10 Contamination – Land and Water Quality

10.1 Introduction

10.1.1 This Chapter assesses the impact of the proposed development with respect to ground and groundwater contamination. In particular, it considers the potential effects of the disturbance of contamination and hazardous materials on human health and the environment, and the impacts of potentially contaminated ground or groundwater conditions on existing adjacent structures and the new development.

10.1.2 This Chapter describes the methods used to assess the impacts, the baseline conditions currently existing at the site and in the surrounding area, the potential direct and indirect impacts of the development arising from existing ground contamination conditions and hazardous materials, and the mitigation measures required to prevent, reduce or offset the impacts.

10.2 Relevant Legislation and Policy

Legislation and National Planning Policy

10.2.1 Environmental legislation applicable to this Chapter is included in Part 2A of the Environmental Protection Act 1990, Planning Policy Statement 23 (PPS23) *Planning and Pollution Control* and policy regarding groundwater is detailed within *Groundwater Protection: Policy and Practice* (GP3).

10.2.2 Part 2A of the Environmental Protection Act 1990 included the first statutory definition of "contaminated land" and conferred new responsibilities and powers on local authorities and (what is now) the Environment Agency to identify contaminated land and ensure that it is dealt with. For the purposes of Part 2A, contaminated land is defined as:

> *"any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land that:*
>
> *(a) significant harm is being caused or there is a significant possibility of such harm being caused; or*
>
> *(b) pollution of controlled waters is being, or is likely to be caused".*

10.2.3 PPS23 provides guidance on how the development of contaminated land can be controlled through the planning process. Historic land contamination is a material planning consideration which must be taken into account at various stages in the planning process, including proposals for the future use and redevelopment of a site. PPS 23 states that:

> *"the presence of contamination in land can present risks to human health and the environment, which adversely affect or restrict the beneficial use of land but development presents an opportunity to deal with these risks successfully and contamination is not restricted to land with previous industrial uses, it can occur on greenfield as well as previously developed land and it can arise from natural sources as well as from human activities"*

10.2.4 With regards to applications for new development, PPS23 advocates that *"in considering proposals for development, LPAs should take account of the risks of, and from, pollution and land contamination, and how these can be managed or reduced"* (para. 9).

10.2.5 PPS23 recognises that contaminated land can pose a serious risk to human health, property and the wider environment. Where land is contaminated, development can provide an opportunity to bring the land back into beneficial use for the benefit of the wider community. However, the significance of the risks to public health and safety and the natural and built environment means that land contamination is a material consideration in determining applications and *"it remains the responsibility of the landowner/developer to identify land affected by contamination and to ensure that remediation is undertaken to secure a safe development"* (para. 20). The local authority needs to be satisfied that *"the potential for contamination and any risks arising are properly assessed and that the development incorporates any necessary remediation and subsequent management measures to deal with unacceptable risks, including those covered by Part 2A of the EPA 1990"* (para. 20).

10.2.6 Annex 2 of PPS 23 advocates that it is the developer's responsibility to ensure that proposed development is safe and suitable for use for the purpose for which it is intended. It states that the developer should:

> *"carry out an adequate investigation to inform a risk assessment to determine:*
>
> - *whether the land in question is already affected by contamination through source – pathway – receptor pollutant linkages and how those linkages are represented in a conceptual model;*
> - *whether the development proposed will create new linkages, e.g. new pathways by which existing contaminants might reach existing or proposed receptors and whether it will introduce new vulnerable receptors; and*
> - *what action is needed to break those linkages and avoid new ones, deal with any unacceptable risks and enable safe development and future occupancy of the site and neighbouring land"* (para. 2.17).

10.2.7 The developer needs to show that *"unacceptable risk from contamination will be successfully addressed through remediation without undue environmental impact during and following the development"* (para. 2.18).

10.2.8 Part 4 of GP3 summarises the legislation relevant to the management and protection of groundwater and sets out the Environment Agency's associated and complementary policies. Section 9 sets out the land contamination policy and legal framework regarding land contamination and the protection of groundwater.

Regional Planning Policy

10.2.9 The Regional Spatial Strategy (RSS) for the South West 2006 - 2026 was first issued as a draft in 2006 and ongoing reviews resulted in a delay in the final publication. The coalition Government has also changed the role of regional spatial planning. Nevertheless, the draft documents give guidance to Local Planning Authorities when preparing their Local Development Documents (LLDs) as follows:

"LDDs should aim to maximise the opportunities for development within urban areas and in providing for development, priority should be given to the re-use of land which has been developed previously…"

"L*ocal authorities should consider the potential of previously developed land in terms of the best future use and appropriateness in relation to the development needs of individual settlements."*

"Development Policy H: Re-using Land. 'Local authorities will ensure that the full potential of previously used land is taken into account in providing for new development, whilst recognising that previously developed land may not always be in the most sustainable locations that development may not necessarily always be the most sustainable land use. For the region as a whole the aim should be to achieve at least 50% of new development on previously developed land (including the conversion of existing buildings)."

"Policy SD3: The Environment and Natural Resources. Planning and design of development to reduce pollution and contamination and to maintain tranquillity."

Local Planning Policy

10.2.10 The Local Development Framework (LDF) of Plymouth City Council comprises a number of documents detailing development policy for the city. Although the site of the proposed EfW CHP facility is not within the Area Action Plan (AAP) for Devonport 2006 – 2021, there is a reference within that AAP that is instructive for the purposes of this assessment:

"Use of the land over a number of decades by the Ministry of Defence makes it essential that detailed contaminated land assessments are undertaken and the necessary mitigation measures implemented before development takes place."

10.2.11 The Plymouth Waste Development Plan Document 2006 – 2021 sets out the local requirements for waste management for the next decade and includes a discussion of the development of an Energy from Waste plant. The document does not directly discuss contaminated land issues but identifies that locating the plant on previously developed land – such as the North Yard site – would be favourable.

10.3 Assessment Methodology

10.3.1 This section gives details of the impact assessment methodology adopted, including determination of magnitude and significance criteria, any guidance used and details of any limitations regarding methodology or available data.

10.3.2 Guidance on the risk assessment process is given in the Contaminated Land Reports 7 to 11 prepared by DEFRA, which also introduce the Contaminated Land Exposure Assessment (CLEA) model. The CLEA model is intended to be used as the common basis for contamination assessments in the UK.

10.3.3 With regard to pollution of controlled waters, the Environment Agency has prepared guidance on methods of assessment. These are contained in their Research and Development Publication No 20 'Methodology for the Derivation of Remedial Targets for Soils and Groundwater to protect Groundwaters' and in GP3 parts 1 to 4.

10.3.4 Underpinning both sets of guidance is a hazard-pathway-receptor methodology which is used to identify significant pollutant linkages (SPLs). The following definitions apply:

- Hazard: source of contamination.
- Receptor: the entity which is vulnerable to harm from the hazard.
- Pathway: the means by which the hazardous contamination can come into contact with the receptor.

10.3.5 Without a SPL the contamination may be a hazard but does not constitute a risk to human health or the environment.

10.3.6 Therefore, in assessing the potential for contamination to cause a significant effect, the extent and nature of the potential source or sources of contamination must be assessed, pathways identified, and sensitive receptors or resources identified and appraised, to determine their value and sensitivity to contamination related impacts.

Sources of Contamination

10.3.7 The following methods have been used to assess the magnitude of the sources of contamination:

- Consideration of previous land use: this includes the study of historic site maps and anecdotal information, covering both the site itself and the surrounding area.
- Review of ground investigation data, including chemical contamination data.

10.3.8 The magnitude of sources of land contamination can be described qualitatively according to the categories shown in Table 10.1 overleaf.

Table 10.1: Descriptive Scale for Magnitude of Extent and Potential Sources of Existing Land Contamination

Magnitude	Definition	Previous Land Uses
High	Site investigation data indicating widespread and/or severe localised contamination.	Previous or ongoing activity on or near to site with high potential to cause land contamination (e.g. gasworks, chemical works, landfill).
Moderate	Detectable localised soil contamination above threshold limits, identified during ground investigation.	Previous or ongoing activities with some potential to cause moderate contamination (e.g. railways, collieries, scrapyards).
Minor	No detectable contamination from site investigation work on the site OR Detectable but minor soil contamination. Soil quality standards less than threshold and unlikely to affect most sensitive receptors. Site investigation data detecting no significant contamination.	Greenfield site OR Previous or ongoing activities with low potential to cause contamination (e.g. residential, retail or offices).

Receptor Identification

10.3.9 The presence and sensitivity of receptors at risk from potential land contamination can be assessed by consideration of the following:

- Surrounding land uses, based on mapping and site visits and existing planning designations.
- Proposed end-use, based on the nature of the proposed development.
- Type of construction operations that will be necessary as part of the site development.
- Surrounding sites of nature conservation importance.
- Geology, hydrogeology and hydrology of the site and its surrounding area.

10.3.10 The sensitivity of potential receptors can be described qualitatively according to the categories shown in Table 10.2 overleaf.

