11 Hydrology, Hydrogeology and Flood Risk

11.1 Introduction

11.1.1 This chapter provides an assessment of the potential impacts on surface water and groundwater receptors, together with the flood risk associated with the proposed development.

11.1.2 Consideration is given to temporary effects during the construction phase and the effects of operation during the lifetime of the development. (There are potential effects associated with the future decommissioning of the facility, although because these would be generally similar in nature and significance to construction effects, for the sake of brevity this assessment does not describe decommissioning effects separately.) The need for site specific mitigation measures to be put in place to protect the water environment are also identified and described. The nature of any residual risks that remain after mitigation are also discussed.

Overview of Potential Impacts

11.1.3 Impacts to the water environment resulting from the proposed EfW CHP facility relate to four main issues:

- Erosion and sediment transport;
- Chemical / effluent pollution events;
- Alteration / interruption of surface water flows; and
- Alteration / interruption of groundwater flows.

Water Related Consultation Responses

11.1.4 The following stakeholders were consulted during the preparation of this ES Chapter:

- Environment Agency;
- Plymouth City Council;
- Natural England;
- South West Water; and
- Kelda Water Services.

Relevant Design Characteristics

11.1.5 The relevant design characteristics in terms of reducing potential surface water, groundwater and flood risk impacts associated with the proposed EfW CHP facility are as follows:

- The waste bunker will be constructed from reinforced concrete rendering it impermeable and preventing seepage to groundwater;
- Operational activities (e.g. tipping of waste, transfer of bottom ash, filling and emptying of silos etc) will take place within the building envelope to significantly reduce the risk of accidental release of waste, dust, etc to local watercourses;

- Chemicals, fuels, etc will be stored in suitable bunded areas with impervious bases;
- Any process water discharges will be diverted to a wastewater storage pit for either re-use in the process, off-site disposal or treatment and discharge to foul sewer;
- The two existing access bridges will be removed and replaced with a new clear-span access bridge, opening up the Weston Mill Stream channel;
- The drainage of hardstandings will pass through a class 1 by-pass petrol interceptor prior to being discharged to the Weston Mill Stream, downstream of the existing access bridge;
- The discharge outfall pipe has been designed to ensure flooding does not occur due to tide locking. An isolation valve is also provided on the discharge outfall to control any discharge in critical events;
- All sewers throughout the site will be designed to ensure that no flooding occurs above ground level for events with a return period at a minimum of 30 years including an allowance for the anticipated effects of climate change over the lifetime of the development; and
- The EfW CHP facility will be operated in accordance with the site Environmental Permit issued by the Environment Agency.

11.1.6 In addition, guidance from the relevant Environment Agency Pollution Prevention Guidelines (PPGs) will be followed. A Construction Environmental Management Plan has also been prepared (see Appendix 6.3) and this will be adhered to.

11.2 Relevant Legislation and Policy

11.2.1 There is a very wide range of legislation and policy pertaining to water resources and flood risk; however, this section only refers to related legislation and policy that is directly relevant to the proposed development and the range of potential impacts identified.

Legislation

Water Framework Directive

11.2.2 The Water Framework Directive (WFD) (Directive 2000/60/EC) establishes a single framework for water policy across Europe. Its ultimate aim is to ensure all inland and near shore watercourses and water bodies (including groundwater) are of 'Good' status or better, in terms of ecological, but also chemical, biological and physical parameters, by the year 2015. Therefore, any activities or developments that could cause detriment to a nearby water resource, or prevent the future ability of a water resource to reach its potential status, must be mitigated so as to reduce the potential for harm and allow the aims of the Directive to be realised.

11.2.3 A water body is assessed for Ecological Status and Chemical Status as part of the WFD. The methodology for determining status has been set out by the UK Technical Advisory Group (UKTAG) on the WFD. The Environment Agency is responsible for monitoring and ensuring that the targets are met. Water bodies are classed as either: High, Good, Moderate, Poor or Bad.

11.2.4 The Ecological Status is based on biological quality which includes invertebrates, fish and macrophytes; physicochemical quality which includes temperature, dissolved oxygen, salinity, pH and nutrients; and hydromorphological quality which assesses the range of available habitats.

11.2.5 Chemical Status is assessed on the presence and concentration of Priority Substances for which standards have been established. A full list is located in the UKTAG advice for classification. UKTAG has also proposed water quality, ecology, water abstraction and river flow standards to be adopted in order to ensure that water bodies in the UK (including groundwater) meet the required status.

Freshwater Fish Directive

11.2.6 The Freshwater Fish Directive (2006/44/EC) was originally adopted on 18 July 1978 but consolidated in 2006. The Directive seeks to protect those fresh water bodies identified by Member States as waters suitable for sustaining fish populations. For those waters it sets physical and chemical water quality objectives for salmonid waters and cyprinid waters. The Directive will be repealed and replaced in 2013 by the Water Framework Directive.

Shellfish Water Directive

11.2.7 The Shellfish Water Directive (2006/113/EC) was originally adopted on 30 October 1979 but consolidated in 2006. The directive concerns the quality of shellfish waters and applies to those coastal and brackish waters designated by the European Member States as needing protection or improvement in order to support shellfish (bivalve and gasteropod molluscs) life and growth and thus to contribute to the high quality of shellfish products directly edible by humans. The Directive will be repealed and replaced in 2013 by the Water Framework Directive.

Bathing Water Directive

11.2.8 The current Bathing Water Directive (76/1160/EEC) was adopted on 8 December 1975. The objective of the Directive is to protect public health whilst bathing. The Directive affects sewage works and other types of industry where sewage is discharged. A revised Bathing Water Directive entered into force on 24 March 2006. The revised Bathing Water Directive of 2006 will step by step replace the old Directive of 1976.

Natura 2000 (Habitats and/or Birds Directive)

11.2.9 The Habitats (92/43/EEC) and Birds (2009/147/EC) Directives together provide for the creation of a network of protected areas for important or threatened wildlife habitats across the European Member States to be known collectively as Natura 2000. This network consists of Special Areas of Conservation (SACs) for habitats and non-bird species, and Special Protection Areas (SPAs) for birds.

Acts of Parliament

11.2.10 Activities associated with the construction of the proposed EfW CHP facility will need to conform to existing water legislation in England, including the Environment Protection Act (1990), Environment Act (1995), Water Resources Act (1991), Land Drainage Act (1991) and the Water Act (2003). This is particularly relevant in relation to discharges to water and any engineering works or impoundments. These include the following requirements:

- Any significant dewatering activity will be subject to licensing by the Environment Agency, under the Water Act (2003);
- Any works in, under, over or within 7m of a watercourse (including the new bridge) will require a land drainage consent (from the Environment Agency); and,

- Assurance that riparian owners' common law rights to receive water is undiminished in quantity or quality.

National Policy

Planning Policy Statement 25: Development and Flood Risk

11.2.11 PPS25 aims to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at high risk. PPS25 states that an FRA must be undertaken for all developments in Flood Zones 2 or 3, or for all sites greater than 1 hectare in area.

11.2.12 An FRA is required to highlight and assess the significance of flooding to the proposed development and to assess the flood risk to third parties arising from the development.

Planning Policy Statement 23: Planning and Pollution Control

11.2.13 PPS23 aims to mitigate any negative impacts on the water environment from the proposed development. Annex 2 of PPS23 relates to development on land affected by contamination and provides guidance on how the development of contaminated land can be controlled through the planning process.

Local Policy

11.2.14 The Plymouth Local Development Framework Core Strategy (Adopted 2007) sets out local development control policies used in the determination of a planning application. Relevant policies with regards to surface water, groundwater and flood risk are as follows.

11.2.15 Policy CS20 seeks to promote development which utilises natural resources in as efficient and sustainable way as possible, this will include:

- *Meeting high water efficiency standards, and incorporating new technologies to recycle and conserve water resources;*
- *Promoting the use of Sustainable Urban Drainage Schemes.*

11.2.16 Policy CS21 specifically relates to the importance of considering flood risk by supporting development proposals that avoid areas of current or future flood risk, and which do not increase the risk of flooding elsewhere. This policy reflects the aims of PPS25.

11.2.17 Policy CS22 meanwhile seeks to protect people and the environment from unsafe, unhealthy and polluted environments through:

- *Ensuring development causes no unacceptable impact on water or air quality.*

Environment Agency Policy and Guidance

Groundwater Protection: Policy and Practice (GP3)

11.2.18 The Environment Agency has set out a framework for the regulation and management of groundwater in a set of documents, collectively known as Groundwater Protection: Policy and Practice (GP3). The policies and guidance within GP3 replace the previous policy covered in the Environment Agency's 'Policy and Practice for the Protection of Groundwater'.

Pollution Prevention Guidelines

11.2.19 With regard to hydrology, management of water-borne pollution and protection of ecologically sensitive areas, the Environment Agency has a statutory obligation to manage and control the pollution of water resources. Accordingly, it is reasonable to assume that the adoption of the Environment Agency's Best Practice Guidelines and licensing of the plant under Environmental Permitting Regulations will prevent pollution to recognised standards and reduce any 'significant' impacts to acceptable levels.

11.2.20 The Environment Agency's Pollution Prevention Guidelines (PPGs) are the principal documents used for guidance on preventing the contamination of surface waters from construction activities. The PPGs relevant to this development include:

- PPG1: General Guide to the Prevention of Pollution;
- PPG2: Above Ground Oil Storage Tanks;
- PPG5: Works In, Near or Liable to Affect Watercourses;
- PPG6: Working at Construction and Demolition Sites;
- PPG7: Refuelling Facilities;
- PPG8: Storage and Disposal of Used Oils;
- PPG21: Pollution Incident Response Planning; and
- PPG26: Storage and Handling of Drums & Intermediate Bulk Containers.

