

**LAND SOUTH OF GLAN USK PRIMARY SCHOOL, HERBERT ROAD
NEWPORT**

ENVIRONMENTAL STATEMENT

**VOLUME 2
CHAPTER 9: GROUND CONDITIONS**

9. GROUND CONDITIONS

Introduction

- 9.1.1 This chapter of the Environmental Statement relates to the ground conditions and has been prepared by Terra Firma (Wales) Limited.
- 9.1.2 Terra Firma (Wales) Limited was retained to undertake relevant works to address planning conditions relating to Extant Consent 00/0768: Condition 5 site contamination; Condition 6 site investigation; Condition 7 certification report.
- 9.1.3 Extant Consent 00/0768 originally included both the site (land south of Glan Usk School) excluding the majority of Phase 1, and land to the north now developed as Glan Usk School.
- 9.1.4 All conditions were discharged with respect to Glan Usk School. Condition 7 was discharged with respect to Glan Usk School only under discharge of condition submission reference number 09/0591.
- 9.1.5 Condition 5 and 6 have been discharged for the site (land south of Glan Usk School) following the submission of Terra Firma (Wales) Limited reports: Geotechnical and Geo-Environmental Report 12032 dated March 2013 (see Appendix 9.1); Groundwater Monitoring Letter Report 12032 Letter 18 dated April 2014 (Appendix 9.2); Remediation Strategy Report dated August 2015 (Appendix 9.3).
- 9.1.6 Condition 7 for the site (land south of Glan Usk School) was not discharged as this cannot be fully realised until completion of the development.
- 9.1.7 The residential portion of the site was subsequently granted planning consent (planning reference 13/1279) for 250no residential units. This consent included Phase 1. The extent of Phase 1 is shown at Appendix 9.4. However it should be noted that Phase 1 will be implemented in accordance with the approved details of 13/1279 and is excluded from this application. However the conditions that are of relevance from this consent are: Condition 3 Remediation Strategy, Condition 10 Verification Report, Condition 20 Imported Materials.
- 9.1.8 Phase 1 has since been subject to investigative works relevant to the 13/1279 conditions. This information may be found in Terra Firma (Wales) Limited Geotechnical and Geo-Environmental Report 12032P1, dated February 2017 (see Appendix 9.4)
- 9.1.9 Current on-going earthworks are being undertaken in accordance with the approved Remediation Strategy Report dated August 2015. These earthworks are due to be completed in 2017.
- 9.1.10 Completion of remediation will not be achieved until conclusion of all phases of development. It is noted that the Council have agreed the remediation strategy in relation to

planning consent 13/1279 and as such it is considered that this remediation strategy is relevant to the site in its entirety. ?

9.1.11 All reports previously submitted with respect to 00/0768 and 13/1279 are equally relevant to this planning application as the remedial solutions remain the same. The remediation Strategy (August 2015) for the site, the Verification of Imported Materials report /the Soils Validation Report up to December 2016 have all been agreed and discharged in relation to 13/1279 and are attached at Appendix 9.3, and 9.9 . it is considered that further Verification Reports will be completed as the development progresses. As such the history of the site and the above documents demonstrate that the site has been subject to significant site investigation and remediation measures that are being fully verified to ensure that issues relating to contamination are being addressed and risks to human receptors minimised.

9.1.12 The resulting 13/1279 application verification report (Condition 10) will include information originally compiled under application 00/0768 and all future data acquired under application 13/1279

9.1.13 The purpose of this chapter is to undertake sufficient assessment to identify the nature and properties of the soils, underlying rock, ground water and gas within the development area and to assess the development impacts and the significance of these impacts on the environment. Appropriate mitigation measures are also proposed within this chapter to avoid and prevent the impacts identified.

9.1.14 The main objectives of the geo-environmental assessment were to:

- Identify the potential environmental liabilities at the site associated with any soil, surface water and groundwater contamination from past site uses.
- Provide a summary of the environmental conditions at the site, together with any necessary remediation works to render the site fit for its intended use.
- Provide recommendations with regard to any other geo-environmental aspects pertaining to the development such as radon and ground gas emissions

9.1.15 The main objectives of the geotechnical site investigation were to:

- Determine the type, strength and bearing characteristics of the shallow superficial deposits and underlying solid geology.
- Provide recommendations for a suitable and economic foundation/floor slab solution for the development.
- Provide recommendations with regard to any other geotechnical aspects pertaining to the development

Legislative and Planning Policy Context

9.2 Within the UK there are two areas of legislation in place to address contaminated land.

- The Planning Policy Wales (Edition 9, 2016)

- Part 2A of the Environmental Protection Act (1990)

Planning Policy Wales

9.2.1 The Planning Policy Framework ensures that through the planning process and application of planning conditions a site is only developed once it has been proved suitable for its new use taking account of ground conditions, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation; after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990. Planning decisions need to take into account:

- The potential hazard that contamination presents to development itself, its occupants and the local environment
- The results of a specialist investigation and assessment by the developer to determine the contamination of the ground and to identify any remedial measures required to deal with any contamination.

9.2.2 Where significant contamination issues arise, the local planning authority will require evidence of a detailed investigation and risk assessment prior to the determination of the application to enable beneficial use of land. Where acceptable remedial measures can overcome such contamination, planning permission may be granted subject to conditions specifying the necessary measures. If contamination cannot be overcome satisfactorily, the authority may refuse planning permission.

Part 2A of the Environmental Protection Act

9.2.3 On the 1st July 2001, the National Assembly for Wales enacted Section 57 of the Environment Act 1995, implementing Part 2A of the Environmental Protection Act 1990 (DEFRA). Part 2A provides a risk-based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment.

9.2.4 Under Part 2A the statutory definition of 'contaminated land' is:
" 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;"

9.2.5 Where land has been identified as meeting the statutory definition as being contaminated Part 2A considers that such land, where it is reasonable and practical to do so, should be remediated to ensure that it is suitable for its current use and no longer represents an unacceptable risk.

9.2.6 For land to be classified as 'Contaminated Land' there must be a 'pollutant linkage'. A pollutant linkage requires three essential elements:

Table 9.1: Pollution Linkage Essential Elements

Essential Element	Description
CONTAMINANT (hazard)	a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters
RECEPTOR (target)	something which could be adversely affected by a contaminant
PATHWAY	a route or means which either allows the contaminant to cause significant harm to that receptor, or that there is a significant possibility of such harm being caused to the receptor, or that pollution of controlled waters is being or likely to be caused

9.2.7 The term 'Risk' is widely used in different contexts and situations, but a prescriptive definition is given by the Guidelines for Environmental Risk Assessment and Management (DEFRA et al, 2000) 'Risk is a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence'. A 'Hazard' is defined as 'a property or situation that in particular circumstances could lead to harm'.

Approach and Assessment

9.3 The assessment of the site is carried out in successive stages to determine baseline conditions. As the findings of each stage are understood these may be used to inform and plan the next stage. The stages include the following:

- Preparation of a Desk Study
- Qualitative Geo-Environmental Risk Assessment
- Site Investigation
- Quantitative Human Health and Environmental Risk Assessment
- Geotechnical Assessment

The stages are described in turn in the following section:

Preparation of a Desk Study

A desk study provides the site with an identity, collating information relevant to the site so that it may be understood in the context of its geographical location, history, geological and environmental setting.

9.3.1 The Desk Study includes

- A walk over inspection of the site to obtain an accurate site description and to determine its current state. Any potential issues such as potential contamination sources or receptors to contamination are also identified.
- Review of previous site investigation reports produced for the site produced by other parties

- Review of Ordnance Survey historical plans of the site and surrounding area to determine the past use and occupation of the site. This includes identifying any past uses that may potentially have been a source of contamination.
- Identification of the anticipated ground conditions beneath the site including soil types, bedrock and likelihood of the presence and type of made ground by reference to geological maps and historical plans.
- Consideration of the hydrological and hydro-geological environment beneath and around the site including identification of current drainage, nearby water bodies, suspected groundwater flow regime and the aquifer properties of the underlying soils and bedrock.
- Procurement of a BR211 Radon Report from the British Geological Survey.
- Search on the Environment Agency online 'What's in Your Back Yard' database to obtain information including any known pollution incidents on or close to the site, the presence of any historical or active landfill sites within 250m of the site, risks from flooding, and whether the site situates within a groundwater source protection zone.

