9	0.0	2.9	90.0	O K
5760 min Summer	0.335	0.335	2.6	0.0	2.6	72.1	O K
7200 min Summer	0.272	0.272	2.3	0.0	2.3	58.4	O K
8640 min Summer	0.220	0.220	2.1	0.0	2.1	47.3	O K
10080 min Summer	0.173	0.173	2.0	0.0	2.0	37.1	O K
15 min Winter	0.667	0.667	3.6	0.0	3.6	143.5	O K
30 min Winter	0.758	0.758	3.8	0.0	3.8	162.9	Flood Risk
60 min Winter	0.851	0.851	4.1	0.0	4.1	182.9	Flood Risk
120 min Winter	0.936	0.936	4.3	0.0	4.3	201.3	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	19
30 min Summer	114.035	0.0	33
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	240
360 min Summer	15.597	0.0	330
480 min Summer	12.388	0.0	386
600 min Summer	10.362	0.0	450
720 min Summer	8.954	0.0	514
960 min Summer	6.975	0.0	652
1440 min Summer	4.904	0.0	924
2160 min Summer	3.448	0.0	1324
2880 min Summer	2.686	0.0	1728
4320 min Summer	1.901	0.0	2504
5760 min Summer	1.487	0.0	3232
7200 min Summer	1.230	0.0	3968
8640 min Summer	1.053	0.0	4752
10080 min Summer	0.923	0.0	5448
15 min Winter	198.630	0.0	19
30 min Winter	114.035	0.0	33
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.975	0.975	4.4	0.0	4.4	209.6	Flood Risk
240 min Winter	0.992	0.992	4.4	0.0	4.4	213.3	Flood Risk
360 min Winter	0.997	0.997	4.4	0.0	4.4	214.3	Flood Risk
480 min Winter	0.982	0.982	4.4	0.0	4.4	211.0	Flood Risk
600 min Winter	0.968	0.968	4.3	0.0	4.3	208.0	Flood Risk
720 min Winter	0.952	0.952	4.3	0.0	4.3	204.7	Flood Risk
960 min Winter	0.893	0.893	4.2	0.0	4.2	192.0	Flood Risk
1440 min Winter	0.783	0.783	3.9	0.0	3.9	168.4	Flood Risk
2160 min Winter	0.647	0.647	3.6	0.0	3.6	139.2	O K
2880 min Winter	0.541	0.541	3.2	0.0	3.2	116.3	O K
4320 min Winter	0.392	0.392	2.8	0.0	2.8	84.2	O K
5760 min Winter	0.289	0.289	2.4	0.0	2.4	62.2	O K
7200 min Winter	0.210	0.210	2.0	0.0	2.0	45.1	O K
8640 min Winter	0.118	0.118	2.0	0.0	2.0	25.5	O K
10080 min Winter	0.093	0.093	1.9	0.0	1.9	20.1	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	178
240 min Winter	21.579	0.0	234
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	440
600 min Winter	10.362	0.0	472
720 min Winter	8.954	0.0	548
960 min Winter	6.975	0.0	702
1440 min Winter	4.904	0.0	996
2160 min Winter	3.448	0.0	1428
2880 min Winter	2.686	0.0	1840
4320 min Winter	1.901	0.0	2596
5760 min Winter	1.487	0.0	3400
7200 min Winter	1.230	0.0	4176
8640 min Winter	1.053	0.0	4664
10080 min Winter	0.923	0.0	5248