11.2.21 Other relevant guidance includes:

- Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors C532 (CIRIA);
- Environmental Good Practice on Site C650 (CIRIA);
- Sustainable Drainage Systems C609 Hydraulic, Structural and Water Quality Advice (CIRIA);
- Designing for Exceedance in Urban Drainage C635 - Good Practice (CIRIA); and
- The SuDS Manual C697 (CIRIA).

11.3 Assessment Methodology

11.3.1 In the absence of any standard criteria for undertaking water resource assessments, assessment criteria have been adapted from the Department for Transport, Transport Analysis Guidance (TAG) (2003) which, although designed for road transport developments, can be, and is routinely applied to proposed developments of other kinds. This methodology takes into account the magnitude, sensitivity and significance of predicted effects on the water environment.

Water Resources Methodology

Magnitude

11.3.2 The magnitude of a potential impact is assessed based on the amount and intensity of disturbance and duration (i.e. whether permanent or temporary) (see Table 11.1). Consideration of likelihood is then incorporated into a final risk assessment (see Table 11.4).

Table 11.1 Impact Magnitude Criteria

Magnitude	Definition
High	Fundamental change to hydrological / hydrogeological conditions (including deterioration in water quality/quantity) resulting in temporary or permanent consequential changes.
Moderate	Detectable change to hydrological / hydrogeological conditions resulting in non-fundamental temporary or permanent consequential changes. Some deterioration in water quality/quantity likely to temporarily affect most sensitive receptors.
Minor	Detectable but minor change to hydrological / hydrogeological conditions. Water quality/quantity standards less than threshold and unlikely to affect most sensitive receptors.
Negligible	Unquantifiable or unqualifiable change in hydrological / hydrogeological conditions (including water quality).

Sensitivity

11.3.3 Sensitivity is based on the degree of environmental response to any particular impact, together with the value of the water feature or resource (e.g. a Principal Aquifer or nearby abstraction borehole should be considered more sensitive to any impact than a Secondary Aquifer or unproductive strata) (see Table 11.2).

Table 11.2 Sensitivity Criteria

Sensitivity	Definition
High	Environment is subject to major change(s) due to impact e.g. adjacent to, or within 100m of, a sensitive watercourse or sited directly upon a Principal Aquifer / Source Protection Zone (SPZ).
Medium	Environment clearly responds to effect(s) in quantifiable and / or qualifiable manner e.g. reasonable proximity to a surface water course (within 500m), abstraction point, or Principal Aquifer or sited on a Secondary Aquifer.
Low	Environment responds in a minimal way such that only minor changes are detectable e.g. surface water features present at some distance (>500m) or groundwater resource with minimal sensitivity e.g. Secondary Aquifer.
Negligible	Environment is insensitive to impact, no discernible changes e.g. unproductive strata where little or no effect on groundwater could occur.

Significance

11.3.4 The significance of a specific potential effect on a water feature or resource is then derived by considering the associated the magnitude and sensitivity (see Table 11.3).

Table 11.3 Significance Matrix

Magnitude	Sensitivity			
	High	**Medium**	**Low**	**Negligible**
High	Very High	High	Moderate	Not significant
Moderate	High	Moderate	Minor	Not significant
Minor	Moderate	Minor	Minor	Not significant
Negligible	Not significant	Not significant	Not significant	Not significant

Risk Assessment Methodology

11.3.5 The Source-Pathway-Receptor model has been adopted to undertake this assessment. Firstly potential 'sources' of contamination based on a review of historic, existing and proposed site uses (contaminated land, potential spillages during construction or operational phases) have been identified. Considerations such as the nature and likely extent of any contamination have also been taken into account.

11.3.6 The presence of contamination does not always infer a risk. It is the exposure pathway that determines the risk to the receptor and the effective consequence of exposure. A pathway which transports the contaminants to the receptor, generally involves conveyance via soil, water or air, or, in some cases, direct contact.

11.3.7 The varying effect that a hazard has on an individual 'receptor' depends largely on the sensitivity of the receptor. Receptors include any people, animal or plant populations, or natural or economic resources that are within the range of the potential spread of the source, and which are connected to the source by a transport pathway. Although in this instance the assessment is principally concerned with surface water and groundwater receptors.

11.3.8 By considering the source, pathway and receptor, an assessment has been made for each contaminant type, on a receptor by receptor basis, with reference to the significance and degree of risk. In assessing this information, a judgement has been made as to whether the source contamination can reach a receptor, and whether it is of a major or minor significance. The exposure risks are assessed against the present North Yard, Devonport site conditions (i.e. the 'Do Nothing Scenario').

11.3.9 The environmental risk guidance document 'Guidelines for Environmental Risk Assessment and Management'[1] first published by the Department for the Environment in 1995 states that the designation of risk is based upon a consideration of both:

- The likelihood of an event; (takes into account both the presence of the hazard and receptor and the integrity of the pathway); and,

[1] Available online at: http://www.defra.gov.uk/environment/quality/risk/eramguide/index.htm

- The severity of the potential significance (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

11.3.10 Table 11.4 shows how the risk rating is achieved by combining the likelihood of the event and the degree of significance.

Table 11.4 Risk Assessment Matrix

Likelihood	Significance			
	High	**Moderate**	**Minor**	**Not significant**
High likelihood	Very high risk	High risk	Moderate risk	Low risk
Likely	High risk	Moderate risk	Moderate / low risk	Low risk
Low likelihood	Moderate risk	Moderate / low risk	Low risk	Very low risk
Unlikely	Moderate / low risk	Low risk	Very low risk	Very low risk

11.3.11 A description of the varying degrees of associated risk, shown in the risk assessment matrix (see Table 11.4), is provided in Table 11.5 below.

Table 11.5 Risk Criteria

Term	Description
Very high risk	There is a high likelihood that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remedial action.
High risk	Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remedial action.
Moderate risk	It is possible that, without appropriate remedial action, harm could arise to a designated receptor, but it is relatively unlikely that any such harm would be high, and if any harm were to occur it is more likely that such harm would be relatively minor.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard but it is likely that, at worst, this harm, if realised, would normally be minor.
Very low risk	The presence of an identified hazard does not give rise to the potential to cause significant harm to a designated receptor.

11.3.12 The assessment of likely significant impacts of the proposed EfW CHP facility, both within and outside the site, is initially based on potential impact before mitigation. Levels of assessed impact which are moderate or above will require mitigation/management to reduce the level of impact to negligible or low levels.

Flood Risk Assessment Methodology

11.3.13 The above methodology has been used to assess the significance of all potential impacts to water resources, with the exception of flood risk. The specific methodology for defining and assessing flood risk is dictated by the requirements of PPS25 and as detailed in the PPS25 Practice Guide. The full details of this specific methodology are outlined in the FRA document in support of this chapter (Appendix 11.1).

11.3.14 The FRA reports potential flood risks both to and from the site. Unlike the impact assessment methodology applied for water resources in this chapter, the flood risk methodology used in the FRA assumes that the 'receptors' in the Source-Pathway-Receptor model are any areas of land or development potentially at risk both as a result of the development but also within the proposed development itself. In the context of the water resources methodology reported in this chapter, the application of the Source-Pathway-Receptor model can be considered as reversed, in that the water resources themselves are the potential 'sources' of impact. Nevertheless, the principle of the model is the same in that an impact is only considered if all three elements of the model are identified.

11.3.15 Using the FRA methodology, sites or development areas at risk are not assigned a 'value' as it is assumed that all areas affected by flooding are given equal consideration. PPS25 simply requires that proposed development should not increase flood risk elsewhere (i.e. no adverse impact) and should look to reduce flood risk where possible, thereby promoting beneficial impacts in the context of an ES. Flood risk to the proposed development is assessed and mitigation proposals are proposed to manage any negative adverse flood impacts to the development itself. In the absence of an assigned 'value' for receptors, the significance of impact is largely based on a qualitative assessment of the likely magnitude of flood risk impacts.

11.4 Baseline Conditions

Information Sources

11.4.1 Baseline data on water resources and flood risk in the vicinity of the proposed development site has been collated by reference to the following sources:

- British Geological Survey (BGS) Solid and Drift Geology Map, 1:50 000 Series: Sheet 348, Plymouth;
- Ordnance Survey (OS) Landranger Map, 1:50,000 Series: No 201, Plymouth and Launceston;
- Plymouth City Council (2006) Strategic Flood Risk Assessment. Plymouth City Council website: www.plymouth.gov.uk;
- Landmark Envirocheck Report (September 2009) provides information on Groundwater Vulnerability, Sensitive Land Uses, and surface water and groundwater abstractions and discharges;

- Water Framework Directive (WFD) water quality data. Environment Agency website: www.environment-agency.gov.uk;
- Groundwater Aquifer Designation Maps provide information on superficial drift and bedrock geology. Environment Agency website: www.environment-agency.gov.uk;
- Groundwater Source Protection Zones Maps define groundwater protection zones in relation to public water supply. Environment Agency website: www.environment-agency.gov.uk; and
- Flood Map. Environment Agency website: www.environment-agency.gov.uk;

11.4.2 Specifically commissioned reports and investigation undertaken at the site:

- Geotechnics (August, 2010) Ground Investigation at Proposed Energy from Waste Plant, Devonport, Plymouth. Factual Report;
- GHA Livigunn (September, 2010) Interpretation Summary of the Geotechnical and Contamination Aspects of Geotechnics Ground Investigation Factual Report; and
- Scott Wilson (February, 2011) Level 3 Flood Risk Assessment (Appendix 11.1).