9.3.2 The Desk Study is summarised in the Baseline Conditions section of this Environmental Statement.

Qualitative Geo-environmental Risk Assessment

9.3.3 The Qualitative Geo-environmental Risk Assessment is completed using the information gathered through the desk study together with consideration of the end use of the site. The purpose of the Qualitative Geo-environmental Risk Assessment is to identify the potential sources of contamination, potential pathways by which contamination may travel and the potential human and environmental receptors of any identified contamination. The assessment also considers the risks from landfill, radon and ground gas to future site end users.

9.3.4 A qualitative risk based approach is adopted using the guidelines provided from DEFRA's Guidelines for Environmental Risk Assessment and Management. For the assessment of contamination there must be a potential source, a receptor and a pathway linking the two. The likelihood and consequence of this combination results in an overall risk. The definition of consequence, probability and the risk matrix is outline in Tables 9.1, 9.2 and 9.3 below.

9.3.5 The assessment looks only at potential negative, or adverse potential risks and impacts, not beneficial risks/ impacts.

Table 9.2: Classification of Consequence

Importance	Description
Very high	Short term (acute) risk to human health likely to result in significant harm Short term risk to controlled waters Catastrophic damage to buildings/structures Short term risk to an ecosystem or organism within the particular ecosystem
High	Chronic damage to human health (long term risk)

	Pollution of a sensitive water resource A significant change in an ecosystem or organism within the ecosystem
Medium	Pollution of non-sensitive water resources Significant damage to buildings/structures
Low	Harm (not necessarily significant) which may result in financial loss Non permanent health effects to humans (easily prevented by PPE for example) Easily repairable effects of structural (building) damage

Table 9.3: Classification of Probability

Importance	Description
Major Adverse	There is a complete pollution linkage and an event appears very likely to occur in the short term and is inevitable in the long term Evidence of harm to the receptor
Moderate Adverse	There is a complete pollution linkage which means that it is probable that an event will occur The event is not inevitable but possible in short term and likely in the long term
Minor Adverse	There is a complete pollution linkage and circumstances are possible under which an event could occur It is not certain that an event will occur in the long term, and it is less likely to occur in the short term
Negligible	There is a complete pollution linkage but circumstances are such that it is improbable that an event would occur even in the long term

Table 9.4: Risk Assessment Matrix

Probability	Consequence			
	Very high	High	Medium	Low
Major Adverse	<i>Major Adverse</i>	<i>Moderate/ major Adverse</i>	<i>Moderate Adverse</i>	<i>Moderate/ minor Adverse</i>
Moderate Adverse	<i>Moderate/ major Adverse</i>	<i>Moderate</i>	<i>Moderate/ minor Adverse</i>	<i>Minor Adverse</i>
Minor Adverse	<i>Moderate Adverse</i>	<i>Moderate/ minor Adverse</i>	<i>Minor Adverse</i>	<i>Minor Adverse /negligible</i>
Negligible Adverse	<i>Moderate/ minor Adverse</i>	<i>Minor Adverse</i>	<i>Minor Adverse /negligible</i>	<i>Negligible</i>

9.3.5 The overall description of high to negligible risks are described as follows:

- Major Risk: There is a high probability that severe harm could risk a receptor, or there is evidence that a receptor is being harmed. The risk if realised is likely to result in liability, and urgent investigation or remediation will be required.
- Moderate Risk: It is probable that harm will arise to a receptor. However it is relatively unlikely that such harm would be severe, or if harm does occur the harm is likely to be relatively mild. Investigation will be required to determine the liability, and some remedial works may be required in the long term.

- Minor Risk: It is possible that harm may arise to a receptor, but it is likely that the harm would be mild.
- Negligible Risk: There is a very low risk of harm to the receptor. In the event of harm being realised the harm is not likely to be severe

9.3.6 The Qualitative Geo-Environmental Risk Assessment for the site is summarised in the Baseline Conditions section of this Environmental Statement.

Site Investigation

9.3.7 The desk study and risk assessments are used to design a site specific investigation to investigate the ground conditions and obtain the information required to perform a quantified human health and environmental risk assessment. This takes in to account the findings of previous site investigations carried out on site and any historical site remediation.

9.3.8 The geo-environmental aspect aims to gain soil and groundwater/surface water chemical data from across the site by widespread sampling and by targeted sampling of site soils at locations of known potential contamination sources. It also includes in-situ gas monitoring to assess the presence of any potentially harmful gases.

9.3.9 Geo-environmental investigation should be carried out in accordance with established procedures as set out in:

- BS 10175: 2001: 'Code of Practice for the investigation of potentially contaminated sites.'
- BS 5930: 1999: 'Code of Practice for Site Investigations'.
- Contaminated Land Exposure Assessments (CLEA) and Contaminated Land Reports published by DEFRA (Department for Environment, Food and Rural Affairs).
- CIRIA C665: 2007: Assessing risks posed by hazardous ground gases to buildings

9.3.10 The findings of the Site Investigation are detailed in the Baseline Conditions section of this Environmental Statement.

Quantitative Human Health and Environmental Risk Assessment

9.3.11 The data gathered from the site investigation is collated and assessed against regulatory guidelines in order to determine whether the site or areas of the site are contaminated. This enables a Quantitative Human Health and Environmental Risk Assessments to be completed, identifying the potential impacts of the proposed development.

9.3.12 Soil analytical results are compared to Soil Guideline Values sourced from The Environment Agency Contaminated Land Exposure Assessment (CLEA) Guidelines. Where SGV values are not available reference is made to the 2015 residential (including plant uptake) Suitable 4 Use Levels (S4ULs) provided by Land Quality Management Limited and the Chartered Institute of Environmental Health (CIEH) or Category 4 Screening Levels (C4SLs). Sulphate

results are compared to British Research Establishment (BRE) guidelines as sulphate levels need only be considered for buried concrete risk assessment only, not human health related.

- 9.3.13 The groundwater/surface water chemical data is used to assess whether any contamination has had a detrimental impact on the aquatic environment.
- 9.3.14 Water analytical results are compared directly to generic thresholds provided by the UK Water Framework Directive (WFD), and to the BRE standard for sulphate. Where WFD guidelines are not available UK Drinking Water Directive (DWD) guidelines are used.
- 9.3.15 The results of the Quantitative Human Health and Environmental Risk Assessment will confirm the severity of contamination at the site and represent the potential impacts to the proposed development.
- 9.3.16 The Quantitative Human Health and Environmental Risk Assessment is detailed in the Assessment of Potential Impacts section of this Environmental Statement.
- 9.3.17 The Mitigation Measures section of this Environmental Statement details the proposed mitigation and remedial measures required to protect against contamination identified as presenting a potential risk in the Quantitative Human Health and Environmental Risk Assessment.

Geotechnical Assessment

- 9.3.18 The ground conditions at the site are identified through the site investigation and Quantitative Human Health and Environmental Risk Assessment and included in the Assessment of Potential Impacts section. The assessment of the ground conditions will enable the most suitable foundation solution to be determined.