Table 10.2: Sensitivity Criteria and Indicative Descriptive Scale for Sensitivity / Importance of Receptors

Sensitivity	Future Site Users Residents / Workers / Visitors	Surrounding Land Uses	Construction Workers	Ecological Sites	Built Environment	Groundwater	Surface Water
High	Residential, allotments or play areas	Residential, allotments or play areas	Extensive earthworks, and demolition of buildings	Nationally or internationally designated ecological sites	As above but of high historic value or other sensitivity	Principal	Surface water feature close to and in hydraulic conductivity with groundwater beneath site. Has good water quality and many licensed abstractions
Medium	Commercial landscaping or open space areas	Commercial landscaping or open space areas	Limited earthworks	Locally designated ecological sites	Buildings, including services and foundations	Secondary	Surface water feature within vicinity of site with poor water quality and no or few abstractions
Low	Industrial with hard standing i.e. car parking	Industrial areas	Minimal disturbance of ground	No sites of significant ecological value close by	Infrastructure (roads, bridges, railways)	Unproductive strata	No local surface water features

Significance Criteria

Prediction and Evaluation of Effects

10.3.11 If a significant hazard has been identified and potential sensitive receptors are present, then the potential impacts can be determined by considering the pathways whereby the hazard may impact upon the receptors. Table 10.3 overleaf indicates the most feasible potential impacts that

may generally occur in relation to development sites for different classes of receptor. During the assessment it will be assumed that there is (or will be during or after construction) a pathway present between the source and the receptor, unless there is a clear indication that this will not be the case.

Table 10.3: Potential Impacts of Land Contamination on Sensitive / Important Receptors

Receptor	Potential Impact
Future Site Users (residents/ workers / visitors)	Direct or indirect ingestion of contaminated soil, inhalation, dermal contact (operational) Concentration of flammable or asphyxiating in-ground gases in enclosed spaces (operational) Inhalation of harmful in-ground vapours indoors and outdoors (operational)
Surrounding Land Uses	Inhalation or deposition of wind-borne dust (construction stage) Migration of contamination in sub-surface strata (including gases) (operational and/or construction stage)
Construction Workers	Direct or indirect ingestion of contaminated soil and groundwater, inhalation, dermal contact (construction stage) Concentration of flammable or asphyxiating gases in confined spaces (construction stage) Inhalation of asbestos during building demolition (construction stage)
Groundwater	Leaching contaminants such as metals to the local aquifer Transport of contamination through groundwater to local surface water features or ecological sites
Surface Water Features	Contamination of local surface water features from site including via groundwater, from site run-off of from direct pollution.
Ecological Sites	Phytotoxic impacts on plant species (operational) Toxic impacts on fauna (operational) Indirect impacts via contamination of water resources (operational and/or construction stage)
Built Environment	Chemical attack of buried concrete structures (operational) Permeation of water supply pipelines (operational) Concentration of explosive gases above lower explosive limit (LEL) (operational)

10.3.12 The strength of pathway between a source and receptor is a function of the distance between the two and the ease or otherwise of the migration pathway. For example, on sites underlain by impermeable clays, the migration pathway via groundwater would be weak even over short distances, whereas within sands or gravels, the migration pathway would be strong for receptors in close proximity to a source and weak for receptors at some distance from the source.

10.3.13 For construction workers on contaminated sites, the pathway is invariably strong because they are likely to be in close proximity to the soils, particularly during ground works.

10.3.14 For industrial and commercial developments, where much of the ground may be covered in hard surfacing, the migration pathways for soil or water contamination are generally moderate or weak.

Significance of Effects and Associated Risks

10.3.15 A combination of the source and receptor rankings will provide an indication of the level of contamination on the site and the nature and severity of possible effects. It should be noted that both rankings may vary in the different scenarios being considered (i.e. baseline, construction and operation).

10.3.16 For sites where there is no (or very limited) site investigation data, this stage consists of comparing the magnitude of the hazard and the sensitivity of the receptor for each potential impact, using the qualitative descriptions outlined in Tables 10.1 and 10.2 above.

10.3.17 Where site investigation data is available, as is the case with the proposed EfW CHP facility project, the assessment of the magnitude of impact can be enhanced by an assessment of the testing results that exceed relevant contaminant screening levels for each particular type of impact. Appropriate screening levels are selected based on the nature of the hazard-pathway-receptor linkage and with reference to current published guidelines.

10.3.18 The likely significance of effects (before any mitigation) can then be assessed on the basis of the matrix as shown in Table 10.4 in conjunction with professional judgement of the site-specific factors that may be of relevance.

Table 10.4: Significance of Effects Matrix

Magnitude of source	Sensitivity		
	High	**Medium**	**Low**
High	Major (5)	Moderate (4)	Minor (3)
Moderate	Moderate (4)	Minor (3)	Slight (2)
Minor	Minor (3)	Slight (2)	Negligible (1)

NOTE:
Negligible and slight = Not significant in terms of the EIA Regulations 1999
Minor to major = Significant in terms of the EIA Regulations 1999

10.3.19 The severity of the potential significance (determined using the above matrix), and consideration of likelihood of an event occurring, can then be incorporated into a final risk based assessment. Likelihood would take into account both the presence and distribution of a particular hazard within the site as well as the integrity (strength) of the pathway between the hazard and receptor. Table 10.5 demonstrates the perceived likelihood of an event occurring and Table 10.6 provides details of the level of risk based on the combination of the likelihood of an event occurring and significance of effects. Descriptions to aid interpretation of the terms in Table 10.6 can be found in Table 10.7.

Table 10.5: Likelihood Matrix

Magnitude of Source	Strength of Pathway		
	Strong	**Moderate**	**Weak**
High	High	Likely	Low
Moderate	Likely	Likely	Low
Minor	Low	Low	Unlikely

Table 10.6: Risk Assessment Matrix

Likelihood	Significance				
	Major	**Moderate**	**Minor**	**Slight**	**Negligible**
High likelihood	Very high risk	Very high risk	High risk	Moderate risk	Moderate / low risk
Likely	Very high risk	High risk	Moderate risk	Moderate / low risk	Low risk
Low likelihood	High risk	Moderate risk	Moderate / low risk	Low risk	Very low risk
Unlikely	Moderate risk	Moderate / low risk	Low risk	Very low risk	Very low risk

Table 10.7: 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. It is relatively unlikely that any 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.

10.4 Baseline Conditions

Baseline Information / Data Sources

10.4.1 Unless otherwise noted, a (not unreasonable) assumption has been made that the baseline conditions presented in this report will remain unchanged at the time of construction.

10.4.2 The baseline information pertaining to the site and its surroundings has been derived from the following sources:

- Environmental Science Group (ESG), November 2005 report entitled *Phase 1 Land Quality Assessment: Blackies Wood, HMNB Devonport.* (ESG/05/033). Provided by the Ministry of Defence.
- Environmental Science Group (ESG), May 2006 report entitled *Phase 1 Land Quality Assessment: HM Naval Base Devonport Weston Mill*. (ESG/06/011). Provided by the Ministry of Defence.
- Report: *Preliminary Geological Assessment*. Devonport Dockyard by Scott Wilson for MVV (October 2009). Including Envirocheck Report Ref: 28953943_1_1.
- Ground Investigation Final Factual Report by Geotechnics (August 2010).

Site Walkover

10.4.3 A site walkover was undertaken on 4th September 2009 for the Scott Wilson 2009 report and the findings are presented in Table 10.8 below.

Table 10.8: Site Walkover Information

Site Name	Dockyard
Address	Weston Mill Lakes, Plymouth
National Grid Reference	SX 446 573.
Approximate Size (ha)	4
Site Setting	The site lies in the north of the dockyard area approximately 2km downstream of the Tamar bridge. The proposed development site is currently dissected in two by a road running approximately north-east to south-west. It is now understood that the proposed development is to take place in the northern section of the site only.
Occupiers	Ashcroft currently process demolition rubble in the northern section of the site[1], created from different construction projects throughout the dockyard prior to removal of site. It was noted that the lease agreement with the MoD requires the site to be returned to its original state on completion. During the site visit the compound was closed and a full walkover of this section of the site was not undertaken. The southern section is currently used as a storage compound for a variety of containers and skips.
Current Owners	Ministry of Defence (MoD)
Areas of Fill	Underlying the concrete rubble layer is made ground of unknown thickness, comprising material derived from a variety of construction projects since the mid 1990's. Further information on the ground conditions is given in Section 10.4.16 and Table 10.10.
General Ground Slope	The northern section[2] is relatively flat lying at an elevation of approximately 5m ODN (Ordnance Datum Newlyn). The southern section is a relatively flat lying area at an elevation of approximately 10m ODN (i.e. approximately 5m higher than the northern section).
Additional Comments	The raised area, southern section[3], is surrounded on all sides by embankments. The embankment to the south and south east, which leads to Weston Mill Lake is approximately 8m high, with an estimated slope angle of 45^{o} covered by grass and shrubs. At the base of the slope are a series of gabion baskets. To the north and west, the embankments are between 2-4m high with an estimated slope angle of 45^{o}. To access the site, two bridges cross the small creek to the east and appear to be constructed from a series of gabion baskets. These baskets show signs of bulging which could indicate movement of the banks.
Land Use to North	Overgrown scrub land with residential properties along Savage Road and Poole Park Road
Land Use to East	Overgrown scrub land, rail track and residential properties to north along Hamoaze Avenue and Wolesley Road and industrial land use to the south.
Land Use to South	Industrial 'southern section' including containers and parking and Weston Mill Lake.
Land Use to West	Overgrown scrub land and residential properties at Talbot Gardens.

[1] At the time of this writing (April 2011) Ashcroft had vacated the site.

[2] This refers to the general area on which the EfW CHP facility main building will be located.

[3] This refers to the area known as "Table Top Mountain" on which the construction compound will be located.