Site Description

11.4.3 The proposed development site is located on land currently owned by the Ministry of Defence (MoD) within Her Majesty's Naval Base (HMNB) Devonport, Plymouth. A site location plan showing water features is provided in Figure 11.1.

11.4.4 The main access road into the site is from the east, via the existing bridge over the Weston Mill Stream. The area where the EfW CHP facility will be located consists of low lying land on which remains stockpiled earth and rubble left by former tenants Ashcroft. To the north-west of the main development area is an area of woodland known locally as 'Blackies Wood' within which is a dismantled railway line.

11.4.5 In the south of the site is an area of made-ground raised approximately 5 m above the land to the north. This area of land is known colloquially as 'Table Top Mountain'. It is understood that the made-ground consists of waste material from other parts of the dockyard. The made-ground area is currently used by the MoD as storage for heavy vehicles and machinery and will be sued for the construction compound for the proposed development.

Surrounding Area

11.4.6 The residential area of Barne Barton is located to the north-west of the site. This area of housing is at a higher elevation to the proposed site, with ground levels of approximately 15 m AOD up to 40 m AOD.

11.4.7 The Weston Mill Stream flows adjacent to the eastern and southern boundary of the site. Prior to this the Stream flows beneath the Weston Mill Viaduct situated to the east of the site. To the west of the site is an MoD car park, whilst to the south lies Weston Mill Lake, beyond which lies the majority of the Dockyard complex.

11.4.8 The wider area consists of mid density residential housing to the east, north east and south east of the site within the residential areas known as Weston Mill, St. Budeaux, King's Tamerton, Camel's Head, North Prospect and Keyham. To the west (approximately 500 m) and beyond the Dockyard to the south is the Hamoaze, an estuarine stretch of the River Tamar. The Tamar

Estuary discharges to the sea via Plymouth Sound, located approximately 5 km south of the site. The towns of Saltash (to the northwest) and Torpoint (to the southwest) are located on the western side of the Tamar Estuary.

Surface Hydrology

Topography and Drainage

11.4.9 The site is relatively flat with ground levels ranging between 7-8 m AOD. 'Table Top Mountain' in the south of the site is also relatively flat with ground levels ranging between 11-13 m AOD. Ground levels along the site access range from 5.5 m AOD to the east of Weston Mill Stream down to 3.7 m AOD adjacent to the Weston Mill Viaduct.

11.4.10 There is currently no drainage network servicing the site. Surface water generated on the low lying land to the north of the site is thought to infiltrate into the subsoil or drain to Weston Mill Stream.

11.4.11 Beyond the site boundary, to the northwest of the site, in the vicinity of Barne Barton residential area, the land rises steeply to a maximum elevation of around 40 m AOD. A drainage channel has been identified during the site walkover at this location. Surface water runoff from the surrounding land drains to the channel, which is located immediately north-west of the built development area. This drainage channel is thought to infiltrate into the subsoil or eventually drain into Weston Mill Stream via the Barne Brake Creek.

11.4.12 The land to the north, east and the south is relatively low lying, with ground levels in the region of 6 m AOD. Surface water generated in these locations is also likely to drain to the Weston Mill Stream or directly to Weston Mill Lake.

11.4.13 A topographic survey presenting existing pre-development ground levels across the development site including existing access roads is provided in Figure 11.2.

Significant Water Features

11.4.14 Weston Mill Stream is the main watercourse in the vicinity of the site with a catchment area of approximately 6 km^2. The Weston Mill Stream has two tributaries the Camels Head Creek (approximately 200m upstream of the Viaduct) and the Barne Brake Creek, which both have catchment areas of less than 1km^2. All three catchments are relatively steep, heavily urbanised catchments and respond rapidly to rainfall.

11.4.15 Camels Head Sewage Treatment Works (STW) is located approximately 400 m upstream of Camels Head Creek's confluence with Weston Mill Stream.

11.4.16 Weston Mill Stream remains tidally influenced for approximately 1.5 km upstream of the site. Downstream of the site the Stream drains to Weston Mill Lake via a box culvert. Weston Mill Lake, forms part of the Dockyard and is connected to the Tamar Estuary (located to the south and west of the site).

11.4.17 All of these water features are tidally influenced. Admiralty Tide Tables (2003) for the Devonport area indicate that the tidal range between Mean High Water Spring (MHWS) and Mean Low Water Spring (MLWS) is 4.7 m, with the MHWS tide level being 2.28 m AOD and the MLWS tide level being -2.42 m AOD.

11.4.18 The Tamar Estuary forms part of the Plymouth Sound and Estuaries Special Area of Conservation (SAC). The Tamar Estuaries Complex Special Protection Area (SPA) and Tamar-Tavy Estuary Site of Special Scientific Interest (SSSI) are located approximately 2 km to the northwest of the site. The location of significant water features are shown in Figure 11.1.

Surface Water Quality

11.4.19 Water quality of surface watercourses is measured with reference to standards set by the Water Framework Directive (Directive 2000/60/EC). The purpose of the Directive is to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. It will ensure all aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands meet 'good status' by 2015. The Directive requires Member States to establish River Basin Districts (RBD) and for each of these a River Basin Management Plan (RBMP).

11.4.20 Annexe B of the River Basin Management Plan for the South West River Basin District[2] provides information relating to the current status of all the water bodies within the South West River Basin District. Ecological status is recorded on the scale of high, good, moderate, poor or bad. 'High' denotes largely undisturbed conditions and the other classes represent increasing deviation from this natural condition.

11.4.21 Table 11.6 provides a summary of the current status of the Weston Mill Stream reach located within the Lynher (Tidal) and Hamoaze water body and Plymouth Sound.

Table 11.6: Summary of Water Framework Directive Water Body Status

Water body ID	Water body (and reach)	Current Status		
		Ecological status / potential (and certainty that status is less than good)	Overall physico chemical quality	Hydro morphological Quality
GB108047003570	Lynher (Tidal) and Hamoaze (Weston Mill Stream*)	Moderate Ecological Status (Uncertain)	Does not require assessment	Not High
GB520804714300	Plymouth Sound	Good Ecological Potential	Fail	Heavily Modified

*Extent of the Weston Mill Stream reach is identified on the Environment Agency website[3]

11.4.22 Table 11.6 indicates that the Weston Mill Stream is classified as having 'Moderate' ecological status. Plymouth Sound is the downstream water body, and is classified as having 'Good' ecological potential. The waters of Plymouth Sound are protected under the Freshwater Fish Directive, Shellfish Water Directive, Bathing Water Directive and Natura 2000 (Habitats Directive).

11.4.23 Plymouth Sound is also classified as a Heavily Modified Water Body (HMWBs). The physical characteristics of HMWBs have been substantially changed in character to facilitate their water use (i.e. navigation). As changes to their hydromorphological characteristics necessary to

[2] Available online: http://wfdconsultation.environment-agency.gov.uk/wfdcms/en/southwest/Intro.aspx
[3] Available online: http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=wfd_rivers&ep=map&x=245702.075&y=57737.3505&scale=5&lang=_e&layerGroups=default&layerGroupToQuery=1&textonly=off#x=245972&y=57827&lg=1,7,8,9,5,6,&scale=5

achieve good surface water status would have a significant adverse impact on their water use they are instead classified as having good ecological potential[4].

Mains Supply and Sewers

11.4.24 The South West Water Internet Mapping (SWWIM) indicates that no South West Water assets (mains water supply and sewers) are present within the main development site boundary. A South West Water foul sewer crosses the far north west of the site, located approximately 80 – 100 m from the proposed built development area of the site. This foul sewer does not service the existing site and will not be utilised within the proposed development.

11.4.25 All mains water supply and sewers within the dockyard are dealt with by Kelda Water Services. Information provided by Kelda Water Services also indicates that none of their drainage or water supply assets are located within the site boundary.

11.4.26 The proposed surface water drainage strategy for the development (see Section 11.7) will be completely separate from any of the dockyard or neighbouring developments' drainage systems. The proposed mains water supply will connect to a South West Water main located to the west of the site servicing the Barne Barton area. The proposed foul sewer discharges into Kelda Water Services foul drainage system within the Dockyard to the south-east of the development site.

Geology and Hydrogeology

Geology

11.4.27 A review of the Ground Investigation Report undertaken at the site (Geotechnics, 2010) provides the following summary on ground conditions underlying the site.

11.4.28 The made-ground varies in thickness, ranging between 7 m and 11 m below ground level (bgl) and consists mainly of varying sizes of crushed granular material. The made-ground overlies a layer of alluvium deposits varying in thickness from depths between 7 m to 22 m bgl. The deposits comprise mainly soft to firm gravely silts with occasional deposits of shells and clay.

11.4.29 The alluvium overlies Upper Devonian Shales of the Saltash Formation comprising mudstones and siltstones (shales) dipping toward the south with a general east-west strike.

Hydrogeology

11.4.30 The Environment Agency Groundwater Aquifer Designation Map[5] for the area indicates that the superficial (alluvium) deposits underlying the site are not designated an aquifer; however, the underlying Saltash Formation has been designated a Secondary (B) Aquifer. A Secondary (B) Aquifer is classified as:

> *'Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers'.*

11.4.31 The Environment Agency Groundwater Vulnerability Map[6] indicates that the soils underlying the site are shown to be of high leaching potential, able to transmit a wide range of pollutants due to

[4] Further information on HMWBs is available online at: http://www.wfduk.org/UKCLASSPUB/LibraryPublicDocs/gep_hmwb_final
[5] Available online: www.environment-agency.gov.uk
[6] Environment Agency Groundwater Vulnerability Map Sheet 49, South Devon, 1997

rapid drainage and low attenuation potential. This classification is likely to be associated with the alluvium deposits located beneath the made-ground.