Baseline Conditions

- 9.4 The baseline conditions detailed in the following sections are based on the following:

Table 9.5: Terra Firma (Wales) Limited Investigation Reports

Report	Report Date
Geotechnical and Geo-Environmental Report 12032	March 2013
Groundwater Monitoring Letter Report - 12032 Letter 18	April 2014
Geotechnical and Geo-Environmental Phase 1 Report 12032P1	February 2017

Site Walk Over Survey

- 9.4.1 Based on site visits made by Terra Firma (Wales) Limited during October and November 2012 the site was noted to have three distinct areas. The area north of the drainage reën comprised undulated ground surfaced with grass. The main body of the site was covered with dense vegetation and rough hardstanding. Rough grassland/overgrown vegetation and a tarmac cycle path/access road runs southwards from the reën along the western edge of the site.
- 9.4.2 During earthworks in 2016 the area north of the drainage reën was slightly reduced in level with strip off of the topsoil, which now remains stockpiled along the eastern edge of this area, and re-use of underlying soils on the area south of the reën as fill during earthworks. This area has remained unchanged since.
- 9.4.3 The earthworks within the main area of the site is on-going and the raise in level is partially complete. Site level now lies at approximately 9.80m AOD. There has been no activity on the site over the winter and spring and vegetation is now growing upon the fill surface.
- 9.4.4 In February 2017 the tarmac footpath/cycle track/access road along the west of the site was still in regular use, remaining unchanged since 2012. Some minor fly tipping/general rubbish was observed within the vegetated areas.

Desk Study

Planning History and Review of Past Site Investigation and Remediation Reports

- 9.4.5 Glan Usk school (that lies north of the site) along with a residential scheme was granted outline planning permission on the 31st October 2000 (planning reference number: 00/0768) and reserved matters planning permission was granted on the 19th May 2005 (planning reference number: 03/1531).
- 9.4.6 The following conditions were imposed in relation to ground conditions on Planning Permission 00/0768:
- Conditions 5 – Site Contamination: Details provided in accordance with condition (1) and pursuant to discharging siting as a reserved matter shall include a quantitative risk assessment that assesses levels of contamination on site and their potential to impact controlled water (groundwater and surface water) identified end receptors. The risk assessment will have regard to the layout and design of the end development/use, particularly the foundation works required on site. Such a risk assessment must be based upon information acquired following an investigation of the mobility of contamination on site in addition to the results of the site investigation entitled "Durham Roads Schools PFI Project Contamination Investigation Interpretative Report (June 2000) and previous investigations of the area. The risk assessment must identify any/all clean up levels required to ensure the integrity of controlled waters and identified end receptors. A remediation strategy shall be formulated and approved in writing by the local planning authority and the agreed scheme shall be implemented in accordance with the approved detail. Reason: To safeguard the aquatic environment

and prevent pollution from the physical disturbance associated with construction works in the short term and re-development of the site in the longer term, and to protect the integrity of the River Usk candidate Special Area of Conservation.

- Condition 6 – Site Investigation: Prior to the commencement of development on the site (including any demolition or land raising works) the following shall be conducted:
(a) a site investigation consisting of at least 3 months duration of monitoring to ascertain the presence of gas having regard to the end use of the site. This shall include an analysis of the source of any gas and a report on the investigation shall be submitted for the consideration and approval of the local planning authority. This assessment must include the results of the survey and recommendations regarding any structural precautions to be incorporated into the buildings,(b) a quantitative risk assessment of the ground conditions on the site having regard to the end use of the site. Such a risk assessment must use both the results of the site investigation entitled "Durham Road Schools PFI Project Contamination Investigation Interpretative Report" (June 2000) and previous investigations in the area, together with any additional ground investigation as required to carry out a comprehensive risk assessment. A remediation strategy in relation to both (a) and (b) above shall be formulated and approved in writing by the local planning authority and the agreed scheme shall be carried out prior to the commencement of any works on site. Reason: To ensure that the site is comprehensively investigated, the presence of contamination clearly identified and its impacts appropriately mitigated in the interest of residential amenities and to safeguard the interests of future users of the site.
- Conditions 7 – Certification Report: On completion of the works of remediation the applicant shall provide a certification report, compiled by a suitably qualified engineer who has supervised the works, which confirms that the remediation works have been completed fully in accordance with the approved remediation strategy. Reason: To ensure that the remediation strategy is effectively implemented in the interest of residential amenities and to safeguard the interests of future users of the site.

9.4.7 The two applications were accompanied by a number of site investigations which examined the ground conditions at the site. A list of the previous site investigations carried out at the site are listed below:

1. EAU investigation (1994) of the proposed school area.
2. Integral Geotechnique investigation (date not supplied) of the site.
3. Exploration Associates investigation (April 2000) at the Greenhill and School site.
4. Ground conditions desk top study, August 2003 (WYG reference E3808/PG/Aug03GCIA/V2)
5. Report on a Ground Investigation at Durham Road Newport (Volumes 1,2 & 3), October 2003 (Norwest Holst Soil Engineering Ltd, ref.F13041)
6. 'Site investigation interpretative report', October 2003 (WYGE report reference E3808/CBP/GIR/OCT2003/V1)
7. 'Quantitative risk assessment of ground conditions recorded during the 2000 and 2003 site investigations', October 2003 (WYG report reference E03808/JV/SP/Oct03/QRA/V1)
8. 'Enhanced ground conditions risk assessment and remediation strategy', February 2005 (WYG report ref.E3808/GO/Remstrat/Feb05/V1).

9. 'Site investigation factual report, Durham Road School', February 2005 (WYGE report reference E3808/AE/FacRep/Feb04/V1)
10. 'Planning Support – Land gas Monitoring and Risk Assessment Report' issued in July 2005 by White Young Green.
11. 'Summary Report with Proposals for Land Remediation/ Reclamation Works' (Report Ref: 9579/RB/07/REV A) issued by Integral Geotechnique in March 2007.
12. Glan Usk School 'Remediation Validation Report (Volume 1 of 2) issued by White Young Green in November 2009.

9.4.8 The most recent reports (numbered 10, 11 and 12 above) were made available to Terra Firma (Wales) Limited and these were reviewed prior to carrying out the Site Investigations in respect of this development and to inform the preparation of this chapter.

9.4.9 A copy of 'Planning Support – Land gas Monitoring and Risk Assessment Report' by White Young Green is provided in Appendix 9.5. In this report WYG compiled their own and previous gas monitoring data and completed a land gas risk assessment, devising a strategy for the control and management of identified land gas risks. This included recommendations for structural modifications to buildings to control and manage risks associated with potential land gas ingress.

9.4.10 Potential significant concentrations of land gas were recorded ubiquitously across the site, with methane (CH₄) focused in the western site area and carbon dioxide (CO₂) focused in the northern area. The results suggest the natural saturated deposits (peat – thicker in the west, and clays) are a source of CH₄ and CO₂, whilst high CO₂ concentrations are primarily associated with unsaturated made ground and shallow natural deposits.

9.4.11 The risk assessment identified the need for the following land gas risk management and control measures:

- Placement of a 0.65m thick clay cap across the southern housing area at the base of materials introduced to raise site levels to act as a dual function barrier to the upward migration of gas and the downward infiltration of groundwater.
- Land gas protection measures to buildings. Two elements of protection to the houses: passively vented sub floor void with gas membranes sealed to DPC and services. Two elements are proposed for the school building comprising a mechanically introduced 'clean air blanket' positive pressurised sub floor void with upgrade and sealing of the damp proof membrane to DPC and services.
- Band drain drainage blanket (below clay cap). To provide a preferential flow path for gas emitted as a result of the accelerated site consolidation.
- Construction phase land gas monitoring from and boreholes and band drain drainage blanket and water collection and storage systems.
- Decommissioning of historic site investigation boreholes.
- Personnel protective equipment and method statements for safe working.

9.4.12 A copy of 'Proposals for Land Remediation/ Reclamation Works' by Integral Geotechnique is provided in Appendix 9.6.

9.4.13 This report documents recommended remediation and reclamation works to render the site (including the school site) fit for its intended purpose. The report included a review of

previous site data and an update of the human health site specific target levels in accordance with contemporary guidelines for use as remedial targets for site validation/certification purposes.