Site History

10.4.4 The following history of the site and surrounding area has been deduced from historical mapping obtained from the Landmark Information Group *Envirocheck Report* (Ref: 28953943_1_1) purchased for the Scott Wilson LQA October 2009.

10.4.5 The earliest available map from 1867 to 1870 shows the site to comprise the northern section of Weston Mill Lake and a viaduct of the Great Western Railway aligned north-south adjacent to the far east of the site. The site is bordered to the north by undeveloped fields and a small wooded area known as Barne Brake. An approximately 100m long quay (Barne Quay) is present in the centre of the site running approximately north-south into the lake. Several quarries are shown including Barn and Moor quarry approximately 100m to the north and an 'old' quarry approximately 100m to the west.

10.4.6 Few changes occur until the 1907 to 1908 shows that the Royal Naval Barracks have been developed to the south of Weston Mill Lake.

10.4.7 By 1919 a recreation ground has been developed on reclaimed land to the north of the Naval Barracks.

10.4.8 By 1972 the land to the north of the site has been developed into the residential area of Barne Brake and the large dockyard to the west of the Naval barracks has been developed.

10.4.9 The 1982 to 1985 mapping indicates that the land has started to have been reclaimed and large areas of the site are labelled as refuse tips.

10.4.10 The 1991 to 1993 map shows the site to be largely as it is seen today. The site and the area to the west has been fully reclaimed and developed with travelling cranes, sports courts and unlabelled buildings. A track / road runs approximately east-west across the site.

10.4.11 The 1999 map shows that a small amount of development has taken place and an unlabelled structure is present in the north of the site.

10.4.12 According to the Nuclear Decommissioning Authority (NDA) Website, nuclear operations at Devonport Dockland started in the early 1970's.

10.4.13 The Environmental Science Group Phase I report (2005) was undertaken within the area known as Blackies Wood. Blackies Wood is approximately 4 ha in area and is located in the north-western part of the site. The ESG report identified that Blackies Wood historically was a quarry to the north and south, that later become allotments. Part of Blackies Wood was also described as an 'incinerator area' and rail sidings were noted. In 1993, Blackies Wood was subject to an extensive ordnance clearance operation when over 35,000 pieces of ordnance were removed. These were originally collected from the site and surrounding area following extensive WWII bombings and buried in Blackies Wood.

Environmental Setting

Hydrology and Hydrogeology

10.4.14 The site is situated approximately 600m to the east of the River Tamar (Hamoaze) and is immediately adjacent to the north of the tidal Weston Mill Lake. The Weston Mill Stream (or

Creek) flows broadly from west to east, adjacent to the south east of the site and joins the Weston Mill Lake to the south.

10.4.15 According to the Envirocheck Report the site lies on a minor aquifer with soils with a high leaching potential. Minor aquifers are variably permeable and can be fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits. Although not producing large quantities of water for abstraction, minor aquifers are important for local supplies and in supplying base flow to rivers. The leaching potential designation (U – soil of high leaching potential) is based on soil information for restored mineral workings and urban areas and is based on fewer observations than elsewhere, a worst case vulnerability classification (H) has therefore been assumed for the site, unless / until proved otherwise.

10.4.16 The site does not lie within a Source Protection Zone as designated by the Environment Agency.

Geology: Determined from Background Information

10.4.17 According to the Envirocheck Report the solid geology beneath the site comprises basalt and spilite. Based on British Geological Survey (BGS) mapping at 1:10,000 scale sheet SX 45 NW (Saltash) provided in the ESG 2006 report, the underlying geology comprises Upper Devonian Shales of the Saltash Formation. These are mudstones and siltstones (shales) dipping toward the south (between 40 and 60 degrees) with a general east-west strike. This bedrock is overlain by inter-tidal alluvial sediments and made ground would be expected to be present beneath the site.

Geology and Hydrology Determined from Existing Ground Investigations

10.4.18 Table 10.9 is a summary of information from ground investigations carried out in the vicinity of the site, as given in the ESG 2006 report.

Table 10.9: Summary of Existing Ground Investigations

Report	Date	Location	Scope	Ground Conditions / Comments
DCES (FGE/2063)	September 1984	Approx 100m south of site	8No. boreholes	7m of made ground (rubble, brick and slate) over 22m of soft grey silt over shale bedrock
DCES (FGE/2062 Pt 3)	February 1985	On site and 100m south of site	Not given	Borehole on site encountered 6m of made ground (mainly shale, concrete and building rubble) over 4m of silt over shale bedrock.
DCES (G/0509)	January 1991	Adjacent to east of site	10No boreholes	Made ground up to 10m thick. Alluvium and soft silt up to 6m in thickness. Fill placed from 1972 to 1987 comprised demolition rubble. The fill behind the dockside at Weston Mill is engineered granular fill placed in the mid 1980's. Most of the alluvium was dredged and removed prior to the placement of the engineered fill.

Report	Date	Location	Scope	Ground Conditions / Comments
Aspinwall and co. (N3 05760)	July 1995	Adjacent to east of site	33No trial pits, 5No. boreholes	Up to 9.8m of made ground (slate fragments in a clay matrix and occasional cobbles and boulders of brick, concrete, metal, wood and granite). Soft silt up to 25m depth over shale bedrock. As, Cu, Zn were significantly elevated (above ICRCL). Also Pb and Hg were found to be elevated in isolated areas and asbestos was identified in one sample. Surface waters elevated in sulphate and chloride only.

Mining and Ground Conditions

10.4.19 According to the Envirocheck Report there have in the past have been two opencast quarries within the vicinity of the site, Barn Quarry (177m North) and Moor Quarry (200m North).

10.4.20 The ground risks determined from the Envirocheck data are:

- Low potential for shallow mining ground hazard.
- No hazard to moderate potential for compressible ground hazard.
- Very low to low potential for landslide ground hazard.
- Very low to moderate potential for running sand ground hazard.
- No hazard to low potential for shrinking or swelling clay ground hazard.

10.4.21 According to the Envirocheck Report, the site is in a radon affected area where 5 to 10% of homes are above the action level, therefore it is likely that basic radon protection measures will be required for new dwellings and extensions.

Regulatory and Environmental Data

10.4.22 There are a significant number (14 No. within 250m) of discharge consents within the vicinity of the site. The majority are licensed to South West Water for the discharge of treated sewage to the north of the site. There are also consents licensed to the dockyard to the southwest of the site, all discharging into surface water features including Weston Mill Lake and a tributary of the River Tamar (possibly Camel's Head Creek). It is possible that contaminants contained within the discharged waters may in the past have impacted the alluvium present beneath the site.

10.4.23 There are two water abstraction licenses within 500m of the site. These are both to the south where water is abstracted from the River Tamar (Hamoaze) for industrial cooling purposes. There are no surface or groundwater abstractions within the vicinity of the site for potable purposes.

10.4.24 Local Authority Pollution Prevention Controls (LAPPCs) within the vicinity of the site include for two petrol stations within 250m to the east and north and for the dockyard approximately 350m to the south.

10.4.25 Within 500m of the site there is only recorded one pollution incident listed in the Envirocheck Report. This was the release of crude sewage for the sewage works to the north of the site and is registered as a minor incident. This is unlikely to have impacted the site.

10.4.26 According to the report Radioactivity in Food and in the Environment (Rife-14), 2008, compiled by the Centre for Environment, Fisheries and Aquaculture Science on behalf of the Environment Agency, Food Standards Agency, Northern Ireland Environment Agency and the Scottish Environment Protection Agency, an incident occurred at Devonport involving an unauthorised release of liquid radioactive waste into the Tamar Estuary. This occurred after a hose transferring reactor coolant from HMS Trafalgar to a shore side tank was ruptured, releasing liquid contaminated with tritium and cobalt-60. Although the maximum amount of these radionuclides that could have been discharged was very small, additional sampling was carried out by both the Environment Agency and Food Standards Agency for confirmation. There was no increase in levels of these radionuclides in the environment or seafood.

10.4.27 Within 250m of the site the Envirocheck Report lists 4 No. potentially contaminative industries all of which are still active. There is a print works approximately 100m to the north east, a petrol station and used car sales garage approximately 180m east, and a repairs garage approximately 200m east. A further 12 No. are listed between 250m and 500m from the site. Provided these operate within Environment Agency Guidelines, the site should not be impacted.

Waste

10.4.28 There are two historic landfill sites registered on the site and a further one within 500m. The two located on site are known as HMS Drake Recreation Ground and Weston Mill Lake North. No further details of either landfill are given although from the mapping it appears that the HMS Drake Recreation Ground landfill lies predominately to the south of the site. The Weston Mill Lake Playing Field landfill is situated approximately 450m east and received industrial and household waste. The Environment Agency have been contacted as to whether more information is known about the material used to reclaim the site although at time of writing no response had been received.

10.4.29 One waste transfer site is present approximately 103m east of the site at Camel's Head Depot. No further information is given.

10.5 2010 Ground Investigation

10.5.1 An investigation of the site undertaken by Geotechnics, on behalf of MVV, during June and July 2010 identified the following;

10.5.2 The ground investigation comprised 29No. cable percussion boreholes up to 22.50m in depth (19No. of which with rotary follow-on to a maximum depth of 30m), 3No. trial pits up to 2.50m, and 20No. static cone penetration tests. A summary of the ground conditions encountered is presented in Table 10.10 below.