11.4.32 A review of the Environment Agency Groundwater Source Protection Zone (SPZ) Map indicates that the site does not lie within a SPZ.

11.4.33 The Ground Investigation Report (Geotechnics, 2010) indicates that groundwater levels on site range between 5 m and 10 m below ground level (bgl) and are considered to be in hydraulic continuity with the Tamar Estuary.

Existing Contamination

11.4.34 Existing contamination on site is assessed in Chapter 10 'Contamination - Land and Water Quality'. This assessment is based on the site investigation undertaken by Geotechnics, on behalf of MVV, during June and July 2010. The interpretation of results provided in Chapter 10 indicates that low levels of contamination were identified onsite.

Abstractions and Discharges

11.4.35 The Envirocheck Report (September 2009) indicates that a total of 21 discharge consent licences are held within 1 km of the site (see Figure 11.3). These discharge consents are associated with South West Water (Camels Head STW and storm sewage overflows), Devonport Dockyard (trade discharges and storm sewage overflows) and Bull Point Depot (trade discharges and treated effluent discharges). All 21 discharge consents discharge directly or indirectly (via the Weston Mill Stream and Weston Mill Lake) to the Tamar Estuary.

11.4.36 The Envirocheck Report (September 2009) indicates that a total of 4 water abstractions licenses are held within 1 km of the site. These licenses permit water to be abstracted for industrial uses from the Tamar Estuary at 13 abstraction points all located within the Devonport Royal Dockyard to the south of the site. The Environment Agency requested that the MOD be consulted with regard to any unlicensed groundwater abstractions known within the dockyard; the MoD has confirmed that there are no known unlicensed abstractions.

Flood Risk

11.4.37 The Environment Agency Flood Map identifies that the new built development area of the site is located within Flood Zone 1 of the Tamar Estuary (low probability of tidal flooding). A section of the access road, where the road runs parallel to the Weston Mill Viaduct fall within tidal Flood Zone 2. PPS25 defines the Flood Zones as:

- Zone 1 – land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%);
- Zone 2 – land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year; and
- Zone 3 – land assessed as having a 1 in 100 year or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

11.4.38 PPS25: Development and Flood Risk specifies that planning applications for development proposals of 1 ha or greater in Flood Zone 1 and all proposals for new development located in Flood Zone 2 and Flood Zone 3 should be accompanied by an FRA.

11.4.39 It has therefore been necessary to prepare an FRA for this site, which is presented in Appendix 11.1.

11.5 Incorporated Mitigation

11.5.1 Several pollution prevention and drainage management features are inherent within the design of the proposed EfW CHP facility. A number of these will provide protection to surrounding water features and are summarised below. The main mitigation feature will be the carrying out of all operations within a building and/or externally on hardstanding. The proposed development plans are provided in the Figures which accompany ES Chapter 6.

- The facility will operate under strict operational conditions imposed by the Environmental Permit, to be issued and then monitored by the Environment Agency.
- Rapid acting roller shutter doors will be incorporated in the entrance to the tipping hall to minimise the time during which these doors are open.
- All transfer of waste from vehicles to the bunker and all waste handling will occur within the main building.
- Litter and detritus will be cleared up on a daily basis with particular emphasis on public areas. Any litter escaping the site or deposited by site users will be cleared up to a 10m distance from the site boundaries.
- The waste bunker is to be constructed from reinforced concrete rendering it impermeable and so preventing potential seepage to groundwater.
- Air pollution control (APC) residue silos will be emptied into sealed pneumatically loaded bulk powder carriers.
- Incinerator bottom ash (IBA) will be loaded inside the EfW main building by means of an automatic travelling overhead grab crane into a collection vehicle. The vehicle will be sheeted before leaving the ash loading station.
- Air for the furnace will be extracted from above the waste bunker to help maintain a negative air pressure to control accumulation of dust.
- The water treatment plant to be used during the initial fill of the boiler and for small volumes of system top up will be located within a building containing a bunded area, with additional bunded storage areas to store the boiler water treatment chemicals.
- All chemical substances and hazardous materials are to be stored in accordance with Environment Agency guidelines in bunded areas.
- Kelda Water Services will carry out all works necessary to provide the water and sewerage connections to the facility.
- The drainage of hardstandings will pass through a class 1 by-pass petrol interceptor prior to being discharged to Weston Mill Stream, downstream of the existing access bridge.

- In normal operation, the plant will produce no liquid effluent. Clean water such as boiler blowdown water or backwash water from the boiler water treatment plant will be returned to the ash quench water seal system on the boiler. Dirty water such as the run-off from the IBA conveying system will be returned to the ash quench system. There are no emissions to water arising from the baling process. Therefore in normal operation the only discharge to foul sewer is from the sanitary and domestic facilities.
- Occasionally there will be the need to discharge process water from the facility (e.g. during shutdowns for maintenance purposes or when periods of increased steam off-take with high condensate losses by the MOD leads to increased waste water from the water treatment plant) and for this purpose a neutralisation tank and water quality testing facilities are provided with a controlled discharge to the foul sewer to ensure compliance with the requirements of the trade effluent discharge consent for the facility.

11.6 Impact Assessment

11.6.1 The proposed development has in theory the potential to impact water resource features within the area. Impacts arising as a result of the development, both positive and negative, could affect the proposed development's ability to satisfy the criteria outlined within relevant local, national and European planning policy and legislation. The significance of any effect will depend on the sensitivity of the water resources and the current conditions of such resources, the magnitude of any impact and the implementation of any mitigation measures during construction and operation.

11.6.2 The impact assessment in this section takes into account the features incorporated into the design of the facility which offer 'incorporated mitigation' (see section 11.5). Additional mitigation measures to help to manage any identified impacts deemed to be significant are detailed in section 1.7.

11.6.3 As some of the impacts described can have a range of magnitudes, this assessment uses the precautionary principle in assessing the significance of the impact by considering the highest magnitude value where there is a range. The proposed mitigation is therefore based on the worst-case scenario and will also provide mitigation for lesser impacts.

11.6.4 It has been assumed that any construction effects are temporary and any operational effects are permanent, unless otherwise stated.

Effects During Construction

Mobilisation of Sediments

11.6.5 Unmitigated construction sites typically result in an increase in the mobilisation of sediments in surface water runoff from the development areas. This derives from the removal of vegetation, open soil surfaces, ground disturbance, stockpiles of soil and other construction materials, and the erosion caused by the movement of heavy plant and other traffic on temporary access roads or unprotected surfaces.

11.6.6 Higher sediment loads may be washed into local watercourses where sediment will start to settle. If the sediment load is sufficiently high, aquatic vegetation can be smothered, alterations may occur to the bed profile/conveyance of the channel, and/or can lead to the blockage of culverts or

other structures through which the water flows. In particular the construction of the new bridge and the air-cooled condensers have the potential to impact on the adjacent watercourses.

11.6.7 Where soils and/or sediments are contaminated from previous land use, the mobilisation of sediments may cause surface water pollution.

Contamination of Groundwater

11.6.8 Construction at the site will require the use and storage of hydrocarbons and other chemicals. The construction will also involve delivery of materials by heavy goods vehicles and the use of construction plant on the site.

11.6.9 Accidental spillage of hydrocarbons or other chemicals in any areas of the site could result in contamination of the shallow groundwater beneath the site.

11.6.10 Contamination could occur during the construction phase due to mobilisation of low levels of contaminants present onsite (e.g. dewatering, drawing shallow contaminated groundwater into deep excavations).

Contamination of Surface Water

11.6.11 As with potential contamination to groundwater, construction will involve the use and storage of hydrocarbons and other chemicals, along with the presence of delivery vehicles and mechanised construction plant. Accidental spillage of hydrocarbons or other chemicals in any areas of the site could rapidly lead to pollution of surface water runoff from the site either from hard-standing surfaces or via contaminated groundwater (see above).

11.6.12 Polluted water could be generated and enter watercourses through concrete washout or batching operations. Discharging cement based products or water polluted with concrete into any surface water body, groundwater or surface water drain without prior consent is an offence under the Water Resources Act 1991.

11.6.13 Where works are in close proximity to watercourses, silt run-off to watercourses could result, which may physically damage fish, smother vegetation and the river bed, alter the water's pH and/or mobilise pollutants.

11.6.14 If the amount of pollution were significant, or if the nature of the pollutant was toxic, such spillages could result in a significant deterioration in the water quality of runoff from the site. This in turn would impact upon the receiving waters and have the potential to cause adverse impacts on aquatic ecology.

Dewatering

11.6.15 The development will require excavation for the waste bunker. Groundwater levels on site indicate that this construction activity is likely to be within the water table. As a result there is potential for groundwater to seep into such excavations, and therefore, dewatering would be required to allow construction to continue.

11.6.16 This activity may impact surface water flows, draw in potentially contaminated water, open pathways between groundwater in the shallow superficial deposits and the deeper Secondary (B) Aquifer and result in contaminated water requiring appropriate disposal.