- 9.4.14 Integral Geotechnique reviewed the groundwater risk assessment completed by WYG and agreed with its findings. Integral Geotechnique did not consider there to be a significant risk to the River Usk.
- 9.4.15 Integral Geotechnique reviewed WYG's land gas Monitoring and Risk Assessment Report. It was suggested that the clay cap be omitted subject to further gas monitoring in the form of flux box testing.
- 9.4.16 It was concluded that further monitoring would be required across the site, both during and after completion of the required works, including sampling and testing of groundwater, gas monitoring, testing and validation of garden capping materials and settlement monitoring in the form of piezometers, extensometers and plated settlement monitoring.
- 9.4.17 Note referenced in the Integral Geotechnique report was the proposal to line and realign the reën to prevent leachate moving from landfill water into the reën and outfalling into the River Usk.
- 9.4.18 Following the grant of planning permission it became clear the school would be delivered in advance of the residential element of the scheme and therefore it was agreed between the developer of the school and Newport City Council that the planning conditions could be discharged on a phased basis to enable the school development to commence. It was agreed in a letter between the developer of the school and the Development Control Manager that remediation of land south of the reën was to be completed in association with future residential development, a copy of this letter is included at Appendix 9.7.
- 9.4.19 The planning conditions in relation to the contamination were all successfully discharged in relation to the school development. According to the review of the historic planning files it appears Condition 5 was discharged as part of the Reserved Matters application (03/1531). Condition 6 was discharged under three separate discharges of condition submissions (reference numbers 06/0170, 07/0820 and 07/0939).
- 9.4.20 A copy of 'Glan Usk School Remediation Validation Report (Volume 1 of 2)' issued by White Young Green is provided in Appendix 9.8.
- 9.4.21 The WYG remedial works completed for the adjacent school development and the area of the site north of the drainage reën.
- 9.4.22 A total of 778 drums containing PCB type material were removed prior to the construction of the school during the remediation. They were disposed of off Site. In addition over 2000 tonnes of impacted soil type materials were also removed. Each excavation was also chemically validated on each pit face and base to ascertain if all PCB impacted soil material had been removed. The entire PCB identified area was then subject to another Geophysical survey which aimed to identify if any undiscovered drums remained. The results of that

survey showed a large decrease in the presence of metallic objects indicating that all the PCB removal has been conducted successfully.

- 9.4.23 To reduce risk from the remaining contaminants a clean capping layer was laid, built up from existing site levels to a minimum thickness of 600mm across the areas of the site not capped by buildings or hardstanding, namely soft landscaping and playing fields. This capping layer was separated from the underlying waste by a geotextile membrane which provides a visual indicator of the cap interface. Topsoil was imported from a second source and tested prior to import to site and largely found to contain levels below remediation targets and therefore considered fit for purpose. Once the imported gravel material and topsoil layer had been placed a number of trial pits dug across all landscaped areas to record the capping material depth. All locations recorded the capping layer to have a minimum 600mm thickness with the majority of the locations demonstrating a depth significantly more than the 600mm required
- 9.4.24 Groundwater Monitoring – During ground intrusive works groundwater testing was undertaken to monitor potential effects on groundwater quality and assist in check that pollutant pathways were not activated by the works on site.
- 9.4.25 Land gas protection system for the new school – installed in line with ‘Planning Support – Land gas Monitoring and Risk Assessment Report’ (WYG 2006).
- 9.4.26 Lining and realignment of the reën were not undertaken during these remedial works. It is probable this was due to the phased approach of the site development and because this did not apply to the school development and residential development of the area of site north of the reën was not to be developed at this time.
- 9.4.27 Condition 7 was discharged under discharge of condition submission reference number 09/0591. The remediation of the site was signed off by Newport City Council and the Environmental Health Officer confirmed in an email to the Planning Officer that he was satisfied the remediation measures carried out accorded with the requirements of the agreed remediation strategy and were carried out to a satisfactory level. The Environmental Health Officer acknowledges the reën was not realigned but since the residential development was not being progressed this measure could be carried out in the future and was not imperative in relation to the end use of the school. A copy of this email is in Appendix 9.7. There is no doubt the site in relation to the school was successfully remediated to the required standards and all relevant conditions were signed off.
- 9.4.28 The area of the site that lies north of the drainage reën was therefore effectively remediated during these works and contamination successfully removed or treated.

History

- 9.4.29 Historically the site remained as field land, later occupied only by a few small buildings at various locations in the early 1900s. Between 1937 and 1955 a factory was erected on site. This was later demolished between 1970 and 1993, although in 1993 tanks were noted to be present in the southeast of the site.

Geology

9.4.30 The 1:50,000 scale geological map of the area shows the site to be underlain by the St Maughan's Formation of the Devonian Period. These rocks comprise interbedded argillaceous rocks with subordinated sandstone. The solid geology is shown to be overlain by marine and estuarine alluvium. The historical use of the site is indicative of the likelihood for made ground to be present on site overlying the alluvial deposits.

Hydrology & Hydrogeology

9.4.31 Surface runoff is likely to naturally drain into the soil underlying the site and channel/reen crossing the site which orientates towards the river Usk. Shallow groundwater may also flow to the River Usk

9.4.32 Groundwater flow through the bedrock is likely to be heavily influenced by fractures within the rock, topography and bedding planes.

9.4.33 The Environment Agency website illustrates the bedrock beneath the site to be a Secondary A aquifer. These aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

9.4.34 The superficial soils overlying the east of the site have also been classified as a Secondary A aquifer. The west portion of the site, along the bank of the River Usk is not classified as it is considered unproductive strata.

Radon Gas

9.4.35 A British Geological Survey BRE211 Radon Report obtained for the site confirms that basic radon protection is required for any new development.

Environmental Information

9.4.36 The Environment Agency website 'what's in your back yard' database was searched for relevant information on the site and surrounding area.

9.4.37 There are no sites within a 1km radius of the site where pollution is regulated.

9.4.38 There are no industrial pollution scores within a 1km radius of the site where pollution is regulated.

- 9.4.39 There has been one pollution incident within close proximity of the site. The incident took place in February 2004 approximately 250 metres south of the site. The incident caused a significant impact to land and involved 'specific waste materials'.
- 9.4.40 Two historical landfill facilities are located within influencing distance of the site; one of which encroaches into the far north of the site (Glebelands South and relates to the area previously remediated under planning reference number: 00/0768) and one located 120 metres west of the site (Shaftsbury Park historic landfill).
- 9.4.41 Shaftsbury Park historic landfill is located approximately 120 metres west of the site. No information is provided regarding the date at which the landfill was active. Shaftsbury Park received industrial and household waste.
- 9.4.42 The Environment Agency database confirms that the site is at risk from flooding from rivers, sea and reservoirs. The site does however benefit from flood defences
- 9.4.43 The site is not located within a groundwater protection zone.

Qualitative Environmental Risk Assessment

- 9.4.44 The desk study information, including details of known completed remedial works on the part of the site north of the reen, enables the identification of the potential receptors, the potential sources of contamination and gases and the potential pathways between source and receptors.
- 9.4.45 The potential receptors are taken to be:
- Construction workers
 - Future site residents
 - Future site visitors
 - Adjacent sites
 - Drainage Reen
 - River Usk
 - St Maughan's Group Bedrock (Secondary A Aquifer)
 - Concrete used in construction
- 9.4.46 The potential sources of contamination and gases are taken to be:
- Based on the desk study information the potential sources of contamination identified on site were demolition rubble from former buildings on site, which may contain asbestos fibres or fragments of asbestos containing materials, and the former tanks noted in the southeast of the site on the 1993 historical plan.
 - The area north of the reen had been successfully remediated and as such no potential source of contamination was attributed to this area.

- An historic landfill site also occupies the far north of the site.
- Peat or organic clay/silt may be found within the alluvium beneath the site, potentially the source of ground gas.
- Off-site sourced soils imported on to site.
- Basic radon protection measures are required.

9.4.47 The potential pathways between source and receptors are taken to be:

- Dermal contact with soil and soil dust
- Ingestion of soil and soil dust
- Inhalation of soil dust
- Consumption of site grown vegetables/fruit
- Ingestion of groundwater
- Permeation of drinking water pipes
- Inhalation of ground gas
- Inhalation of radon gas
- Inhalation of landfill gas
- Run-off water
- Accidental spillage during construction
- Leaching of contamination
- Groundwater flow and migration
- Corrosion of concrete by contaminants in soil

Site Investigation

9.4.48 Investigation of the site has occurred at various stages. These works were designed to identify any contamination present, both in soils and waters, identify the underlying ground conditions, and to further assess the risks from ground gas.