Table 10.10: Summary of Ground Conditions from 2010 Ground Investigation

Strata	Depth Range (m BG)L	Depth Range (m AOD)	Generalised Description
Made Ground	GL – 13.10	13.68 to -3.80	Grey silty sandy gravel with occasional cobbles. Gravel and cobbles of brick, concrete, limestone, flint with rare metal, wood and plastic fragments.

Strata	Depth Range (m BG)L	Depth Range (m AOD)	Generalised Description
Alluvium	6.60 – 22.30	0.32 to -14.57	Soft grey sandy, gravelly SILT/CLAY. Gravel of slate. Occasional wood and partially decomposed organic material and shells.
Saltash Formation	2.70 – 29.80	10.98 to -14.77	Extremely weak grey brown occasionally bluish SLATE. Occasionally interbedded with strong light grey tuff.

10.5.3 The encountered ground conditions are in line with those reported in existing ground investigations and support the case that demolition rubble was used to reclaim the land. Although during the time of reclamation (mid 1980's) historical mapping labelled refuse tips, only one location was found to contain household rubbish (TP3) and given that this is on the edge of the site it is possibly a result of fly tipping and is not representative of the made ground across the site.

Groundwater

10.5.4 Detail of groundwater encountered during the ground investigation and during post fieldwork monitoring, where installations were available, is given in Table 10.11 below.

Table 10.11: Groundwater Encountered During 2010 Ground Investigation

Exploratory Hole	Depth of Strike (m AOD)	Monitored Depth Range (m AOD)	Strata
BH1	0.64		Made Ground
BH1A	-1.58 and -8.88	1.67 - 2.21 (P1) 2.28 – 2.55 (P2)	Alluvium
BH2	-0.43	1.09 – 1.36	Made Ground
BH3	0.28	1.06 – 1.58	Made Ground
BH3	-12.92		Alluvium
BH6B	-2.20	1.48 – 2.00	Made Ground
BH7		4.10 – 4.50	Saltash Formation
BH8A		8.66	Saltash Formation
BH10	0.61		Made Ground
BH12	2.35		Made Ground
BH12A	0.33	2.21 - 3.16	Probable Alluvium
BH13	0.68		Made Ground
BH14	-0.93		Made Ground

Exploratory Hole	Depth of Strike (m AOD)	Monitored Depth Range (m AOD)	Strata
BH15	0.51	1.03 – 1.36	Made Ground
BH17	-0.50	1.97 – 2.04	Alluvium
BH18		1.26 – 1.60	Made Ground
BH19		1.00 – 1.30	Made Ground
BH21		1.43 – 1.48	Made Ground
BH22	0.43	0.65 – 1.06	Made Ground

Contamination

10.5.5 During the 2010 Geotechnics ground investigation evidence of contamination, such as odours, and potentially contaminating materials, were observed and are detailed in Table 10.12.

Table 10.12: Contamination Observed During 2010 Ground Investigation

Exploratory Hole	Depth (m BGL)	Observation
BH1	GL – 2.30	Metal fragments within Made Ground
BH1A	GL – 7.00	Ash within Made Ground
BH1A	9.5	Slight organic/hydrocarbon odour within alluvium
BH2	9.70 – 11.70	Slight hydrocarbon odour and sheen within Made Ground
BH2	11.70 – 15.50	Slight hydrocarbon odour within Made Ground
BH6B	0.25 – 1.80	Metal fragments within Made Ground
BH6B	6.50	Bitumen fragments
BH7	GL – 0.40	Rare slag within Made Ground
BH8	GL – 0.20	Railway hard core with black ash within Made Ground
BH9	GL – 7.30	Rare metal fragments within Made Ground
BH10	7.30 – 8.00	Tarmac within Made Ground
BH13	GL – 0.60	Tarmac within Made Ground
BH15	6.00	Hydrocarbon odour within Made Ground
BH19	12.20 – 15.70	Sulphur smell within alluvium
BH20A	GL – 13.10	Hydrocarbon odour within Made Ground
TP1	0.25 – 0.60	Wire fragments within Made Ground
TP1	1.10	Tarmac layer within Made Ground

Exploratory Hole	Depth (m BGL)	Observation
TP1	1.30	Cast iron fire grate within Made Ground
TP1	1.40	Thick stainless steel sheet within Made Ground
TP2	1.00	Fragment of suspected cemented asbestos within Made Ground
TP3	0.80	Layer of tarmac within Made Ground
TP3	1.60	Becoming ashy within Made Ground
TP3	2.40	Household refuse and odour within Made Ground

10.5.6 Chemical testing was undertaken on a total of 26No. soil samples from both made ground (22No.) and the alluvium (4No.) to determine the presence, nature, concentration and distribution of contamination at the site. All samples were analysed for Metals, Total Petroleum Hydrocarbon (TPH) and Tributyltin which is *inter alia* found in pesticides and fungicides, is used for preserving wood, and is a paint additive which in the past has been used in marine applications. Eleven samples were analysed for Polyaromatic Hydrocarbon (PAH) and fifteen for Cyanide, Soil Organic Matter (SOM) and pH. Volatile Organic Compound (VOC) and Semi-Volatile Organic Compound (SVOC) testing was undertaken on a total of fifteen samples and seven were analysed for Polycyclic Biphenyl (PCBs).

10.5.7 Leachate testing of all the above analytes was undertaken on eight of the samples and chemical testing of groundwater was carried out on 12No. samples.

10.5.8 Analysis of the results was undertaken by Kier Construction's civil engineering designer GHA Livigunn and a summary of the findings is given in Table 10.13 below.

Table 10.13: Analysis of Contamination Results by GHA Livigunn

Analysis of Contamination Results
Soil: The critical receptor is considered to be end users of the EFW facility. Total soil concentrations have been directly assessed against Soil Guideline Values (SGVs) published by the Environment Agency for a commercial / industrial land use where available and in their absence, Generic Assessment Criteria (GAC) developed by ERM in line with the CLEA Framework of documents. None of the samples have recorded concentrations exceeding the SGVs / GACs for a commercial / industrial land use. A fragment of cemented bound asbestos was identified at a single location during the intrusive works. Based on the findings of the ground investigation works, there is limited evidence of any widespread impact from asbestos.
Leachate: Leachable soil samples have been compared against published marine Environmental Quality Standards (EQS). A limited number of leachable soil samples identified only marginally elevated substances (1 sample for PAHs, 4 samples for Tin).

Analysis of Contamination Results

Groundwater:

Groundwater samples have been compared against published marine Environmental Quality Standards (EQS), where available, and drinking water standards in their absence.

Marginal and isolated exceedances of chromium and pH were detected at a single location.

Exceedances of tin and sulphate have been detected extensively across the site. Concentrations of tin have been recorded above the marine EQS in 9 out of 12 groundwater samples from across the site. Elevated tin concentrations were also detected in leachable soil samples obtained from site, however, tributyltin concentrations were not detected within any of the groundwater or leachable samples. Elevated sulphate concentrations have been detected within 8 out 12 samples.

Conclusions and Recommendations:

Based on the soil testing undertaken, it is considered unlikely that site soils represent a source of contamination and are therefore considered suitable to be retained on site for use within the works.

A Materials Management Plan will be produced in accordance with the CL:AIRE Waste Code of Practice to facilitate the re-use of excavation arising across the site.

A Construction Environmental Management Plan will be produced to set out the framework and requirements for the management of environmental impacts associated with the construction phase of the works.

Soils containing asbestos shall be reused, either at depth or beneath hardstanding.

The presence of hardstanding across the majority of the site will limit direct contact pathways to underlying materials.

Given the marginal and isolated nature of elevated chromium and pH, we do not consider the recorded groundwater concentrations of pH or chromium to represent a significant risk to the River Tamar, therefore remedial works are not considered necessary for pH or chromium.

The potential for tin and sulphate to pollute surface waters is considered to be low, insofar as they would be subject to substantial dilution at the estuary, and are of relatively low toxicity, however, further sampling, including surface water sampling, and modelling may be required to fully demonstrate this.

Whilst no extensive soil or groundwater impact has been identified from the intrusive investigations works, additional monitoring and sampling has been allowed for in the event unforeseen ground conditions.

An allowance has been made for disposal of unexpected soils not suitable for re-use categorised as hazardous materials. Allowance has also been included for the production of assessment reports including a Detailed Phase 1 Desk Study, a Controlled Waters Risk Assessment and a Contamination Assessment.

Pile arisings will require lime stabilisation to dry out and be suitable as engineering fill in the hard standing areas. We have made the assumption that the current stockpiles of crushed concrete from the Ashcroft crushing operation will no longer be on site during the start of the construction works. Retaining on-site materials will allow a cut and fill balance of +9m AOD.

The groundwater has high sulphate levels and as such measures have been included to allow for mitigation regarding disposal to the estuary as follows; Dewatering discharge may require treatment to ensure that it does not have any adverse impacts to receiving water bodies. Treatment may include, but is not limited to, sediment filtration, settlement or neutralisation. Final proposals will be dependent on further sampling during construction.

10.5.9 An independent assessment of the contamination results was undertaken by Scott Wilson using SW GAC's generated in-house using CLEA V1.06 (settings and results are presented in Appendix 10.1) for soils and EQS and DWS for leachate and groundwater results. The

assessment identified pH elevated i.e. alkaline across the site soils and also within leachates (ranging between 8.1 and 11.5 with an average of 10 in soil). Leachate testing revealed elevated ammoniacal nitrogen in all samples and tin was elevated in four samples. Given that tin was also found to be elevated within groundwater indicates that the made ground may be a source of tin contamination. PAH was elevated within 1 sample from BH20A at 5.00m depth and this corresponds to the detection of a hydrocarbon odour during the ground investigation.