11.6.17 Table 11.7 provides an assessment of potential construction impacts prior to mitigation.

Table 11.7 Unmitigated Construction Phase Impacts

Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Likelihood	Risk
Erosion / Sediment Loading	Direct surface water runoff	Weston Mill Stream	Medium	Moderate	Moderate	Likely	Moderate
	Surface water flow via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Minor	Minor	Likely	Moderate / low
Reduction in Water Quality	Mobilisation of existing contamination	Weston Mill Stream	Medium	Moderate	Moderate	Likely	Moderate
	Mobilisation of existing contamination	Weston Mill Lake and the Tamar Estuary	Medium	Minor	Minor	Likely	Moderate / low
	Mobilisation of existing contamination	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Moderate	Not significant	Likely	Low
	Mobilisation of existing contamination	Deeper groundwater Secondary (B) Aquifer	Low	Moderate	Minor	Likely	Moderate / low
	Surface water runoff Direct discharge	Weston Mill Stream	Medium	Moderate	Moderate	Likely	Moderate

Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Likelihood	Risk
Reduction in Water Quality	Surface water runoff Direct discharge	Weston Mill Lake and the Tamar Estuary	Medium	Minor	Minor	Low	Low
	Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Moderate	Not significant	Low	Very low
	Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Moderate	Minor	Low	Low
Dewatering (Flow Alteration)	Infiltration through baseflow	Weston Mill Stream	Medium	Minor	Minor	Low	Low
	Infiltration through baseflow	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Moderate	Not significant	Unlikely	Very low
	Infiltration from shallow groundwater	Deeper groundwater Secondary (B) Aquifer	Low	Moderate	Minor	Low	Low

11.6.18 Table 11.7 indicates that the majority of impacts during the construction phase have been classed as moderate or lower. Sediment loading to Weston Mill Creek has been assessed as moderate risk with sediment loading to Weston Mill Lake being assessed as moderate to low risk. Impacts due to mobilisation of existing low levels of contamination on site and a reduction in water quality due to surface water runoff from the construction site have been assessed as moderate risk to Weston Mill Stream and moderate to low risk to Weston Mill Lake.

11.6.19 There is also a moderate risk to Weston Mill Creek in terms of a reduction in water quality from direct discharges of pollutants arising from the site during the construction phase. Excavation and piling activities are likely to require dewatering and therefore suitable mitigation measures will be implemented to prevent contamination of the Creek.

11.6.20 Piling activities required for the waste bunker and building foundations may extend down to the Secondary (B) Aquifer (Saltash Formation). Contamination of this Secondary Aquifer through the mobilisation of existing contamination within the made-ground during these activities has been classified as moderate to low risk.

Effects During Operation

11.6.21 On site and off site impacts to the water environment that could potentially arise during the operation of the EfW CHP facility are discussed below. Impacts are assessed with consideration of the incorporated mitigation measures inherent in the design of the EfW CHP facility (see Section 11.5).

Sediment Runoff Increase

11.6.22 The increase in built hard surface areas (e.g. concrete) can lead to flushing effects, whereby site runoff mobilises sediment accumulated over time. This sediment would then be discharged into the proposed drainage system or discharge to adjacent surface waters potentially leading to sedimentation in the channels, or smothering within the system. The potential effect of an increase in sedimentation over time could reduce channel capacity, and could cause an adverse ecological impact by smothering the bottom of the watercourse and cutting light infiltration. However, as the site surface currently consists of unconsolidated made-ground, it is considered unlikely that sediment loadings could increase through replacing these surfaces with hardstanding. Therefore, this issue has not been considered further within this assessment.

Contamination from Process Wastes

11.6.23 APC residues, IBA, waste oils and lubricants have in theory the potential to create contamination on and off site if operational practices are not managed effectively under the terms of the site Environmental Permit, for example in the unlikely event of an accidental spillage. These materials could both be flushed from the site as surface water runoff or by wind (i.e. litter) potentially affecting the local water bodies and shallow groundwater.

11.6.24 Any such contamination would likely remain within the shallow groundwater for longer periods than the tidally influenced local water bodies.

Pollution of Site Runoff by Oils and Hydrocarbons

11.6.25 Routine use / presence of lorries, cars and other vehicles across the site and on access routes and associated accidental spills or minor leaks all have the potential to contaminate runoff in the locality with hydrocarbons or other chemicals.

11.6.26 The incorporated mitigation includes drainage from hardstanding areas to be discharged via a Class 1 Oil Separator directly to Weston Mill Stream. This will reduce the potential for chemicals being flushed through the system during heavy rainfall events into the local water bodies. An isolation valve will be provided on the discharge outfall to control any discharge in critical events.

Pollution of Site Runoff by Gritting

11.6.27 Site access roads are likely to be treated with salt during winter periods for safety purposes to prevent ice forming on roads. During subsequent melts or rainfall this becomes entrained and dissolved in site runoff potentially polluting downstream receptors.

11.6.28 As the surface water receptors in the vicinity of the site are tidally influenced the degradation caused by the introduction of dissolved salts to the estuarine environment is likely to be very limited compared to a freshwater environment.

11.6.29 Furthermore, any gritting will not significantly increase over existing local levels and the periods of potential contamination will be limited to the winter months which tend to be associated with high rainfall resulting in greater levels of dilution than in the summer, therefore reducing the associated risk.

Contamination of Shallow Groundwater

11.6.30 Routine use of heavy goods vehicles, cars and other vehicles across the site, as well as oils and chemicals stored and utilised on site, all have the potential to create contamination which could, in theory, then infiltrate into the shallow groundwater either through cracks in hardstanding, or through runoff onto undeveloped areas. The risk will be reduced through the design of concrete to appropriate standards. In addition run-off will be directed to the drainage system with run-off from hardstanding areas passing through a Class 1 Oil Separator before discharge to Weston Mill Stream.

Contamination from Imported Waste

11.6.31 Waste imported to, and stored at, the site for processing has in theory the potential to cause contamination if not handled correctly. Any liquid wastes / leachates may seep into shallow groundwater through cracks in hardstandings or bunkers or runoff into local watercourses. Accidental releases of the waste, or waste leachates, to surface waters or groundwater could potentially cause deterioration of water quality and smothering and/or entrapment of aquatic ecology.

11.6.32 Any such contamination would likely remain within the shallow groundwater for longer periods than the tidally influenced local water bodies. The risk of contamination occurring will be reduced through storage of waste within buildings and design of concrete to appropriate standards.

11.6.33 Table 11.8 overleaf assesses the potential impacts on the basis of the facility design including the incorporated mitigation measures described in Section 11.5.

Table 11.8 Operational phase impacts including incorporated mitigation in the EfW CHP facility design

Source	Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Incorporated mitigation	Likelihood	Risk
Site (operations and storage)	Contamination by oils and hydrocarbons	Surface water runoff Uncontrolled discharge	Weston Mill Stream	Medium	Moderate	Moderate	Oils and hydrocarbons to be stored in accordance with Environment Agency guidelines in bunded areas.	Unlikely	Low risk
		Surface water flow via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Minor	Minor		Unlikely	Very low risk
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Moderate	Not significant		Unlikely	Very low risk
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Minor	Minor		Unlikely	Very low risk
	Contamination by process waste	Surface water runoff Uncontrolled discharge	Weston Mill Stream	Medium	Minor	Minor	Transfer of waste and waste handling within building Waste bunker constructed from reinforced impermeable concrete APC residues will be emptied into sealed pneumatically loaded	Unlikely	Low risk
		Surface water flow via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Minor	Minor		Unlikely	Very low risk

Source	Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Incorporated mitigation	Likelihood	Risk
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant	bulk powder carriers IBA will be loaded inside building and vehicle will be sheeted before leaving ash loading station	Unlikely	Very low risk
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Minor	Minor		Unlikely	Very low risk
Road Maintenance	Contamination by gritting	Surface water runoff	Weston Mill Stream	Medium	Negligible	Not significant	Not applicable	Likely	Low risk
		Surface water runoff	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Likely	Low risk
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant		Low	Very low risk
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Negligible	Not significant		Unlikely	Very low risk
Waste delivery and operation of plant	Contamination from delivery waste	Surface water runoff	Weston Mill Stream	Medium	Minor	Minor	Transfer of waste and waste handling within building	Unlikely	Low risk

Source	Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Incorporated mitigation	Likelihood	Risk
		Surface water Runoff via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Minor	Minor	Waste bunker constructed from reinforced impermeable concrete APC residues will be emptied into sealed pneumatically loaded bulk powder carriers IBA will be loaded inside building and vehicle will be sheeted before leaving ash loading station	Unlikely	Very low risk
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant		Unlikely	Very low risk
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Minor	Minor		Unlikely	Very low risk

11.6.34 Table 11.8 indicates the significance of effects on surface and groundwater receptors ranges from not significant to moderate. However, the assessment also shows that the risk of these effects actually occurring is either very low or low.

Flood Risk

Flood Risk Assessment

11.6.35 An FRA in line with PPS25 has been undertaken. The FRA is provided in full in Appendix 11.1 and summarised in the following sections.

Sequential and Exception Tests

11.6.36 The site is not allocated in the Plymouth Waste Development Plan Document (DPD) nor was it assessed in the Plymouth City Council Strategic Flood Risk Assessment (SFRA). The significant majority of this site is within Flood Zone 1 (low probability of flooding; i.e. land assessed as having less than 1 in 1000 annual probability of flooding in any year), except a small section of the proposed access road which falls within Flood Zone 2 (medium probability of flooding; i.e. land assessed as having up to a 1 in 1000 year annual probability of flooding in any year).

11.6.37 The proposed development is classified as 'less vulnerable' according to PPS25, Table D.2. PPS25 Table D.3 indicates that 'less vulnerable' developments are considered appropriate in all Flood Zones except Flood Zone 3b. The Exception Test is therefore not required.

11.6.38 It is considered that in terms of the Sequential Test the site of the proposed development compares favourably with Coypool, Moorcroft and Ernesettle, and is preferential to Chelson Meadow, in flood risk terms.