9.4.49 A site investigation was carried out across the majority of the site between the 31st of October and the 8th of November 2012 comprising 19 trial pits (TP1 – TP19) and six cable percussive boreholes (BH1 – BH6) and three mini percussive boreholes (WS1 – WS3). Three in-situ soakaway tests were also undertaken during the site investigation.

9.4.50 Sampling and testing of groundwater was completed in April 2014.

9.4.51 Investigation of Phase 1 was completed in February 2017 comprising four cable percussive boreholes and twelve trial pits.

9.4.52 The trial pits were excavated using a JCB 3CX excavator.

9.4.53 The cable percussive boreholes, 200mm in diameter were sunk using a conventional drilling rig. Within the boreholes Standard/Cone (SPT/CPT) Tests were carried out at close and regular intervals. All of the boreholes were terminated within in-situ hard strata after a minimum of 1 hours chiselling in each hole for a nominal penetration.

9.4.54 The mini percussive boreholes were sunk using a Terrier 2000 mini percussive drilling rig. The mini percussive boreholes were sunk within the vicinity of the historic landfill at the north of the site. The holes were sunk for the installation of gas monitoring wells to check the ground gas potential from the landfill.

9.4.55 The 2012 Site Investigation confirmed the following ground conditions on site:

Table 9.6: Ground Conditions 2012 Investigation

Depth(m)	Thickness(m)	Stratum
GL - 0.20/3.30	0.20/3.30	MADE GROUND
0.30 - 3.90/10.30	2.20/8.40	Soft grey and brown mottled CLAY (Alluvium)
3.90/10.30 - 4.10/8.60	0.60/2.30	PEAT
4.10/8.60 - 5.90/9.70	0.00/1.80	SAND & GRAVEL (intermittent)
5.90/10.30 - 0.00/12.70	0.50/4.10	Firm becoming very stiff red brown gravelly CLAY
10.00/12.70 - >12.90	-	MUDSTONE

9.4.56 The basal Sand & Gravel layer was not encountered in BH1, BH2, BH4 and BH5.

9.4.57 Very loose red brown silty SAND and very soft red sandy SILT was encountered between 6.20m and 7.00m and 7.00m and 8.80m respectively.

9.4.58 Soft grey sandy SILT was encountered between 6.20m and 9.10m.

9.4.59 The 2017 Phase 1 Site Investigation confirmed the following ground conditions on site:

Table 9.7: Ground Conditions Phase 1 2017 Investigation

Depth(m)	Thickness(m)	Stratum
GL - 5.2/5.4	5.2/5.4	MADE GROUND
5.2/5.4 - 15.9/16.3	10.6/11.1	Soft to very soft grey silty CLAY (Alluvium) with peat and peaty clay bands
15.9/16.3 - 16.8/19.0	0.2/1.7	GRAVEL AND COBBLE
>16.8/19.0	-	MUDSTONE or SANDSTONE

Soil and Water Laboratory Chemical Analysis

9.4.60 During the site investigations small disturbed soil samples were collected. The soil samples taken were despatched to the laboratories of Derwentside Environmental Testing Services Limited for laboratory chemical testing. The following soil chemical tests were undertaken:

Table 9.8: Summary of Soil Chemical Tests

Metals and Metalloids	In-Organics	Organics	Other
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Lead	Cyanide	Phenols	pH (acidity)
Arsenic	Sulphate	Polycyclic Aromatic	Organic matter
Mercury		Hydrocarbons	Asbestos
Chromium		Aromatic & Aliphatic	
Copper		Hydrocarbons	
Nickel		Polychlorinated Biphenyls	
Cadmium			
Zinc			
Selenium			

9.4.61 Groundwater samples retrieved, as well as water samples from upstream and down-stream of the drainage reën were tested for the following.

Table 9.9: Summary of Water Chemical Tests

Metals and Metalloids	In-Organics	Organics	Other
Lead	Cyanide	Phenols	pH (acidity)
Arsenic	Sulphate	Polycyclic Aromatic	Organic matter
Mercury	Sulphide	Hydrocarbons	Conductivity
Chromium		Aromatic & Aliphatic	Hardness
Copper		Hydrocarbons	Chemical Oxygen Demand
Nickel		Polychlorinated Biphenyls	Biological Oxygen Demand
Cadmium			
Zinc			
Selenium			

Soil and Groundwater / Reën Water Test Results

9.4.62 A number of substances tested for in the 2012 site investigation were found to exceed their respective soil guideline values, as summarised in the following table:

Table 9.10: Summary of 2012 Soil Test Results

Hole and depth (m bgl)	Chemical	Guideline (mg/kg)	Exceedence (mg/kg)
TP5 1.30m	Arsenic	32	40
TP2 0.90m	Cyanide	8	10
TP8 0.50m	Benzo(a)anthracene	7.2	13
	Benzo(a)pyrene	2.2	11
	Benzo(b)fluoranthene	2.6	9
	Dibenzo(a,h)anthracene	0.24	1.6
TP6 0.60m	PCB	0.08	0.15
	2,3',4,4',5-Pentachlorobiphenyl	0.01	0.02
	2,2',4,4',5,5'Hexachlorobiphenyl	0.01	0.02
	2,2',3,4,4',5'Hexachlorobiphenyl	0.01	0.05

	2,2',3,4,4',5,5'-Heptachlorobiphenyl	0.01	0.04
TP6 1.80m	Chrysotile – Loose Bundles	-	-
TP7 0.20m	Dibenzo(a,h)anthracene	0.24	0.3
	Chrysotile – Loose Bundles	-	-
TP13 0.60m	PCB	0.08	0.16
	2,4,4'-Trichlorobiphenyl	0.01	0.12
	2,2',5,5'-Tetrachlorobiphenyl	0.01	0.05

9.4.63 Substances tested for in the 2012 Phase 1 site investigation that were found to exceed their respective threshold values are summarised in the following table:

Table 9.1: Summary of Phase 1 Soil Test Results

Hole and depth (m bgl)	Chemical	Guideline (mg/kg)	Exceedence (mg/kg)
TP2 0.6m	Lead	200	470
TP6 0.4m	Chrysotile asbestos fibres. ACM fragment.	-	-

9.4.64 A number of substances tested for were found to exceed their respective threshold levels in water samples taken for the 2012 site investigation, as summarised in the Table 9.12.

9.4.65 Assessment of groundwater undertaken in 2012 was according to threshold levels available at that time.

Table 9.12: 2012 Site Investigation Summary of Contaminants of Concern in Water

Location	Chemical	Threshold (mg/l)	Exceedence (mg/l)
BH1 (08/01/2013)	Aliphatic C16-C21	0.01	0.11
	Aliphatic C21-C35	0.01	0.14
BH2 (08/01/2013)	Aliphatic C16-C21	0.01	0.037
	Aliphatic C21-C35	0.01	0.19
BH3 (08/01/2013)	Aliphatic C12-C16	0.01	0.017
	Aliphatic C16-C21	0.01	0.031
	Aliphatic C21-C35	0.01	0.42
	Aromatic C12-C16	0.01	0.014
BH6 (08/01/2013)	Aliphatic C16-C21	0.001	0.03
	Aliphatic C21-C35	0.001	0.011
Drainage Reen 1 (Upstream)	Fluoranthene	0.0001	0.00013
Drainage Reen 1 (Upstream)	Aliphatic C16 - C21	0.01	0.021
	Aliphatic C21 - C35	0.01	0.17
	Aromatic C10 - C12	0.01	0.018

	Aromatic C21 - C35	0.01	0.062
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9.4.66 The petroleum hydrocarbons identified during the first groundwater monitoring round were attributed to contamination that occurred from the drilling process. Following purging of the boreholes on the second round of water sampling all hydrocarbons were below guideline values.

9.4.67 The hydrocarbons noted at the ree were identified up-stream but not down-stream and it was concluded that all of the determinants exiting the site and entering the River Usk from the ree were below threshold values.