10.5.10 The EQS value for some analytes is dependent on the hardness of the water. However, no carbonate analysis was undertaken and when compared to the most conservative EQS i.e. where the carbonate level is low, copper is found to be elevated. However, given that the EQS used is likely to be conservative and that concentration of copper is only just above this figure, the risk is considered to be very low.

10.5.11 It should be noted that if site won material is to be used on site but is not required for engineering purposes, for landscaped areas for example, then lime stabilisation and drying may not be required.

10.5.12 Although observations of potential hydrocarbons were identified during the ground investigation, the soil and groundwater analysis did not identify potentially harmful concentrations of TPH to be present at the site.

10.5.13 An area of the proposed development within Blackies Wood comprises an amenity space / nature reserve. There will be public access through this area. A site-specific human health risk assessment was undertaken by Scott Wilson with a view to assessing whether a potential risk might exist to visitors to this area. Appendix 10.2 presents a summary statement prepared as a formal record of the risk assessment undertaken. This treated the area north of Borehole BH3 to be a defined averaging area. Nine soil samples recovered from a depth range of 1 m to 5 m were assessed against site specific assessment criteria generated using CLEA version 1.06. The default residential land use exposure scenario was modified to consider the potential risk to visitors to this part of the site. The critical receptor was identified to be a female child of 0-6 years that might visit the area for up to 1.5 hours on 91 days in any one year. This was considered a reasonable (but conservative) assumption based on the age of the child and low likelihood of the child being unsupervised. A child of this age is considered the critical receptor due to lower body weight and hence higher potential impact of any contaminant uptake. Based on the soil quality data from the nine soil samples and the assessment assumptions, there is not considered to be a significant risk to human health. Asbestos was identified in one sample at 1 m depth in TP2 within the area and the Environmental Science Group report (2005) refers to some tipped asbestos at the surface. Asbestos contained within the soil profile below suitable cover was not considered likely to pose a risk if the soils were to remain undisturbed. Any asbestos at the surface would be identified, delineated and disposed of in accordance with statutory legislation.

Ground Gas

10.5.14 The following ground gas risk assessment was completed by Scott Wilson. Thirteen of the boreholes were fitted with installations to allow ground gas monitoring which took place during four site visits. Table 10.14 below, presents the maximum hazardous gas concentration (either CO_2 or CH_4), the maximum flow rate recorded and the Gas Screening Value, calculated in accordance with guidance from CIRIA document 665 *Assessing Risks Posed by Hazardous Ground Gases to Buildings* (C665) for each monitored borehole.

Table 10.14: Gas Risk Assessment

BH	Maximum Hazardous Gas Concentration (%)	Maximum Flow Rate (L/hr)	Gas Screening Value	Strata
BH1A (1)	1.1 (CH_4)	4.5	0.0495	Made ground
BH1A (2)	86 (CH_4)	4.5	3.87	Alluvium
BH2	1.6 (CO_2)	<0.1	0.0016	Made ground alluvium and slate
BH3	21 (CH_4)	-0.1	0.021	Made ground alluvium and slate
BH6B	1.2 (CO_2)	<0.1	0.0012	Made ground alluvium and slate
BH7	1.9 (CO_2)	<0.1	0.0019	Made ground alluvium and slate
BH8A	0.3 (CO_2)	<0.1	0.0003	Made ground alluvium and slate
BH12A	2.9 (CO_2)	<0.1	0.0029	Made ground alluvium and slate
BH15	1.9 (CO_2)	-0.1	0.0019	Made ground alluvium and slate
BH17	4.9 (CO_2)	<0.1	0.0049	Made ground alluvium and slate
BH18	0.6 (CO_2)	<0.1	0.0006	Made ground alluvium and slate
BH19	0.4 (CO_2)	-0.2	0.0008	Made ground alluvium and slate
BH21	0.2 (CH_4/CO_2)	<0.1	0.0002	Made ground alluvium and slate
BH22	1.1 (CH_4)	<0.1	0.0011	Made ground alluvium and slate

10.5.15 In accordance with C665 the development is assessed under Situation A. The worst case gas concentration in (methane BH1A (2) (from the alluvium)) and the maximum flow rate (4.5 L/hr) produces a GSV of 3.87 which equates to a Characteristic Situation of 4 'Moderate to high risk'. However, the range for this rating is between 3.5 and 15 i.e. the calculated GSV is only just within this range. In addition, this value is significantly higher than all the other calculated GSV and therefore is it considered more representative for this section of the site to be designated as a Characteristic Situation 3 'Moderate risk'. The remainder of the site has a GSV below 0.05 which equates to a Characteristic Situation 1 'Very low risk' where no special gas protection precautions are required.

10.5.16 In accordance with C665, for an industrial end-use with a high gas generation potential, a total of nine monitoring visits are recommended. Additional monitoring at the site, with particular attention to BH1A should be undertaken.

10.5.17 According to C665, sites with a risk rating of Characteristic Situation 3 require gas protection measures typically comprising the following measures:

- Reinforced concrete cast *in situ* floor slab (suspended, non-suspended or raft) with at least 1200 g DPM_2.
- Beam and block or pre cast concrete slab and minimum 2000 g DPM / reinforced gas membrane.
- Possibly underfloor venting or pressurisation in combination with a) and b) depending on use.
- All joints and penetrations to be sealed.
- Minimum 2000g DPM reinforced gas proof membrane and passively ventilated underfloor sub-space, or positively pressurised underfloor sub-space.

10.5.18 It is recommended that further monitoring and assessment is carried out across the site, and in the area of BH1A in particular, to enable an accurate characterisation of the site. Additional ground gas monitoring is currently underway in accordance with the methodology presented in Appendix 10.3.

10.5.19 The use of piled foundations may create a preferential gas pathway, if present, to the new development and special design requirements may be needed to account for this such as the use of gas venting or a positive pressurisation system. An example of the type of passive system that could be employed if required is presented in Appendix 10.4.

10.6 Initial Impact Assessment

10.6.1 Sources of potential contamination have been identified from historic maps, the Envirocheck Report, site reconnaissance and previous reports and ground investigations relating to the site.

On-site Sources

- Made ground from land reclamation and structure construction such as roads – variable contamination including metals, TPH, PAH, asbestos, possible radioactivity and ground gas.
- Alluvium – Ground gas.
- Quarry within Blackies Wood.
- Possible tipped asbestos (ESG, 2005).
- 'Incinerator area' (ESG, 2005).

Off-site Sources

- Quarries north of the site.
- Land filled areas adjacent to the south and 450m east – migration of leachates and hazardous ground gases.

- Former railway land to the north and east of the site – hydrocarbons, asbestos.
- Industry surrounding the site including a garage, filling station and printworks – Low potential source of metals and hydrocarbons including fuels, oils and lubricants and chemicals (from printing process) provided Environment Agency guidance is followed.
- Groundwater from off-site sources could pass beneath the site and may be a source of contamination.

Predicted Effects

10.6.2 This section outlines the human health and environmental risks to identified receptors arising from potential contamination sources currently on site or on adjacent land. It provides a qualitative assessment of the risks involved.

Risk to Future Site Users

10.6.3 Ingestion and inhalation of dust and soil particles, and ingestion, inhalation and dermal contact of contaminated drinking water, are the most likely pathways for contamination to enter the body, whereas dermal contact with soil particles is only likely when open wounds are present.

10.6.4 Future site users (including regular employees, site maintenance workers and visitors) are locally at risk from any contamination within the soils and groundwater. This will particularly be the case within areas of soft landscaping. Ground investigations have identified only localised areas of minimal soil contamination, including asbestos, and therefore the risk is low / moderate.

Risk to Construction Workers

10.6.5 There is potentially a risk from dermal contact and ingestion of contaminated groundwater on site which may be encountered such as during the excavation of trenches for new underground electricity cables. Ground investigations have identified only localised areas of minimal soil contamination, including asbestos, and therefore the risk is moderate to construction workers.

Risk to Adjacent Site Users

10.6.6 There is potentially a risk from dermal contact, ingestion and inhalation of contaminated dust released from site soils. Ground investigations have identified only localised areas of minimal soil contamination, including asbestos, and therefore the risk to adjacent site users is low.

Risk to Groundwater Quality

10.6.7 The site geology comprises a minor aquifer and the site does not lie in or near to a Source Protection Zone. However, it is considered that groundwater will be in continuity with local surface water features which have a higher sensitivity. Ground investigations have identified widespread contamination of tin and sulphate to already be present within groundwater and therefore the groundwater has a low sensitivity. The risk to groundwater is therefore considered to be low / moderate.

Risk to Surface Water

10.6.8 The risk to surface water is potentially significant i.e. moderate to high, given the close vicinity of the Weston Mill Stream and Lake and the River Tamar (Hamoaze). However, given the low level

of contamination identified during the gorund investigation, this can be reduced to low / moderate.

Risk from In-ground Gases

10.6.9 The risk of ground gas is low to high as ground investigation data has identified a potentially significant risk in one part of the site but a very low risk in the majority of the site.