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.584	0.584	46.9	0.0	46.9	1716.0	O K
30 min Summer	0.664	0.664	49.9	0.0	49.9	1949.4	O K
60 min Summer	0.746	0.746	52.6	0.0	52.6	2191.7	Flood Risk
120 min Summer	0.822	0.822	55.0	0.0	55.0	2416.2	Flood Risk
180 min Summer	0.857	0.857	56.0	0.0	56.0	2517.4	Flood Risk
240 min Summer	0.872	0.872	56.4	0.0	56.4	2563.1	Flood Risk
360 min Summer	0.877	0.877	56.6	0.0	56.6	2576.3	Flood Risk
480 min Summer	0.876	0.876	56.5	0.0	56.5	2572.4	Flood Risk
600 min Summer	0.872	0.872	56.4	0.0	56.4	2560.6	Flood Risk
720 min Summer	0.865	0.865	56.2	0.0	56.2	2542.8	Flood Risk
960 min Summer	0.830	0.830	55.2	0.0	55.2	2438.3	Flood Risk
1440 min Summer	0.762	0.762	53.1	0.0	53.1	2237.4	Flood Risk
2160 min Summer	0.671	0.671	50.1	0.0	50.1	1970.8	O K
2880 min Summer	0.596	0.596	47.4	0.0	47.4	1750.2	O K
4320 min Summer	0.489	0.489	42.6	0.0	42.6	1436.5	O K
5760 min Summer	0.418	0.418	38.2	0.0	38.2	1228.5	O K
7200 min Summer	0.368	0.368	34.3	0.0	34.3	1079.8	O K
8640 min Summer	0.329	0.329	31.1	0.0	31.1	966.4	O K
10080 min Summer	0.299	0.299	28.4	0.0	28.4	879.8	O K
15 min Winter	0.655	0.655	49.5	0.0	49.5	1924.1	O K
30 min Winter	0.745	0.745	52.6	0.0	52.6	2187.4	Flood Risk
60 min Winter	0.838	0.838	55.4	0.0	55.4	2462.3	Flood Risk
120 min Winter	0.927	0.927	57.9	0.0	57.9	2723.1	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	22
30 min Summer	114.035	0.0	37
60 min Summer	65.469	0.0	66
120 min Summer	37.586	0.0	124
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	242
360 min Summer	15.597	0.0	328
480 min Summer	12.388	0.0	384
600 min Summer	10.362	0.0	446
720 min Summer	8.954	0.0	512
960 min Summer	6.975	0.0	648
1440 min Summer	4.904	0.0	916
2160 min Summer	3.448	0.0	1320
2880 min Summer	2.686	0.0	1704
4320 min Summer	1.901	0.0	2428
5760 min Summer	1.487	0.0	3168
7200 min Summer	1.230	0.0	3896
8640 min Summer	1.053	0.0	4592
10080 min Summer	0.923	0.0	5344
15 min Winter	198.630	0.0	22
30 min Winter	114.035	0.0	36
60 min Winter	65.469	0.0	64
120 min Winter	37.586	0.0	122

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.968	0.968	59.1	0.0	59.1	2845.3	Flood Risk
240 min Winter	0.989	0.989	59.6	0.0	59.6	2906.2	Flood Risk
360 min Winter	0.999	0.999	59.9	0.0	59.9	2936.4	Flood Risk
480 min Winter	0.990	0.990	59.6	0.0	59.6	2908.1	Flood Risk
600 min Winter	0.982	0.982	59.4	0.0	59.4	2884.6	Flood Risk
720 min Winter	0.971	0.971	59.1	0.0	59.1	2852.2	Flood Risk
960 min Winter	0.920	0.920	57.7	0.0	57.7	2702.7	Flood Risk
1440 min Winter	0.821	0.821	54.9	0.0	54.9	2412.4	Flood Risk
2160 min Winter	0.693	0.693	50.9	0.0	50.9	2036.2	O K
2880 min Winter	0.591	0.591	47.2	0.0	47.2	1736.7	O K
4320 min Winter	0.456	0.456	40.7	0.0	40.7	1340.4	O K
5760 min Winter	0.374	0.374	34.9	0.0	34.9	1100.0	O K
7200 min Winter	0.320	0.320	30.3	0.0	30.3	939.0	O K
8640 min Winter	0.280	0.280	26.7	0.0	26.7	824.0	O K
10080 min Winter	0.251	0.251	23.8	0.0	23.8	737.4	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	180
240 min Winter	21.579	0.0	236
360 min Winter	15.597	0.0	344
480 min Winter	12.388	0.0	438
600 min Winter	10.362	0.0	472
720 min Winter	8.954	0.0	548
960 min Winter	6.975	0.0	700
1440 min Winter	4.904	0.0	994
2160 min Winter	3.448	0.0	1408
2880 min Winter	2.686	0.0	1792
4320 min Winter	1.901	0.0	2552
5760 min Winter	1.487	0.0	3280
7200 min Winter	1.230	0.0	3968
8640 min Winter	1.053	0.0	4752
10080 min Winter	0.923	0.0	5448