9.4.68 Substances tested for in Groundwater samples taken in 2014 that were found to exceed their respective threshold values are summarised in the Table 9.13.

9.4.69 Assessment of groundwater undertaken in 2014 was according to threshold levels available at that time.

Table 9.13: 2014 Summary of Contaminants of Concern in Water

Location	Chemical	Threshold (mg/l)	Exceedence (mg/l)
BH5 (06.03.2014)	Zinc	0.125	0.16

Gas Monitoring

9.4.70 Nine gas monitoring wells were installed on site during the 2012 Site Investigation

9.4.71 Three gas monitoring wells were installed on site during the 2017 Phase 1 Site Investigation

9.4.72 A programme of gas monitoring for the presence of methane, carbon dioxide and oxygen has been undertaken. This is currently on-going in the Phase 1 site and due to complete in April 2017.

9.4.73 The maximum recorded methane content was 58.9% and the highest carbon dioxide concentration recorded was 12.9%. A maximum flow rate of 0.4l/h was recorded.

9.4.74 In line with CIRIA Publication C665 (2007) these results were used to calculate a gas screening value of 0.23l/hr.

9.4.75 When compared to Table 8.5 of CIRIA publication C665 (2007) the site is classified as being 'Characteristic Situation 2'. This classification is used to determine the mitigation measures required to protect future site users from gas.

Assessment of Potential Impacts

- 9.5 The site is to be residentially developed. This is to be carried out in a series of phases.
- 9.5.1 Prior to initiation of construction works the level of the area south of the drainage reen but not including the section along the River Usk must be raised in the interest of flood protection level to a level of 9.80m AOD. To achieve this off-site sourced fill materials will be imported, and will include a top 600mm of subsoil and topsoil in garden and landscaped areas. To date fill of the site is part complete.
- 9.5.2 It is intended that prior to construction works the fill attain a level of 9.80AOD and then be left for a period to allow for settlement of the underlying in-situ soft clay and peat deposits. Settlement is being monitored. It is expected to occur on site in two phases, instantaneous and primary settlement and subsequent secondary settlement/consolidation. Only once the degree of settlement has reduced to acceptable levels will development proceed.
- 9.5.3 The imported fill materials (excluding the topsoil and subsoil) are considered within the Assessment of Potential Impacts.

Environmental Impacts

- 9.5.4 This section summarises the Quantitative Risk Assessment carried out for the site informed by the baseline conditions, which identifies the environmental impacts of the proposed development.
- 9.5.5 The impacts have been assessed in relation to two stages; the construction stage of the development and the future residential use of the site.
- 9.5.6 Table 9.14 details the contamination identified on site, the potential receptors of the contamination and the potential pathways by which the contamination may reach the receptors. It also provides the level of risk that each receptor type is deemed to be at from the contamination if no mitigation measures or remedial measures are applied during and upon development of the site.

Table 9.14: Potential Impacts During Construction Phase

Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment
Contaminated site soils	Ingestion of soil/dust Inhalation of soil dust Dermal contact with soil/dust	Construction workers	Arsenic, Cyanide, PCBs, Benzo(a)anthracene, Benzo(a)pyrene Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Moderate adverse to Major adverse Risk Construction workers involved in excavation phase of development

Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment
Contaminated site soils	Inhalation of asbestos fibres		Chrysotile fibres Moderate adverse to Major adverse Risk at location of TP7 (2012) and TP6 (Phase 1) Construction workers involved in excavation phase of development
Contaminated site soils	Inhalation of vapours		PCBs Minor adverse Risk Construction Workers operating in open air environment
Soils Imported Fill to Raise Site Levels	Ingestion of soil/dust Inhalation of soil dust Dermal contact with soil/dust Inhalation of asbestos fibres Inhalation of vapours		Negligible Risk Only soils screened and confirmed to present no human health risk to be permitted for import
Reen water	Dermal Contact Ingestion		Petroleum Hydrocarbons Negligible Risk Levels very low and diluted within the drainage reen
Contaminated site soils	Ingestion of soil dust Inhalation of soil dust Dermal contact with soil dust	Passers-by/ Neighbouring site users	Arsenic, Cyanide, PCBs, Benzo(a)anthracene, Benzo(a)pyrene Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Minor adverse Risk
Contaminated site soils	Inhalation of asbestos fibres		Chrysotile fibres Minor adverse Risk
Soils Imported Fill to Raise Site Levels	Ingestion of soil dust Inhalation of soil dust Dermal contact with soil dust Inhalation of asbestos fibres		Negligible Risk Only soils screened and confirmed to present no human health risk to be permitted for import
Site construction materials/fuel etc	Accidental Spillage	Site Soils, Surface Waters, Groundwater, Drainage Reen, River Usk	Minor adverse Risk
Contaminated site soils	Overland surface water flow	Surface waters Reen	No Risk

Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment
Contaminated site soils	Leaching of contaminants into groundwater beneath the site	Groundwater beneath the site St Maughan's Group Bedrock (Secondary A Aquifer)	No Risk Groundwater and ree water testing identified no site derived contaminants of concern
Contaminated site soils Groundwater	Overland surface water flow Shallow groundwater flow	Drainage Reen River Usk	No Risk Groundwater and ree water testing identified no site derived contaminants of concern

Table 9.15: Potential Impacts Operational Development

Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment
Contaminated site soils	Ingestion of soil/dust Inhalation of soil dust Dermal contact with soil/dust Consumption of home grown vegetables/fruit	Site End Users (Residents and Visitors)	Arsenic, Cyanide, PCBs, Benzo(a)anthracene, Benzo(a)pyrene Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Moderate adverse Risk
Contaminated site soils			No Risk Contaminated site soils to be buried under imported fill during raising of site levels
Contaminated site soils	Inhalation of asbestos fibres		Chrysotile fibres Moderate adverse to High adverse Risk at location of TP7 (2012) and TP6 (Phase 1)
Contaminated site soils	Inhalation of vapours		PCBs Moderate adverse Risk
Soils Imported Fill to Raise Site Levels	Ingestion of soil/dust Inhalation of soil dust Dermal contact with soil/dust Consumption of home grown vegetables/fruit Inhalation of asbestos fibres		Negligible Risk Only soils screened and confirmed to present no human health risk to be permitted for import

Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment
	Inhalation of vapours		
Contaminated site soils	Organic contaminants have the potential to be absorbed into plastic water pipes which may be used for drinking water supply.	Site end users (Residents and Visitors)	Arsenic, Cyanide, PCBs, Benzo(a)anthracene, Benzo(a)pyrene Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Moderate adverse Risk
Contaminated site soils	Ingestion of soil dust Inhalation of soil dust Dermal contact with soil dust	Passers-by/ Neighbouring site users	Arsenic, Cyanide, PCBs, Benzo(a)anthracene, Benzo(a)pyrene Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Minor adverse Risk
Made Ground	Inhalation of asbestos fibres		Chrysotile fibres Minor adverse Risk
Radon gas	Inhalation	Site end users (Residents and Visitors)	Basic radon protection measures will be required. Moderate adverse Risk
Landfill / Ground Gas	Inhalation		In-situ gas monitoring has identified high levels of methane and carbon dioxide (including Phase 1) Minor adverse Risk
Contaminated site soils	Overland surface water flow	Surface waters	No Risk
Contaminated site soils	Leaching of contaminants into groundwater beneath the site	Groundwater beneath the site St Maughan's Group Bedrock (Secondary A Aquifer)	No Risk Groundwater and ree water testing identified no site derived contaminants of concern
Contaminated site soils Groundwater	Overland surface water flow Shallow groundwater flow	Drainage Reen River Usk	No Risk Groundwater and ree water testing identified no site derived contaminants of concern
Site soils	Direct contact with contaminants	Building materials	BRE Special Digest 1 lists the chemical agents that aggressively attack concrete as sulphates, sulphides, magnesium ions, ammonium ions, carbon dioxide, chloride ions and phenols. Minor adverse risk

Geotechnical Risk Assessment

- 9.5.7 Specific foundations designs are advised given the grounds conditions at the site. The presence of soft clay bands beneath the site traditional shallow foundations are not recommended. Such foundations are likely to lead to high total and differential settlements.
- 9.5.8 A piled foundation is advised for the proposed residential properties.
- 9.5.9 The majority of proposed development is to include the raising of the site by 1.0m to 2.0m as part of the flood prevention measures.
- 9.5.10 As the building foundations are to be piled this will result in differential settlements between the development infrastructure and the buildings of a similar order.
- 9.5.11 With raising of the site new slope faces will be created.