Risk to Proposed Buildings and Below Ground Services

10.6.10 Some contaminants present in the ground or groundwater (hydrocarbons, solvents, ammoniacal nitrogen) can permeate through / corrode plastic pipe work and possibly contaminate water supplies. Plastic water supply pipes can be at risk of attack from oils and phenols and concrete can be subject to attack from sulphates in the ground. Existing ground investigation work has encountered groundwater contaminated with sulphates and therefore the risk is considered to be moderate.

Risk to Flora

10.6.11 Plants within proposed areas of soft landscaping may be at risk from phytotoxic contaminants within ground / made ground and groundwater. However, existing ground investigations have not identified significant levels of phytotoxic chemicals and therefore the risk is considered to be low.

Summary

10.6.12 Potential pathways created during construction, operational and decommissioning phases of the project are summarised within Table 10.15 below:

Table 10.15 Potential Construction, Operational and Decommissioning Phase Pathways

Receptor	Sensitivity	Comments
Construction / maintenance workers	High	Construction workers involved in below ground activities will have a high sensitivity as they have a high risk of coming into contact with contamination.
Adjacent site users	Low to medium	Neighbouring residents will have a greater sensitivity than those who work or visit neighbouring sites due to them spending a greater amount of time there.
Future site users	Low	Includes employees, visitors i.e. commercial setting receptor.
Existing built environment	None	N/A
New built environment	Medium	Includes the new development buildings, services, and landscaping.
Surface water	High	The River Tamar and Weston Mill Lake and Stream are within a close proximity of the site.
Groundwater	Low	Site lies on a major aquifer and within a source protection Zone 2.
Ecology		See Chapter 7

10.6.13 Of the above, it is considered that the most sensitive receptors will be construction workers and surface water features.

10.7 Incorporated Mitigation

10.7.1 The impact assessment (Tables 10.18, 10.19 and 10.20 that follow) assumes the incorporation of the following standard mitigation measures:

- Construction and operation in accordance with Pollution Prevention Guidelines (PPGs) (see Table 10.15 below);
- Licensing by the Environment Agency (EA) under the Environmental Permitting regime;
- All bulk storage tanks will be appropriately bunded and located on areas of hard standing;
- All wastes (including wastes to be delivered to the proposed EfW CHP facility) will be stored appropriately within the building; and
- All tanks, bunds, drains and hard standing will be inspected frequently for damage, maintained and remedial works conducted if necessary.

10.7.2 The Environment Agency has prepared a series of Pollution Prevention Guidelines to assist developers in the prevention of pollution. The most relevant guidelines are PPG6, PPG7 and PPG21. GP3 is also applicable. The main applicable aspects of guidelines are detailed in Table 10.16 below:

Table 10.16: Applicable Aspects of Relevant PPGs

PPG6: Working at construction and demolition sites	
Section 3: Planning and Preparation	In planning and carrying out any works, precautions must be taken to ensure the complete protection of watercourses and groundwater against pollution. These should include an investigation of past use of the site to ensure that operation will not disturb contaminated land and a survey of the sitting and contents of all storage tanks and pipelines. The Industry Profiles published by DETR will assist in identifying potential contamination and ways to reduce their impact, based on former industrial uses of the site. If there is any contaminated land on site, the local authority and local agency officer should be consulted on its remediation or disposal.
Section 4: Site Drainage	Foul Water: Foul water drains carry contaminated water to sewage works for treatment before discharge to a watercourse or soakaways. It may be possible to pump dirty water to a foul sewer, provided the approval of the water undertaker has been received. Where no foul sewer is available, alternative arrangements will be necessary for sewage disposal (Further guidance given in PPG4).
Section 5: Deliveries	Special care should be taken during deliveries, especially when fuels and hazardous material are being handled. Ensure that all deliveries are supervised by a responsible person, that storage tank levels are checked before delivery to prevent overfilling and that the product is delivered to the correct tank. Put in place a contingency plan and suitable materials to deal with incident. Ensure that employees know what to do in the event of a spillage. If properly dealt with, a spillage need not result in pollution.

Section 6: Storage	Many of the materials used in construction operations, such as oil, chemicals, cement, lime, cleaning materials and paint have the potential to cause serious pollution
	All fuel, oil and chemical storage must be sited on an impervious base with a bund and secured. The base and bund walls must be impermeable to the material stored and of an adequate capacity. Detailed guidelines concerning above ground oil storage tanks are available (PPG2 – Reference 7). Storage at or above roof level should be avoid. Leaking or empty oil drums must be removed from the site immediately and disposed of via a licensed waste disposal contractor (Further guidance given in PPG8).
	Removal: Before any tank is moved or perforated at the end of a contract or particularly during demolition works, all contents and residues must be emptied by a competent operator for safe disposal. Pipes may contain significant quantities of oil or chemicals, and should be carefully drained and then capped, or valves closed off to prevent spillage.
Section 7: Waste Management	Waste treatment and storage: All wastes must be stored in designated areas which are isolated from surface drains. Under some circumstances, for example if storing or treating materials from a contaminated site, a waste management licence may be required. Skips should be covered to prevent dust and litter being blown out and rainwater accumulation and should be provided so that wastes can be segregated for recycling or to prevent cross contamination. Used chemical containers may need special handling and the manufacturer's instructions should be followed. If plant maintenance is carried out on site, used oil should de stored in a bounded area for collection. Oil and fuel filters should also be stored in a designated bin in a bounded area for separate collection and recycling. Used oil filters are "special waste".
Section 9: Refuelling	The risk of spilling of fuel is at its greatest during refuelling of plant. Where possible, refuel mobile plant in a designated area, preferably on an impermeable surface and away from any drains or watercourses. Keep a spill kit available. Never leave a vehicle unattended during refuelling or jam open a delivery valve. Check hoses and valves regularly for signs of wear and ensure that they are turned off and securely locked when not in use. Diesel pumps and similar equipment should be placed on drip trays to collect minor spillages. These should be checked regularly and any accumulated oil removed for disposal.
Section 11: Emergencies	In the event of a spillage on site, the material should be contained (using an absorbent material such as sand or soil or commercially available booms) and notify the Agency immediately using the emergency hotline number: 0800 80 70 60
PPG7: Fuelling station construction and Operation	
Section 4: Disposal of surface water	All areas within the cartilage of a filling station should be positively drained on an impervious surface. Any joints in the surface must be adequately sealed and those sealants must be resistant to attack from petroleum and oil products.
	c. Surface water drainage from all areas, except uncontaminated roof water, must discharge through a full retention oil/petrol separator with a minimum capacity adequate to contain at least the maximum content of a compartment of a road tanker likely to deliver petrol at the filling station. Gullies draining to the separator should be the trapped type to prevent the spread of fire.
PPG21: Pollution Incidence Response Planning	
Response Planning	Regarding the sensitivity of groundwater on site, the detailed and informed plan may be produced to prevent any impact, following the PPG21 guidance.

GP3: Environment Agency Groundwater Protection Policy (See also PPG5)	
Part 4	To protect groundwater certain structures such as underground storage tanks and petrol stations will not be allowed to be constructed.

10.7.3 This summary table is not exhaustive of the information contained within the listed documents and we recommend that the complete documents are consulted.

10.7.4 MVV and it's contractors have agreed that the above will be followed during the design and construction of the proposed development.

10.8 Refined Impact Assessment

10.8.1 An assessment of the impact that the proposed development will have on these and other receptors is given in the following tables. The hazard ranking of sources has already been described in Section 10.3 and the sensitivity of the potential receptors in the vicinity of the site which may be affected by site contamination has been described in Table 10.16. Table 10.17 provides a matrix showing those sources and receptors for which potentially significant pathways exist. Finally Tables 10.18, 10.19 and 10.20 indicate the assessed significance of potential impacts for the construction, operation and decommissioning phases based on the sources, receptors and pathways identified, together with the level of the risk from each hazard upon the identified receptor prior to any mitigation measures.

10.8.2 It is a fundamental objective of the project that contaminated land should not cause significant effects. The required mitigation to achieve this objective is described in the various paragraphs following tables 10.18, 10.19 and 10.20.