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Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.541	0.541	0.9	0.0	0.9	55.2	O K
30 min Summer	1.616	0.616	1.0	0.0	1.0	62.9	O K
60 min Summer	1.697	0.697	1.1	0.0	1.1	71.0	O K
120 min Summer	1.777	0.777	1.1	0.0	1.1	79.2	Flood Risk
180 min Summer	1.819	0.819	1.2	0.0	1.2	83.5	Flood Risk
240 min Summer	1.843	0.843	1.2	0.0	1.2	86.0	Flood Risk
360 min Summer	1.866	0.866	1.2	0.0	1.2	88.3	Flood Risk
480 min Summer	1.870	0.870	1.2	0.0	1.2	88.7	Flood Risk
600 min Summer	1.865	0.865	1.2	0.0	1.2	88.3	Flood Risk
720 min Summer	1.861	0.861	1.2	0.0	1.2	87.8	Flood Risk
960 min Summer	1.830	0.830	1.2	0.0	1.2	84.6	Flood Risk
1440 min Summer	1.774	0.774	1.1	0.0	1.1	79.0	Flood Risk
2160 min Summer	1.698	0.698	1.1	0.0	1.1	71.2	O K
2880 min Summer	1.633	0.633	1.0	0.0	1.0	64.5	O K
4320 min Summer	1.536	0.536	0.9	0.0	0.9	54.7	O K
5760 min Summer	1.461	0.461	0.9	0.0	0.9	47.0	O K
7200 min Summer	1.401	0.401	0.8	0.0	0.8	40.9	O K
8640 min Summer	1.352	0.352	0.8	0.0	0.8	36.0	O K
10080 min Summer	1.311	0.311	0.7	0.0	0.7	31.8	O K
15 min Winter	1.607	0.607	1.0	0.0	1.0	61.9	O K
30 min Winter	1.691	0.691	1.1	0.0	1.1	70.5	O K
60 min Winter	1.782	0.782	1.1	0.0	1.1	79.8	Flood Risk
120 min Winter	1.874	0.874	1.2	0.0	1.2	89.2	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	198.630	0.0	19
30 min Summer	114.035	0.0	34
60 min Summer	65.469	0.0	64
120 min Summer	37.586	0.0	122
180 min Summer	27.167	0.0	182
240 min Summer	21.579	0.0	242
360 min Summer	15.597	0.0	360
480 min Summer	12.388	0.0	480
600 min Summer	10.362	0.0	546
720 min Summer	8.954	0.0	598
960 min Summer	6.975	0.0	720
1440 min Summer	4.904	0.0	982
2160 min Summer	3.448	0.0	1388
2880 min Summer	2.686	0.0	1812
4320 min Summer	1.901	0.0	2596
5760 min Summer	1.487	0.0	3352
7200 min Summer	1.230	0.0	4112
8640 min Summer	1.053	0.0	4848
10080 min Summer	0.923	0.0	5640
15 min Winter	198.630	0.0	19
30 min Winter	114.035	0.0	33
60 min Winter	65.469	0.0	62
120 min Winter	37.586	0.0	120

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	1.923	0.923	1.2	0.0	1.2	94.2	Flood Risk
240 min Winter	1.953	0.953	1.3	0.0	1.3	97.3	Flood Risk
360 min Winter	1.984	0.984	1.3	0.0	1.3	100.4	Flood Risk
480 min Winter	1.994	0.994	1.3	0.0	1.3	101.4	Flood Risk
600 min Winter	1.992	0.992	1.3	0.0	1.3	101.2	Flood Risk
720 min Winter	1.984	0.984	1.3	0.0	1.3	100.4	Flood Risk
960 min Winter	1.945	0.945	1.3	0.0	1.3	96.4	Flood Risk
1440 min Winter	1.874	0.874	1.2	0.0	1.2	89.2	Flood Risk
2160 min Winter	1.773	0.773	1.1	0.0	1.1	78.9	Flood Risk
2880 min Winter	1.685	0.685	1.1	0.0	1.1	69.9	O K
4320 min Winter	1.552	0.552	1.0	0.0	1.0	56.3	O K
5760 min Winter	1.452	0.452	0.9	0.0	0.9	46.1	O K
7200 min Winter	1.375	0.375	0.8	0.0	0.8	38.3	O K
8640 min Winter	1.315	0.315	0.7	0.0	0.7	32.1	O K
10080 min Winter	1.267	0.267	0.7	0.0	0.7	27.2	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	27.167	0.0	180
240 min Winter	21.579	0.0	238
360 min Winter	15.597	0.0	352
480 min Winter	12.388	0.0	462
600 min Winter	10.362	0.0	570
720 min Winter	8.954	0.0	670
960 min Winter	6.975	0.0	752
1440 min Winter	4.904	0.0	1056
2160 min Winter	3.448	0.0	1512
2880 min Winter	2.686	0.0	1932
4320 min Winter	1.901	0.0	2768
5760 min Winter	1.487	0.0	3568
7200 min Winter	1.230	0.0	4320
8640 min Winter	1.053	0.0	5096
10080 min Winter	0.923	0.0	5848

Series 05 Technical Documents

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