Mitigation Measures and Residual Impacts

- 9.6 Terra Firma (Wales) Limited produced a Remediation Strategy Report for the site in relation to the extant consent 00/0768. A copy of this may be found in Appendix 9.3.
- 9.6.1 This Remediation Strategy Report has been approved by Newport City Council and NRW
- 9.6.2 A Remediation Strategy has not been prepared for the Phase 1 site (excluding that part of Phase 1 that sits within the main body of the site and is covered by the 00/0768 Remediation Strategy). However, the required remedial measures on the Phase 1 site generally comply with those for the remainder of the site as detailed in the Remediation Strategy prepared under extant consent 00/0768 and are detailed below.

Environmental Mitigation Measures

- 9.6.3 The Potential Impact Assessment has identified major, moderate and minor adverse potential risks to construction workers and future site users from the contamination identified in site soils. Site end users are also deemed to be a minor adverse risk from ground gas.
- 9.6.4 Mitigation measures will be required to protect human health by severing the potential contamination source to receptor pathways.

Mitigation From Fill Imported Prior To Construction

- 9.6.5 Fill is required to raise levels for flood protection prior to construction works across the main

area of the site. This fill could potentially present a risk to human health and the environment.

9.6.6 This raise in site level is currently part complete. All soils imported on to site to date have been confirmed suitable for import in accordance with the Remediation Strategy Report prepared under extant consent 00/0768. Where there have been exceptions specific permission for use has been sought from Newport City Council and NRW prior to import. A Soils Validation Report produced by Terra Firma details the fill works up to December 2016, including soil test results and council and NRW correspondence. A copy of the Soil Validation Report may be found in Appendix 9.9. Further verification reports will be provided as the works progress.

9.6.7 As a precaution additional sampling and testing of ree waters is currently being implemented to confirm the imported fill is not causing contamination. This will continue until all the already approved fill has been imported.

Mitigation Measures During Construction Phase

9.6.8 During the construction phase, risks to construction workers should be mitigated by:

- COSHH Assessment and good standards of site hygiene, PPE etc.;
- Appropriate health and safety instructions being in place to cover the above;
- Dust suppression measures when necessary;
- Measures to limit contact with any contaminated groundwater;

9.6.9 It should be noted that the appointed contractor should provide Method Statements and Risk Assessments in place to deal with these matters. During the ground works, the contractor should comply with all current Health and Safety regulations. If during the development materials or abnormal ground conditions are encountered that are significantly different to those encountered in the investigation, the occurrence should be reported to the Engineer and appropriate action taken prior to continuing with the works.

9.6.10 All health and safety procedures should be adequate for protection of construction workers from asbestos containing soils when working in the vicinity of TP7, and Phase 1 TP6.

9.6.11 In accordance with EC Regulation 1272/2008 and Environment Agency Guidance WM2 (v. 2.3/2011) soils and other materials destined for off-site disposal should be classified on the basis of their hazard phrases prior to disposal.

9.6.12 During the site works, the following mitigation measures should be applied:

- Measures to avoid accidental spillage of materials during earthmoving activities;
- Measures to control surface run off;
- Appropriate measures when stock piling material

9.6.13 It should be noted that the appointed contractor should provide Method Statements and Risk Assessments to deal with these matters.

9.6.14 Appropriate mitigation measures should be put in place such as site screening and dust

suppression to prevent risks to neighbouring site users and passers-by from fugitive dust

- 9.6.15 Based on analysis of site soils for pH and sulphate it is recommended that all buried concrete should conform to Design Class DS-1, ACEC Class AC-1, of BRE Digest 1:2005.

Mitigation Measures Upon Development

- 9.6.16 The section of Phase 1 to be residentially developed does not require remediation.
- 9.6.17 Remediation in the area north of the drainage reen (Phase 2) will comprise capping of all garden and landscaped areas with 600mm clean imported topsoil and subsoil to create a barrier between contaminated soils and site end users.
- 9.6.18 Creation of a new raised embankment plus new access road and cycle path will act to cap the Phase 1 section of the site along the River Usk and sever the pathway between contaminated soils and human receptors.
- 9.6.19 The remainder of the site will capped by the filling required as part of a flood prevention scheme. This will include subsoil and topsoil in garden and landscaped areas.
- 9.6.20 All imported materials will be validated clean and suitable for use by laboratory chemical screening in accordance with the Terra Firma Remediation Strategy Report. This includes soils imported to raise site levels and will be relevant for all soils imported on to the Phase 1 site under 13/1279
- 9.6.21 All materials imported on to site should be accompanied by appropriate certification.
- 9.6.22 Prior to the placement of water supply pipes an assessment should be made, by the water provider, of soils along the route of the pipe with reference made to the material selection criteria quoted in the Water Regulations Advisory Scheme guidance Note No.9-04-03 (October 2002).
- 9.6.23 Basic radon protection measures should be incorporated into all new buildings on site.
- 9.6.24 In-situ gas monitoring on the Phase 1 site remains on-going. However, levels of carbon dioxide present have confirmed that in accordance with BRE 665 the site is classed as 'Gas Characteristic 2' and gas protection measures as follows should be installed in the Phase 1 development:
- For a reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft) - at least 1200g DPM and underfloor venting. All joints taped and sealed.
 - For a beam and block or pre-cast concrete floor - 2000g DPM/reinforced gas membrane and underfloor venting.
 - All joints taped and sealed.

- 9.6.25 Currently a Gas Characteristic 2 situation has been assigned to the remainder of the site in accordance with BRE 665 and the gas protection measures recommended are in line with this. However, additional gas monitoring is proposed in the form of flux box testing following placement of fill on site during the surcharge and settlement monitoring period. Further flux box testing is proposed during piling. A more detailed gas risk assessment can then be carried out. If the results conform with those already collected by Terra Firma then gas characteristic 2 recommendations will stand. If a greater risk from methane gas is identified then the required gas protection measures will be upgraded in line with a gas characteristic 3 or 4 site, depending on the results. The final gas protection measures recommended will be agreed with Newport City Council prior to development.
- 9.6.26 With the exception of new buildings to be constructed in the Phase 1 section of the site the radon/gas barrier should also be effective as a barrier to PCB vapours.
- 9.6.27 If during the development materials are encountered that are significantly different to those encountered in the investigation, the occurrence should be reported to the Engineer and appropriate action taken prior to continuing with the works.

Geotechnical Mitigation Measures

- 9.6.28 Full geotechnical recommendations can be found in Terra Firma Geotechnical and Geo-Environmental Reports.
- 9.6.29 A piled foundation is advised for the proposed residential properties.
- 9.6.30 Floor slabs should be designed as suspended.
- 9.6.31 The proposed development is to include the raising of the site by 1.0m to 2.0m as part of the flood prevention measures.
- 9.6.32 Consolidation settlement and differential settlement between development infrastructure and the buildings can be expected and the development should either be designed with flexible constructions and service entries into buildings or alternatively the fill should be placed prior to development and allowed to settle prior to construction.
- 9.6.33 The design and construction of the retaining walls and cut and fill should be in accordance with BS 6031: 1981 Code of Practice for Earthworks and other relevant guidance.
- 9.6.34 Any materials to be removed from site should be taken to an appropriately licensed tip.
- 9.6.35 Following adequate compaction of the imported fill, a California Bearing Ratio (CBR) Value of 5% is likely to be acceptable for design purposes. The local Highway Authority will require field in-situ CBR tests to be carried out at formation level of the roads to be adopted.

Residual Impacts

9.6.36 Tables 9.15 and 9.16 detail a summary of the residual human health and residual impacts following implementation of the recommended mitigation and remedial measures.