Table 10.17: Identified Pathways between Sources and Receptors During Construction, Operational and Decommissioning Phases

Potential Receptors / Generic Sources	Construction / Maintenance Workers	Adjacent Site Users	Future Site Users	New Built Environment	Surface Water Features	Groundwater
Contaminated Soils	C/O/D	C/D	O	C/O	C/D	C/O/D
Contaminated Site Surface Water	C/O/D	C/O/D	O	C/O	C/O/D	C/O/D
Contaminated Groundwater	C/O/D	C/O/D	O	C/O	C/O/D	C/O/D
Contaminated Dust	C/O/D	C/O/D	O	N/A	N/A	N/A
Ground Gas	C/O/D	C/O/D	O	C/O	N/A	N/A

Note: *C indicates a pathway during the Construction Phase*

O indicates a pathway during the Operational Phase (post-construction)

D indicates a pathway during the Decommissioning Phase

Table 10.18: Construction Phase Impacts

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk
Contaminated soils **Minor hazard rating** due to lack of widespread contamination identified during ground investigation.	Inhalation, ingestion and dermal contact with contaminated soils	Construction Workers (H)	3	Strong	Low likelihood	Moderate / low
	Inhalation, ingestion and dermal contact with contaminated soils	Adjacent Site Users (L - M)	1 - 2	Weak	Unlikely	Very low
	Attack of concrete, water pipes and vegetation in landscaped areas	New Built Environment (M)	2	Strong	Low likelihood	Low
	Contamination of local surface water features via run off or groundwater	Surface Water Features (H)	3	Strong	Low likelihood	Moderate / low
	Contamination of minor aquifer	Groundwater (L)	1	Strong	Low likelihood	Very low
Contaminated site surface waters **Moderate hazard ranking** due to potential spills during development	Ingestion and dermal contact with contaminated water	Construction Workers (H)	4	Strong	Likely	High
	Ingestion and dermal contact with contaminated water	Adjacent Site Users (L - M)	2 - 3	Weak	Low likelihood	Low to moderate / low
	Attack of concrete, water pipes and vegetation in landscaped areas	New Built Environment (M)	3	Strong	Likely	Moderate
	Contamination of local surface water features via run-off	Surface Water Features (H)	4	Strong	Likely	High
	Contamination of minor aquifer	Groundwater (L)	2	Strong	Likely	Moderate / low
Contaminated groundwater	Ingestion and dermal contact	Construction Workers	4	Strong	Likely	High

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk
Moderate hazard rating due to identification of some groundwater contamination during ground investigation	with contaminated water	(H)				
	Ingestion and dermal contact with contaminated water	Adjacent Site Users (L - M)	2 - 3	Weak	Low likelihood	Low to moderate / low
	Attack of concrete, water pipes and vegetation in landscaped areas	New Built Environment (M)	3	Strong	Likely	Moderate
	Contamination of local surface water features	Surface Water Features (H)	4	Strong	Likely	High
	Contamination of minor aquifer	Groundwater (L)	2	Strong	Likely	Moderate / low
Contaminated dusts **Minor hazard rating** due to lack of widespread contamination identified during ground investigation.	Inhalation of contaminated dusts.	Construction Workers (H)	3	Strong	Low likelihood	Moderate / low
	Inhalation of contaminated dusts.	Adjacent Site Users (L - M)	1 - 2	Moderate	Likely	Low to moderate / low
Ground gases **Moderate hazard rating** some elevated concentrations identified during the ground investigation but not widespread	Inhalation of ground gases, explosive risk	Construction Workers (H)	4	Strong	Likely	High
	Inhalation of ground gases, explosive risk	Adjacent Site Users (L - M)	2 - 3	Weak	Low likelihood	Low to moderate / low
	Explosive risk	New Built Environment (M)	3	Moderate	Likely	Moderate

Table 10.19: Operational Phase Impacts

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk
Contaminated soils **Minor hazard rating** due to removal or remediation of contamination hotspots, if necessary, and placement of hardstanding.	Inhalation, ingestion and dermal contact with contaminated soils	Maintenance Workers (H)	3	Strong	Low likelihood	Moderate / low
	Inhalation, ingestion and dermal contact with contaminated soils	Site Users (L)	1	Weak	Unlikely	Very low
	Attack of concrete, water pipes and vegetation in landscaped areas	New Built Environment (M)	2	Weak	Unlikely	Very low
	Contamination of minor aquifer	Groundwater (L)	1	Weak	Unlikely	Very low
Contaminated site surface water **Minor hazard rating** due to controlled working practices and drainage.	Inhalation, ingestion and dermal contact with contaminated water	Maintenance Workers (H)	3	Strong	Low likelihood	Moderate / low
	Ingestion and dermal contact with contaminated water	Site Users (L)	1	Weak	Unlikely	Very low
	Ingestion and dermal contact with contaminated water	Adjacent Site Users (L - M)	1 - 2	Weak	Unlikely	Very low
	Attack of concrete, water pipes and vegetation in landscaped areas	New Built Environment (M)	2	Weak	Unlikely	Very low
	Contamination of local surface water features via run-off	Surface Water (H)	3	Weak	Unlikely	Low
	Contamination of minor aquifer	Groundwater (L)	1	Weak	Unlikely	Very low
Contaminated groundwater **Minor hazard rating** due to	Inhalation, ingestion and dermal contact with	Maintenance Workers	3	Strong	Low likelihood	Moderate / low

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk
reduction of infiltration pathway and soil contamination removal.	contaminated water	(H)				
	Ingestion and dermal contact with contaminated water	Site Users (L)	1	Weak	Unlikely	Very low
	Ingestion and dermal contact with contaminated water	Adjacent Site Users (L - M)	1 - 2	Weak	Unlikely	Very low
	Attack of concrete, water pipes and vegetation in landscaped areas	New Built Environment (M)	2	Strong	Low likelihood	Low
	Contamination of local surface water features	Surface water (H)	3	Strong	Low likelihood	Moderate / low
	Contamination of minor aquifer	Groundwater (L)	1	Strong	Low likelihood	Very low
Contaminated dust **Minor hazard rating** due to lack of widespread contamination identified during ground investigation.	Inhalation, ingestion and dermal contact with contaminated dusts	Maintenance Workers (H)	3	Moderate	Low likelihood	Moderate / low
	Inhalation of contaminated dusts.	Site Users (L)	1	Weak	Unlikely	Very low
	Inhalation of contaminated dusts.	Adjacent Site Users (L - M)	1 - 2	Weak	Unlikely	Very low
Ground gases **Moderate hazard rating** some elevated concentrations identified during ground investigation but not widespread, assumes protective measures put in place.	Inhalation of ground gases, explosive risk	Maintenance Workers (H)	3	Strong	Likely	Moderate
	Inhalation of ground gases, explosive risk	Site Users (L)	2	Weak	Low likelihood	Low
	Inhalation of ground gases.	Adjacent Site Users	2 - 3	Weak	Low likelihood	Low to moderate / low

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk
	explosive risk	(L - M)				
	Explosive risk	New Built Environment (M)	3	Weak	Low likelihood	Moderate / low

Table 10.20: Decommissioning Phase Impacts

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk
Contaminated soils **Minor hazard ranking** due to lack of widespread contamination identified during previous site investigation and remediation of any 'hotspots' prior to construction	Inhalation, ingestion and dermal contact with contaminated soils	Construction Workers (H)	3	Moderate	Low likelihood	Moderate / low
	Inhalation, ingestion and dermal contact with contaminated soils	Adjacent Site Users (L - M)	1 - 2	Moderate	Low likelihood	Very low to low
	Contamination of local surface water features via run off or groundwater	Surface Water Features (H)	3	Strong	Low likelihood	Moderate / low
	Contamination of minor aquifer	Groundwater (L)	1	Strong	Low likelihood	Very low
Contaminated site surface waters **Moderate hazard ranking** due to potential spills during decommissioning.	Ingestion and dermal contact with contaminated water	Construction Workers (H)	3	Strong	Likely	Moderate
	Ingestion and dermal contact with contaminated water	Adjacent Site Users (L - M)	2 - 3	Weak	Low likelihood	Low to moderate / low
	Contamination of local surface water features via run-off	Surface Water Features (H)	4	Strong	Likely	High
	Contamination of minor aquifer	Groundwater (L)	2	Strong	Likely	Moderate / low
Contaminated groundwater **Moderate hazard rating** due to potential reinstatement of infiltration pathway.	Ingestion and dermal contact with contaminated water	Construction Workers (H)	4	Strong	Likely	High
	Ingestion and dermal contact with contaminated water	Adjacent Site Users (L - M)	2 - 3	Weak	Low likelihood	Low to moderate / low

Source Hazard and Ranking	Potential Impacts	Receptor Sensitivity and Ranking	Significance Without Mitigation	Pathway Strength	Likelihood	Risk
	Contamination of local surface water features	Surface Water Features (H)	4	Strong	Likely	High
	Contamination of minor aquifer	Groundwater (L)	2	Strong	Likely	Moderate / low
Contaminated dusts **Minor hazard rating** due to lack of widespread contamination identified during ground investigation.	Inhalation of contaminated dusts.	Construction Workers (H)	3	Strong	Low likelihood	Moderate / low
	Inhalation of contaminated dusts.	Adjacent Site Users (L - M)	1 - 2	Moderate	Low likelihood	Low to very low
Ground gases **Moderate hazard rating** some elevated concentrations identified during the ground investigation but not widespread	Inhalation of ground gases, explosive risk	Construction Workers (H)	4	Strong	Likely	High
	Inhalation of ground gases, explosive risk	Adjacent Site Users (L - M)	2 - 3	Weak	Low likelihood	Moderate / low to low

10.9 Summary of Identified Impacts

10.9.1 For the contamination linkages in Tables 10.18, 10.19 and 10.20 which had a risk rating of either Moderate, High or Very High, the impacts are summarised below.

Contaminated Soils

10.9.2 Due to the lack of widespread contamination identified during the ground investigation, the risk to construction workers from contaminated soils is moderate / low although it is assumed that appropriate PPE will be utilised, including asbestos-grade face masks, during excavation works such as for the development of the new underground electricity cables. During the operational phase contaminated soil will not be exposed and therefore the risk is reduced, but there is a possibility that maintenance workers may open trenches and come into contact with contamination; again this should be mitigated against with the appropriate use of PPE.

10.9.3 During decommissioning the potential pathway to contaminated soils may be re-opened, with the removal of hardstanding, though remediation during the construction phase and appropriate use of PPE would mitigate against the risk.

10.9.4 Contaminated soils have a moderate risk potential to damage the new construction by chemical attack of the concrete and permeation of contamination through service pipes laid within contaminated soils. The ground investigation did not identify widespread contamination although a study of the soil aggressivity in terms of concrete design was not carried out. This study (required prior to construction but not in advance of a decision on the planning application) will show what grade of concrete should be used at the site or that a barrier membrane can be installed around concrete footings to prevent direct attack of the concrete.