Flood Risk – To Development

11.6.39 PPS25 requires that all potential sources of flooding that could affect the proposed development be considered. This section considers all of the potential sources as listed in Annex C (Forms of Flooding) of PPS25.

Tidal Flooding

11.6.40 The Environment Agency has confirmed that the site is not within an area classified as benefiting from defences and that no records of historic flood events have been recorded at or in the vicinity of the site.

11.6.41 The Environment Agency Flood Map, together with the modelling undertaken identifies that the built development area of the site is located within Flood Zone 1. Proposed finished floor levels for the built development area are 9 m AOD, approximately 4.80 m above the modelled peak flood level for the tidal Flood Zone 3 including climate change scenario (4.19 m AOD).

11.6.42 The modelling undertaken indicates that parts of the access road, where the road runs parallel to the Weston Mill Viaduct fall within the tidal Flood Zone 2 extent and the Flood Zone 3 climate change (up to 2071) extent. Tidal flood depths during the Flood Zone 2 scenario are predominantly less than 0.3 m, increasing to between 0.3 m and 0.5 m during the Flood Zone 3 climate change (up to 2071) scenario.

11.6.43 During the flood peak the average flood depth and assumed velocity indicates no associated hazard within the flood extent during the tidal Flood Zone 2 extent and the Flood Zone 3 climate change (up to 2071), however the max hazard is 'danger for most'.

11.6.44 The modelling undertaken identifies that the site entrance at Wolseley Road is located within Flood Zone 1 for all tidal scenarios considered.

11.6.45 The upstream impact on flood levels resulting from the replacement of two existing access bridges (over the Weston Mill Stream) with a single open span bridge has been assessed during the hydraulic modelling. The results indicate that on average a 10 mm reduction in peak water levels is experience throughout the model extent when the bridges are removed from the model. Therefore the removal of the two access bridges is considered to have a negligible impact on flood levels upstream or downstream of the site.

11.6.46 Taking the above information into account the tidal flood risk posed to the built development area of the site is considered low. The tidal flood risk posed to the access road is considered medium.

Fluvial Flood Sources

11.6.47 The Environment Agency Flood Map, together with the modelling undertaken identifies that the built development area of the site is located within Flood Zone 1. The overall modelled peak fluvial flood level (3.58 m AOD) adjacent to the site is during the Flood Zone 3 including climate change (up to 2071) scenario, which is considerably less then the peak tidal flood level.

11.6.48 The modelling undertaken identifies that the onsite access road is located within Flood Zone 1 for all fluvial scenarios considered.

11.6.49 The modelling undertaken identifies that the site entrance at Wolseley Road is located within Flood Zone 1 during the fluvial Flood Zone 3 scenario. The entrance to the site at Wolseley Road is inundated for less than 4 hours over the flood peak, during the fluvial Flood Zone 2 and fluvial Flood Zone 3 including climate change scenarios after which dry access to the site via this route would again be available. During this 4 hour period, if required, alternative dry emergency access remains available via the dockyard to the south.

11.6.50 At the flood peak, during the fluvial Flood Zone 2 extent and the fluvial Flood Zone 3 climate change (up to 2071) scenario both the average and max flood depth and assumed velocity within the flood extent results in a flood hazard of 'danger for most'. However, flood depths greater than 0.3 m would only be experienced for limited periods of time over the flood peak (1.5 hours during the fluvial Flood Zone 2 scenario and 0.5 hours during the fluvial Flood Zone 3 including climate change scenario).

11.6.51 The modelling undertaken identifies that during the fluvial Flood Zone 3 event floodwaters, overtopping at the upstream Wolseley Road Culvert inlet would be contained within the subway void. Therefore, no floodwaters would flow down Weston Mill Drive during this scenario.

11.6.52 The modelling indicates that flooding is observed during the fluvial Flood Zone 2 scenario, and to a slightly lesser extent the Flood Zone 3 including climate change. Floodwaters flow down Weston Mill Drive to Wolseley Road to the east of Camel's Head Junction and then inundate the site entrance for a limited period of time over the flood peak (less than 4 hours), before dry access to the site is again available.

11.6.53 As previously mentioned, peak flood depths and the associated hazard would only be experienced for a short duration (less than 4 hours) over the tidal peak, after which flood waters would recede. Furthermore, the probability of a 1 in 1000 year fluvial event occurring over the 40 year life expectancy of the development is less than 4%.

11.6.54 Taking the above information into account the fluvial flood risk posed to the built development area of the site and the onsite access road is considered low and is not considered further within this assessment.

Overland Flow

11.6.55 Due to the urban nature of the catchment, overland flow generated within the catchment drains to the public and private sewer network. During events exceeding the design capacity of the system, sewers may become surcharged and overland flow may occur.

11.6.56 At the local scale, to the north and north-west of the site boundary in the vicinity of Barne Barton residential area the land rises steeply to a maximum elevation of around 40 m AOD. The land to the east and the south is relatively low lying, with ground levels in the region of 6 m AOD.

11.6.57 The Environment Agency has confirmed that the site is located within an area considered to be a Critical Drainage Area. The Critical Drainage Area map included in Appendix B of the FRA (Appendix 11.1) also highlights a series of reported incidents to the east of the site, where Weston Mill Stream passes under the railway line, through the Weston Mill Viaduct. However, there are no reported flooding incidents at the site of the proposed EfW CHP facility.

11.6.58 The Environment Agency Flood Map for Surface Water included in Appendix B of the FRA (Appendix 11.1) shows areas in the vicinity of the site potentially affected by surface water flooding during the 1 in 30 year and 1 in 200 year rainfall events.

11.6.59 The maps indicate that land to the north-west, north and north-east of the built development area of the site may be affected by surface water flooding. A drainage channel has been identified during the site walkover at this location. Surface water runoff from the surrounding land drains to the channel, which is located immediately north-west of the built development area. This drainage channel is thought to infiltrate into the subsoil or eventually drain into Weston Mill Stream via the Barne Brake Creek.

11.6.60 This drainage channel is located approximately 4m below the proposed finished floor levels of the built development. Therefore the risk posed by this flood source is considered low due to absence of a flow pathway.

11.6.61 The maps also indicate that parts of the access road, where the road runs parallel to the Weston Mill Viaduct, may also be affected by surface water flooding. This area is a natural low point where surface water is thought to pond after significant heavy rainfall. A small area of the access road at the junction with Wolseley Road is also shown to be affected by surface water flooding during the 1 in 200 year rainfall event.

11.6.62 The maps indicate that flood depths along these access routes are greater than 0.1 m but less than 0.3 m. Therefore the flood risk posed by surface water flooding to site access and egress routes is considered low.

11.6.63 Taking into account the above information, flooding on site from overland flow is considered to pose a low flood risk to the site.

Sewers

11.6.64 Sewer flooding occurs when the sewer capacity becomes exceeded or where a blockage occurs causing the sewer to surcharge and flood. South West Water (SWW) Internet Mapping has been consulted and identifies that no SWW assets are present within area of the site proposed for built development, however a foul sewer crosses the far north west of the site, located approximately 80 – 100 m from the proposed built development area.

11.6.65 All drainage and water supply in the dockyard is dealt with by Kelda Water Services. A review of the asset plan indicates that no surface water or foul drainage networks exist within the site boundary.

11.6.66 The proposed surface water drainage strategy for the development (see Section 11.7) will be completely separate from any of the HMNB Devonport or neighbouring developments' drainage systems.

11.6.67 Taking the above information into account the flood risk posed by sewer flooding is considered to be low and is not considered further within this assessment.

Artificial Sources

11.6.68 Artificial flood sources include raised channels such as canals or storage features such as ponds and reservoirs. There are no artificial flood sources close to the site. Therefore the flood risk posed by this flood source is considered to be negligible.

Groundwater

11.6.69 Groundwater flooding can occur when groundwater levels rise above the surface of a site. No groundwater level or historic flooding information has been provided by the Environment Agency to inform the FRA.

11.6.70 Groundwater levels recorded during the ground investigation undertaken by Geotechnics are between 5 m and 6 m bgl and are tidally influenced. When considering groundwater levels, together with the site's underlying geology and hydrogeology characteristics, the risk posed by groundwater flooding is considered low and is not considered further within this assessment.

Summary of Flood Sources

11.6.71 The Environment Agency Flood Map identifies that the new built development area of the site is located within tidal Flood Zone 1 (low probability of tidal flooding). Some parts of the access road, where the road runs parallel to the Weston Mill Viaduct, fall within the tidal Flood Zone 2 extent (medium probability of tidal flooding) and tidal flood Zone 3 climate change (up to 2071) extent. The overall flood risk posed to the built development area of the site by tidal flood sources is considered to be low. The tidal flood risk posed to the access road is considered medium.

11.6.72 The flood risk posed by fluvial, surface water, sewers, artificial flood sources and groundwater has been reviewed and is considered to be low to negligible.

11.6.73 As the proposed development will result in an increase in the hardstanding area on site compared with existing conditions, surface water runoff from the site will increase. Additional mitigation is required in the form of a surface water drainage strategy (see Section 11.7) to ensure surface water generated on site does not pose a flood risk to the development and third parties off site.

11.7 Additional Mitigation and Monitoring

Mitigation During Construction

11.7.1 Mitigation measures during construction will help to manage any identified negative impacts deemed to be significant. If possible, works should be avoided, or sensibly managed, during adverse ground and / or weather conditions occurring such as heavy rainfall.

11.7.2 The civil engineering contractor Kier has produced a number of documents which contain information regarding the techniques and methods that will be used to limit the impact of the construction phase on the water environment as follows:

- Outline Construction Environmental Management Plan (CEMP) – see Appendix 6.3;
- Method Statement for the installation of foundations for the Air Cooled Condensers – see Appendix 6.4;
- Method Statement for the construction of the new clear span bridge – see Appendix 6.5; and
- Method Statement for the construction of the Bull Point access road – see Appendix 6.6.