10.9.5 Ground investigations at the site identified contamination within groundwater which is believed to have leached from the site soils and this poses a potentially high risk to local surface water features. Control of drainage during construction can reduce this risk and also the construction itself will result in an increase in the hardstanding across the site and will therefore reduce water infiltration and the leaching of contaminants.

10.9.6 The risk assessment showed that during the operational phase the risk was reduced to low i.e. the development will result in a risk that is less than is currently present.

10.9.7 During decommissioning the infiltration pathway may be re-opened, with the removal of hardstanding, though any soil remediation during the construction phase would have reduced the risk.

Contaminated Site Surface Waters

10.9.8 During construction site surface waters may become contaminated due to accidents and spills and because construction workers would, if such an accident were to occur, be likely to come into contact with this contamination, the risk is potentially high. The risk to local surface water features, i.e. the Weston Mill Lake and stream, is high due to potential contaminated run off. The risk to the new development is moderate. However, good site practices such as the use of drip trays and bunded areas for fuel storage should greatly reduce the likelihood of this occurring and the appropriate use of PPE would help to protect construction workers on site.

10.9.9 During operation the site would have adequate drainage and environmental control measures in place to limit the possibility of accidents and spills causing contamination and the risk would be reduced.

10.9.10 During decommissioning the risk would again be increased, due to increased activity at the site, although again good site practices, as illustrated in Section 10.5, would control this risk.

Contaminated Groundwater

10.9.11 Ground investigations have identified groundwater containing elevated levels of sulphate and tin and an isolated elevated concentration of chromium. During construction and decommissioning, ground workers may come into contact with groundwater and should therefore use PPE and maintain a high level of site hygiene to minimise the risk. The most likely contact between construction workers and groundwater will be during the excavation of the bunker which will be formed using a secant pile wall which will prevent water ingress.

10.9.12 The development will limit the pathway between site receptors and groundwater and also remediation works to site soils may reduce the concentration of contaminants in groundwater. During the operational phase this risk will be reduced as the majority of the site will be covered in hard standing, yet maintenance workers may excavate and come into contact with contaminated groundwater and should therefore be vigilant with the use of PPE.

10.9.13 Contaminated groundwater could impact the new development, particularly via chemical attack on concrete due to elevated sulphate levels. The facility should be protected from contaminated groundwater (which may also be tidally influenced) in some way, such as a protective membrane and/or adequate concrete design to protect concrete footings. The following was given in the analysis of the contamination results by GHA Livigunn:

> *"Dewatering: To minimise the impact to the excavation works from the tidal ground water level and taking into consideration the ground conditions, the optimum solution developed is to use a secant piled wall with grout curtain for the retaining walls of the receiving waste bunker. We have collectively reduced the size of the deep section of the bunker to reduce the risk of the obstructions present. 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 has been completed and watertight."*

10.9.14 There is a potentially pathway between groundwater beneath the site and the Weston Mill Lake, stream and the River Tamar (Hamoaze). Ground investigations have identified contaminants within groundwater which exceed guidance values for surface waters and therefore there is considered to be an existing contamination source. It is considered that the proposed construction will reduce this risk due to the significant amount of hardstanding proposed across the site which will prevent leaching from the made ground into groundwater.

10.9.15 Assuming the contamination source is made ground on the site, the development will reduce the amount of rainwater infiltration and reduce contaminant leaching.

10.9.16 Decommissioning of the site will again increase the rate of infiltration, assuming the hardstanding is removed, although soil remediation during the construction phase may have reduced or removed the contamination source.

Ground Gases

10.9.17 Gas monitoring has identified some very high gas concentrations in part of the site (in the vicinity of BH1A). Although the source is unclear, this may be due to organic-rich alluvium, but this was not found to be a widespread problem. During construction, ground gases can build up within excavations and pose a risk to construction workers. Further monitoring should reveal where the high risk areas are and measures such as personal gas alarms should be utilised in these areas to protect the workforce.

10.9.18 The use of piled foundations for the development has the potential to create preferential pathways for ground gas migration and the design of the proposed development must include measures to protect the development and future site users from ground gas hazards, if one is identified.

10.9.19 Dependent on the findings of further monitoring, gas membranes may be required to be installed into the floor slab of part of the proposed development to protect both the buildings and future site users. Other gas protection measures could include passive venting or the use of positive pressurisation; see Appendix 10.4 for an example of the type of passive system that could be employed if required.

10.9.20 During the operational phase there is the possibility that maintenance workers will open trenches at the site and could be exposed to hazardous ground gases. Gas protection precautions should be taken to protect maintenance workers.

10.9.21 During decommissioning there is less likelihood that confined excavations will be created, although if this is a possibility then gas protection measures should be put in place at that time.

10.10 Potential Mitigation and Monitoring Measures

Contaminated Soil

10.10.1 Previous ground investigations at the site have not encountered significant concentrations of contaminated soils and in addition, it is expected that the majority of excavated material, such as from excavations for the new underground electricity cables, should be suitable for re-use across the site. The proposed development will comprise a large proportion of hardstanding, i.e. tarmac and concrete cover. There will, therefore, be a reduced pathway between any contamination and site receptors.

10.10.2 The procedure for dealing with unforeseen contamination should be detailed in the site Construction Environmental Management Plan and if contamination is encountered during site works, it should be reported to the Local Authority and may require remediation.

10.10.3 A methodology will be applied for screening the ground for the presence of asbestos including the use of dampening to prevent fibres, if present, becoming airborne and a procedure must be established to appropriately dispose of any asbestos identified.

10.10.4 Remediation options for contaminated soil typically include removal to a suitable landfill site, remediation on-site or the placement of a 'clean cover system' in areas of soft landscaping. Imported soils for the clean cover system, or other fill materials required for the new development, must be free of contamination. All imported topsoil must comply with the Environment Agency's Soil Guideline Values (SGVs), generated using CLEA software, for

residential gardens and with BS 3882: 2007, Specification for Topsoil. In addition, the source and supplier of any imported materials must be provided to the Local Authority together with appropriate analysis certification. Further guidance can be found in report BRE 465. Soil sampling at the final formation level, within landscaped areas, will be required to validate the affectivity of the cover system.

10.10.5 Any excavated soils removed from site for disposal to a landfill should undergo Waste Acceptance Criteria (WAC) testing in order to correctly classify the material in terms of waste disposal. The results of the WAC testing should be supplied to the chosen waste acceptor at an early stage of the development in order to locate a suitable landfill site.

Contaminated Surface Waters

10.10.6 Contamination of site surface waters is most likely to take place during the construction and decommissioning phases of the development where accidental spills may occur. In order to minimise the chance of surface water contamination taking place, good site controls and working practices must be employed – further information can be found in Section 10.5 and the relevant PPGs.

10.10.7 It is recommended that a programme of surface water quality monitoring be undertaken in advance of and during construction in order to establish a baseline and to monitor water quality. This has been discussed with the Environment Agency and it has been agreed that it would be suitable for Plymouth City Council to require this under a planning condition.

Contaminated Groundwater

10.10.8 Previous ground investigations at the site have revealed groundwater beneath the site to be contaminated with sulphate and tin and isolated chromium and it is considered that the tin may come from leaching from site soils. In order to reduce the contamination of groundwater, measures including the placement of an impermeable cover across the site i.e. increased hard standing or the placement of a permeable reactive barrier down-gradient of the site, could be carried out. To protect the new development from contaminated groundwater, dewatering could take place or protective covers could be installed around concrete structures and services, or a suitably designed concrete mix should be employed.

10.10.9 Due to the close proximity of the Weston Mill Lake and Stream and the River Tamar, and potentially high ground water levels, contaminated groundwater is also likely to be impacting controlled watercourses. This risk, if present, is likely to be reduced by the development due to the increase amount of hardstanding and the remediation where required of contamination hotspots during construction.

Contaminated Dusts

10.10.10 The risk from contaminated dusts is considered to be low, due to the lack of contamination identified within site soils, and can be controlled with good working practices such as dust control measures during construction and decommissioning works.

Hazardous Ground Gases

10.10.11 The previous site investigation identified some areas of the site as having elevated levels of hazardous ground gases. These pose a risk to construction workers, particularly within confined

spaces such as excavations. Appropriate equipment can be employed to monitor the ground gas levels at the site.

10.10.12 In addition, to protect any new development from hazardous ground gases, a gas protection membrane can be installed. The membrane, if required, must be installed in accordance with the manufacturer's instructions, should not be damaged during installation and must be fully sealed, particularly where joints overlap and around service entry points. The membrane should pass beneath internal walls.

10.11 Residual Effects

10.11.1 The risk assessment tables above, and accompanying text, show that contaminated groundwater is likely to pose a residual effect to local surface water features. However, this risk is currently present and will not be exacerbated by the development, provided that good working practices are employed during the operation of the proposed EfW CHP facility. In addition, the potential impact will be at its highest during construction and decommissioning as, once the site is operational, there will be no 'pathway' between site users and the groundwater, providing flooding does not occur and this risk will be mitigated with the raising of the site level.

10.12 Conclusions

10.12.1 It is considered that, provided appropriate mitigation measures are employed during each phase of the development, the proposed development will not pose an increased risk to human health or the environment.

10.13 References

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