11.7.3 Where works during construction are likely to affect a local watercourse, Land Drainage Consent will be required from the Environment Agency under the Land Drainage Act of 1991 well in advance of construction commencing. This type of permission would for example, be required for the proposed clear span bridge to replace the two existing bridges crossing Weston Mill Stream and for the construction of the Air Cooled Condensers.

Mobilisation of Sediments

11.7.4 Specific guidance in dealing with silt arising from construction activities is contained within PPG5. A number of measures will be put in place in order to minimise the actual transport of silt into surface water features including:

- Installation of a temporary swale along the eastern side of the site, into which runoff can be directed to reduce silt and suspended solids before discharge into Weston Mill Stream.
- Bulk materials such as aggregate, topsoil and excavated material will be stored in designated areas away from watercourses. Where stockpiles have to be located in the vicinity of a watercourse a 7 m buffer strip should be in place to reduce pollution risks.

Contamination of Groundwater and Surface Water

11.7.5 The storage of polluting materials will be kept to a minimum where practicable, and where less hazardous or inert materials are available these should be specified. For example, the use of biodegradable hydraulic oils could be considered for construction plant.

11.7.6 Spill kits will be made available, and site operatives trained in their use, to deal with any spillages. All spill kits will be fully stocked at all times and an inventory of equipment within the container will be clearly displayed within the lid.

11.7.7 The positioning of fuel storage tanks and other potentially polluting materials and maintenance/refuelling facilities should be on bunded areas of hard standing with dedicated drainage systems. Stored materials on site will be checked regularly for containment integrity (both primary and secondary), quantity stored and security of storage.

11.7.8 Construction of concrete structures would be monitored to prevent associated contaminated material entering any watercourses. Pre-cast work will reduce the amount of in-situ concreting required adjacent and above the watercourses.

11.7.9 Washing out of concrete wagons or other equipment used in concreting operations will be undertaken in designated contained washout areas. These will be located away from all watercourses and drains and will be impermeable to prevent infiltration to ground.

11.7.10 Piling activities required for the waste bunker and building foundations may extend down to the Secondary (B) Aquifer (Saltash Formation). A Foundation Works Risk Assessment will be prepared by the Contractor to confirm that the risk of contamination of the Secondary Aquifer through the mobilisation of contaminants within the made ground is low with the proposed use of rotary bored piles. The risk assessment will be agreed with the Environment Agency.

Monitoring

11.7.11 Short term surveillance monitoring will be undertaken in advance of construction in order to establish a baseline. Further surveillance monitoring will then be undertaken during construction.

11.7.12 The short term surveillance monitoring should include specific water quality monitoring for shallow groundwater and surface water and assessment of existing WFD data regarding the ecological status of the Weston Mill Stream.

11.7.13 It is proposed that surveillance monitoring and water sampling is undertaken on a weekly basis at specific points; these inspections should include a visual inspection as well as measuring turbidity and pH levels. All records of water monitoring inspections will be kept on site throughout the duration of the project and be readily available for inspection. In periods of heavy rainfall or excessive vehicle movements within the vicinity, monitoring should be increased to reduce risks of pollution incidents. Appropriate spill kits/booms will be located nearby to ensure in the unlikely event of any incident, adequate protection is available.

Dewatering

11.7.14 It is proposed to raise the level of the site with inert selected granular material to provide a level platform at 9m AOD. This will minimise the extent of excavation into possible contaminated material whilst raising the deeper elements of the structure (the waste bunker) thus reducing the level of dewatering required during construction.

11.7.15 Ground water levels suggest the deeper portion of the bunker will be within the water table therefore dewatering will be required during construction. The optimum solution that has been developed by Kier and its consultants GHA Livigunn is to use a secant piled wall with grout curtain for the retaining walls of the waste bunker. When the retaining wall is completed the ground will be excavated within and well points and a temporary water pump will be installed until the base of the bunker is complete.

11.7.16 Where there is a requirement for disposal of pumped water due to dewatering activities, water will be discharged through a series of 'Siltbuster' settlement tanks, to remove potential contaminants, before it is allowed to enter the stream.

11.7.17 Permission for any dewatering activities will need to be sought from the Environment Agency under the terms of the Water Act 2003[7], well in advance of construction commencing. Dewatering activity licensed under the Water Act 2003, will control any potential dewatering operation and limit any impacts.

11.7.18 Table 11.10 provides a summary of mitigated construction phase impacts.

Mitigation During Operation

Pollution from Process Wastes

11.7.19 Emergency response plans will be prepared to ensure that minimal waste is released should an accidental spillage occur.

11.7.20 The surface water drainage scheme described above will also provide protection from waste that may accidentally enter the water environment.

Pollution of Site Runoff and Groundwater by Oils and Hydrocarbons

11.7.21 Any operational activities that carry significant risk of oils / hydrocarbon spillage must comply with Environment Agency guidance PPG1 and PPG5.

Pollution from Gritting

11.7.22 Salt gritting of local roads and the site will only take place at intervals when required during the winter period. Spreading should be minimal and carried out with due sensitivity.

Contamination from Delivered Waste

11.7.23 Emergency response plans will be prepared to ensure that minimal waste or leachate is released should an accident occur. Litter and detritus will be cleared up on a daily basis with particular emphasis on public areas. Any litter escaping the site or deposited by site users will be cleared up to a 10m distance from the site boundaries.

11.7.24 Implementation of these mitigation measures will ensure that residual impacts on the receptors are identified and their significance minimised. Table 11.11 provides a summary of mitigated operational phase impacts to the water environment.

Flood Risk Mitigation

11.7.25 Minimum finished floor levels of the building, access road and the soffit level of the new open span bridge should be set above the modelled tidal Flood Zone 3 including climate change (up to 2071) flood level (including 300 mm) freeboard (4.49 m AOD).

11.7.26 The proposed onsite access route is located outside of the fluvial flood extent for all scenarios modelled. Therefore any proposed level changes to the onsite access road would not diminish the fluvial floodplain, and therefore no floodplain compensatory storage is required.

[7] Available online at: http://www.defra.gov.uk/environment/quality/water/legislation/index.htm

Replacement of Existing Access Bridges

11.7.27 The modelling study demonstrates that the removal of the two access bridges will have a negligible impact on flood levels upstream or downstream of the site. However, in addition to the minimum bridge soffit level, the proposed single open span bridge abutments will be positioned to allow a 15 m wide channel, this channel capacity provides considerable betterment compared to the existing bridge structures. A drawing of the bridge design is provided in Figure 6.8.

Enhancement of Drainage Ditch

11.7.28 Enhancement of the existing drain ditch to the west of the site will be carried out in order to collect and convey surface water (generated on higher ground to the north-west of the site) to the Barne Brake Creek. The drainage plan provided in Appendix J of the Level 3 FRA includes an indicative route for the drainage channel enhancement.

Drainage Policy

11.7.29 PPS25 states that as well as assessing risk to a development, the risk of flooding arising from a development should be considered. In general, site development reduces the permeability of sites, increasing the volume and rate of water running off them, and potentially increasing flood risk to third parties. Therefore appropriate drainage arrangements are required for new developments to ensure that flood risk to others is not increased.

11.7.30 Annex F of PPS25 promotes the use of Sustainable Drainage Systems (SuDS) in new developments to ensure volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

11.7.31 Paragraph 5.54 of the PPS25 Practice Guide indicates that this should be achievable up to and including the 1% annual exceedance probability (1 in 100 years) event, including an appropriate allowance for climate change.

11.7.32 The following SuDS could be used within the site to restrict site runoff rates:

- **Filter strips and swales** - which are vegetated features that hold and drain water mimicking natural drainage patterns;
- **Basins and ponds** - to hold excess water after rain and allow controlled discharge that avoids flooding.

Outline Drainage Strategy

Hardstandings

11.7.33 The proposed drainage strategy provided below has been developed by GHA Livigunn. A drainage layout provided by GHA Livigunn is provided in Appendix J of the FRA.

11.7.34 Positive drainage will be provided to all hardstanding areas through the use of a combination of gullies, linear drains or channels and hard pipe. The surface water will pass through a Class 1 by-pass petrol interceptor (estimated size at this stage NSB20 - to be confirmed at detailed design stage) prior to being discharged to the tidal estuary of the river Tamar. An outfall structure complete with adequate flow calming measures and scour protection will be provided at the point of discharge. This new outfall structure will be located within the foot print of the site, the invert

level of the outfall pipe at the point of discharge will be set such that it is above the maximum tidal water level for a 1 in 200 years return period (i.e 4.48 m AOD - note that this level already includes an allowance for climate change and a 300 mm freeboard). Consequently the design of the surface water system will be based on free discharge flow conditions.

11.7.35 Please note that it is intended to provide an emergency cut-off valve immediately upstream of the outfall such as to prevent any water discharging to the environment in the event of an accidental spill on site.

Roof and walls

11.7.36 It is proposed to provide a drainage system to drain the run-off roof and wall rain water to an infiltration system. It is intended that the main building roof and wall surfaces will be drained to an infiltration basin whereas the workshop building, due to its size, will be drained to an infiltration trench.

Design conditions

11.7.37 The design of the drainage system will be based on the following performance criteria:

- Design return period of 1 in 30 years: No surcharge in the system is allowed;
- Design return period of 1 in 30 years including an allowance of 20% for climate change: Surcharge of pipe work is allowed but no surcharge of the manhole and no flood risk;
- Design return period of 1 in 100 years including an allowance of 20% for climate change: Surcharge of the manhole is allowed and flooding is allowed locally.

11.7.38 At this stage, preliminary sizing calculations have been carried out for both system and the results are presented below:

Roof and Walls Run-off Rain Water

11.7.39 Within these preliminary calculations, a rate of infiltration of 0.7 m/hr has been considered. The description of the made ground material tends to indicate a gravel/sand type of ground. Typical infiltration values for these type of soils range between 0.1 m/hr to 10 m/hr for sands and 10 m/hr to 1000 m/hr for gravels which tend to indicate that the infiltration value used is realistic and could be viewed as conservative. A regime of infiltration tests will be carried out on site to confirm the value to be used at detailed design stage. The ground water table is significantly affected by the tides, however, the anticipated top ground water level is circa 5 m below ground level. This is considered sufficiently low to allow infiltration to be considered.

Infiltration basin

11.7.40 The maximum volume of stored water in the basin in a 1 in 30 years return period and 20% climate change is approximately 381 m^3 (254 m^2 plan area). It is intended that during the 1 in 100 event, the basin with a coping level set slightly below the average level of the site would overspill in to the neighbouring land (the excess volume is in the order of 134 m^3) or an overflow will be provided which will direct all flows to the outfall (in this instance, an additional peak flow of 40 l/s will be discharged at the outfall in addition to the peak outfall flow from the hardstanding, see below).

Infiltration trench (workshop)

11.7.41 The infiltration trench required is 0.6 m wide, 2 m depth and 50 m long. Porous material is provided over a depth of 1.5 m. This preliminary sizing (to be confirmed at detailed design stage) should be sufficient for a 1 in 100 years return period event (including 20% climate change).

Hardstanding

11.7.42 The total contributing area is in the order of 11000 m^2. The expected peak flows are 249 l/s for a 1 in 30 (including 20% climate change) and 298 l/s for a 1 in 100 (including 20% climate change).

Table 11.9 Construction phase environmental impact with additional mitigation

Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Additional mitigation	Likelihood	Risk
Erosion / Sediment Loading	Direct surface water runoff	Weston Mill Stream	Medium	Minor	Minor	Installation of temporary swale into which runoff can be directed Bulk materials will be stored in designated areas away from watercourses	Low	Low
	Surface water flow via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Low	Very low
Reduction in Water Quality	Mobilisation of existing contamination	Weston Mill Stream	Medium	Minor	Minor	Foundation Works Risk Assessment will be prepared and agreed with Environment Agency Storage of polluting materials kept to a minimum Spill kits provided and site operatives trained in their use	Low	Low
	Mobilisation of existing contamination	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Low	Very low
	Mobilisation of existing contamination	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant		Low	Very low
	Mobilisation of existing contamination	Deeper groundwater Secondary (B) Aquifer	Low	Minor	Minor		Unlikely	Very low

Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Additional mitigation	Likelihood	Risk
	Surface water runoff Direct discharge	Weston Mill Stream	Medium	Minor	Minor	Fuel storage tanks and similar facilities will be on bunded areas of hardstanding with dedicated drainage systems Monitoring of construction of concrete structures to prevent contaminated material entering any watercourses Wash out of concrete wagons in designated washout areas away from watercourses and drains	Low	Low
	Surface water runoff Direct discharge	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Low	Very low
	Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant		Low	Very low
	Infiltration throug overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Minor	Minor		Unlikely	Very low

Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Additional mitigation	Likelihood	Risk
Dewatering – Flow alteration	Infiltration throug baseflow	Weston Mill Stream	Medium	Negligible	Not significant	Raising of site level minimises extent of excavation and reduces level of dewatering required Permission for dewatering will be sought from the Environment Agency under the Water Act 2003	Unlikely	Very low
	Infiltration throug baseflow	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant		Low	Very Low
	Infiltration from shallow groundwater	Deeper groundwater Secondary (B) Aquifer	Low	Minor	Minor		Unlikely	Very Low

Table 11.10 Operational phase environmental impact with additional mitigation

Source	Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Additional mitigation	Likelihood	Risk
Site (operations and storage)	Contamination by oils and hydrocarbons	Surface water runoff Uncontrolled discharge	Weston Mill Stream	Medium	Minor	Minor	Compliance with PPG 1 and PPG 5	Low	Low
		Surface water flow via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Unlikely	Very low
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant		Unlikely	Very low
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Negligible	Not significant		Unlikely	Very low
	Contamination by process waste	Surface water runoff Uncontrolled discharge	Weston Mill Stream	Medium	Minor	Minor	Emergency response plans will be prepared to ensure that minimal waste is released should an accidental spillage occur	Low	Low
		Surface water flow via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Unlikely	Very low

Source	Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Additional mitigation	Likelihood	Risk
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Minor	Not significant	Surface Water Drainage Scheme will provide protection from waste which may accidentally enter the water environment	Unlikely	Very low
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Negligible	Not significant		Unlikely	Very low
Road Maintenance	Contamination by gritting	Surface water runoff	Weston Mill Stream	Medium	Negligible	Not significant	Gritting will only take place at intervals when required during the winter period. Spreading will be minimal and carried out with due sensitivity	Low	Very low
		Surface water runoff	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Unlikely	Very low
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Negligible	Not significant		Unlikely	Very low
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Negligible	Not significant		Unlikely	Very low

Source	Nature of Impact	Pathway	Receptor	Sensitivity of Receptor	Magnitude of Impact	Significance of Effect	Additional mitigation	Likelihood	Risk
Waste delivery and operation of plant	Contamination from delivery waste	Surface water runoff	Weston Mill Stream	Medium	Negligible	Not significant	Emergency response plans will be prepared to ensure that minimal waste or leachate is released should an accident occur.	Unlikely	Very low
		Surface water Runoff via Weston Mill Stream	Weston Mill Lake and the Tamar Estuary	Medium	Negligible	Not significant		Unlikely	Very low
		Direct infiltration to ground	Shallow groundwater superficial drift deposits (unproductive strata)	Negligible	Negligible	Not significant		Unlikely	Very low
		Infiltration through overlying superficial drift deposits	Deeper groundwater Secondary (B) Aquifer	Low	Negligible	Not significant		Unlikely	Very low

11.8 Residual Effects

11.8.1 When taking into account the additional mitigation set out in Section 11.7, all effects for the construction and operation of the proposed EfW CHP facility can be mitigated to a minor level or less. Furthermore, when taking into account the likelihood of such effects occurring, which in all cases is low or unlikely, the associated risks are reduced to low or very low.

11.8.2 Incorporation of best practice during the construction works and during operation will reduce the potential for major pollution incidents to occur and thus protect surface and groundwater receptors.

11.8.3 The proposed drainage strategy will ensure that all runoff from the proposed development is channelled through an interceptor and is then discharged to the Weston Mill Stream (downstream of the new access bridge) via an outfall pipe. The system has been designed so that tidal locking does not occur. As the outfall is directly into tidal waters it is not necessary for the water to be attenuated and will not cause an increase in flooding issues elsewhere.

11.9 Conclusion

11.9.1 The site is located adjacent to the tidally influenced Weston Mill Stream, which flows to Weston Mill Lake, a tidal water body connected to the Tamar Estuary. These surface water receptors are classified as being of medium sensitivity. The underlying superficial deposits are shown to be Unproductive strata and are classified as being of negligible sensitivity. The bedrock below (Saltash Formation) is shown to be a Secondary (B) Aquifer and is classified as being of low sensitivity.

11.9.2 The Level 3 FRA demonstrates that the proposed EfW CHP facility built development site is located within Flood Zone 1, land considered to have a low risk of flooding. An area of the onsite access road in the vicinity of Weston Mill Viaduct is located within Flood Zone 2 unmitigated. However, implementation of proposed mitigation would reduce the risk of flooding posed to the access road to low.

11.9.3 The entrance to the site at Wolseley Road is inundated for less than 4 hours over the flood peak, during the fluvial Flood Zone 2 and fluvial Flood Zone 3 including climate change scenarios after which dry access to the site via this route would again be available. During this 4 hour period, if required, alternative dry emergency access remains available via the dockyard to the south.

11.9.4 The upstream impact on flood levels resulting from the replacement of two existing access bridges (over the Weston Mill Stream) with a single open span bridge has been assessed within the modelling study. The removal of the two access bridges is considered to have a negligible impact on flood levels upstream or downstream of the site.

11.9.5 As the proposed development will result in an increase in the hardstanding area on site compared with existing conditions, surface water runoff from the site will increase. A surface water drainage strategy has been developed to ensure surface water generated on site does not pose a flood risk to the development and third parties off site.

11.9.6 A number of potential impacts on the surface water and groundwater receptors have been identified as a result of the construction and operation of the proposed EfW CHP facility. Potential impacts include the risk of sediment migrating from the site into the identified surface water

receptors, the risk of groundwater and surface water contamination from oils and hydrocarbons, concrete, waste materials and existing contamination present on site within the underlying soils and groundwater. Potential impacts from dewatering activities during the excavation works include disrupting groundwater flows and the requirement for the disposal of pumped groundwater.

11.9.7 However, by employing appropriate construction techniques and good design principles these risks will be successfully mitigated.

11.9.8 The significance of the identified effects and their likelihood of occurrence has been systematically evaluated and mitigation measures for each of the impacts have been identified. When taking into account the mitigation measures, all effects for the construction and operation of the proposed EfW CHP facility can be mitigated to a minor level or less. Furthermore, when taking into account the likelihood of such effects occurring, which in all cases is low or unlikely, the associated risks are reduced to low or very low.

11.10 References

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