9.6.37 A negligible preliminary risk was previously quoted for the construction phase for soils imported to raise site levels. However, this has not been quoted here as subsequent testing did find some contamination in these materials that was permitted following consultation with Newport City Council and NRW.

Table 9.16: Significance of Residual Impacts - Construction Phase

Potential Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment	Mitigation	Residual Impact Risk Assessment
Contaminated site soils Soils Imported Fill to Raise Site Levels	Ingestion of soil/dust Inhalation of soil dust Dermal contact with soil/dust	Construction Workers	Minor adverse to Major adverse Risk	COSHH Assessment and good standards of site hygiene, PPE etc.; Appropriate health and safety instructions being in place to cover the above; Dust suppression measures when necessary;	Negligible
Contaminated site soils Soils Imported Fill to Raise Site Levels	Inhalation of asbestos fibres		Minor adverse to Major adverse Risk		
Contaminated site soils	Inhalation of vapours		Minor adverse Risk		
Reen water	Dermal Contact Ingestion		Negligible Risk		
Contaminated site soils Soils Imported Fill to Raise Site Levels	Ingestion of soil dust Inhalation of soil dust Dermal contact with soil dust	Neighbouring Site Users / Passers-by	Minor adverse Risk	Site Screening and Dust Suppression	Negligible
Made Ground	Inhalation of asbestos fibres		Minor adverse Risk		
Site construction materials/ fuel etc	Accidental Spillage	Site Soils, Surface Waters, Groundwater, Drainage Reen, River Usk	Minor adverse Risk	Measures to avoid accidental spillage of materials during earthmoving activities; Measures to control surface	Negligible
Contaminated site soils	Overland surface water flow	Surface waters Reen	Minor adverse Risk		Negligible

Potential Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment	Mitigation	Residual Impact Risk Assessment
Soils Imported Fill to Raise Site Levels				run off; Appropriate measures when stock piling material;	

Table 9.17: Significance of Residual Impacts - Operational Phase

Potential Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment	Mitigation	Residual Impact Risk Assessment
Contaminated site soils	Ingestion of soil/dust Inhalation of soil dust Dermal contact with soil/dust Consumption of home grown vegetables/fruit	Site End Users (Residents and Visitors)	Moderate adverse Risk	Capping of the main area of the site with 2m thickness of imported materials Capping of landscaped areas with 600mm imported soils (not required in Phase 1)	Negligible
Contaminated site soils	Inhalation of asbestos fibres		Moderate adverse to Major adverse Risk	Capping of contaminated soils with new embankment, access road and cycle track	Negligible
Radon gas	Inhalation	Site End Users (Residents and Visitors)	Moderate adverse Risk	Basic radon protection measures to be installed	Negligible
Landfill / Ground Gas	Inhalation	Site End Users (Residents and Visitors)	Moderate adverse Risk	Gas membrane and venting required	Negligible
Contaminated site soils	Inhalation PCB of vapours	Site End Users (Residents and Visitors)	Moderate adverse Risk	Installation of vapour barrier in all new buildings (excluding Phase 1)	Negligible
Contaminated	Adsorption into	Site End Users	Moderate	'Guidance for the	Negligible

Potential Source	Potential Pathway	Potential Target	Potential Impact Risk Assessment	Mitigation	Residual Impact Risk Assessment
site soils	drinking water supply	(Residents and Visitors)	adverse Risk	Selection of Water Supply Pipes to be Used in Brownfield Sites (Report 10/WM/03/21)' should be consulted	
Contaminated site soils	Overland surface flow	Surface waters	Minor adverse Risk	Capping of the site with imported fill and new roads	Negligible
Contaminated site soils	Leaching into groundwater Overland Groundwater flow	Drainage Reen River Usk St Maughan's Group Secondary A Aquifer	No Risk	N/A	Negligible
Contaminated site soils	Direct contact with contaminants	Building materials	Minor adverse Risk	Buried concrete should conform to Design Class DS-1, ACEC Class AC-1, of BRE Digest 1:2005.	Negligible

9.6.38 The table illustrates that with appropriate mitigation measures and remediation of the site upon development all human health and environmental risks are reduced to negligible levels.

Summary and Conclusions

9.7 This chapter of the Environmental Statement, written by Terra Firma (Wales) Limited, is based upon a reports produced to support the planning application.

9.7.1 This chapter compiles data obtained under planning condition 00/0768 and 13/1279 (Phase 1 only).

9.7.2 All data and reports and significantly Terra Firma (Wales) Limited Remediation Strategy Report produced for planning condition 00/0768 remain entirely relevant. The remedial works planned for the site under planning application 13/1279 are identical to those set out in the Remediation Strategy already approved under 00/0768. The already approved Remediation Strategy has been submitted and agreed in order to discharge condition 3 for the whole site for planning application 13/1279.

- 9.7.3 Phase 1 has subsequently been investigated and relevant conclusions regarding remediation of Phase 1 detailed in Terra Firma (Wales) Limited Geotechnical and Geo-Environmental Report 12032P1, dated February 2017 must be incorporated into the remediation scheme.
- 9.7.4 Through preparing a desk studies and undertaking intrusive investigations of the site, including sampling and analysis of soil and groundwater, the baseline ground conditions of the site have been determined enabling a human health and environmental risk assessment to be completed and suitable geotechnical recommendations to be made.
- 9.7.5 The ground conditions beneath the site were confirmed to comprise in general made ground over soft clay and peat, over firm to stiff clay with intermittent sand and gravel lenses, over mudstone bedrock.
- 9.7.6 Laboratory chemical testing of site soils found contamination from arsenic, cyanide, asbestos, lead, PCBs and polyaromatic hydrocarbons to be present. These substances were considered to present a potential risk to human health.
- 9.7.7 The groundwater beneath the site and ree water were confirmed to not be affected by site soil contamination.
- 9.7.8 During the construction phase, risks to construction workers from contaminated soils should be mitigated by:
- COSHH Assessment and good standards of site hygiene, PPE etc.;
 - Appropriate health and safety instructions being in place to cover the above;
 - Dust suppression measures when necessary;
 - Measures to limit contact with any contaminated groundwater;
- 9.7.9 Due to a flood risk the level of the main body of the site is being raised. Screening and verification that these materials are suitable for use has and will continue to be obtained prior to use.
- 9.7.10 Reen waters will continue to be monitored during fill works as a precaution.
- 9.7.11 Site end users will be protected through capping of gardens and landscaped areas with 600mm clean imported soils and construction of the new access road.
- 9.7.12 No remediation is required in the residential portion of Phase 1.
- 9.7.13 Due to the presence of soft clay bands beneath the site a piled foundation is advised for the proposed residential properties. For a 275mm square precast concrete pile driven to an appropriate set within the underlying gravels a safe working load of typically 500kN should be achieved.

- 9.7.14 For the proposed site fill the materials used are to be inert mainly granular materials conforming to Type 6F2 or similar and should be compacted in layers to the Specification for Highway Works.
- 9.7.15 Earthworks should be supervised on a full time basis by a qualified geotechnical engineer in-situ. In-situ testing of the filling as it progresses should be carried out. These tests should include in-situ density testing and plate load tests.
- 9.7.16 Raising site levels will lead to consolidation settlement. As the building foundations are to be piled this will result in differential settlements between the development infrastructure and the buildings.
- 9.7.17 In order to accommodate this level of differential settlement the development should either be designed with flexible constructions and service entries into buildings or alternatively the fill should be placed prior to development and allowed to settle prior to construction. The settlement process can be speeded up by surcharging the site by 'over filling'. Should this be the desired option then appropriate instrumentation should be installed to determine when 90% consolidation has been achieved.
- 9.7.18 Alternatively, as the site is to be developed in phases, a less formal approach to that outlined above would be to fill areas of follow on phases during the first phase of works in order to allow at least some of the anticipated consolidation settlements to take place prior to development.
- 9.7.19 For new roads and car parking areas, following adequate compaction of the imported fill, a California Bearing Ratio (CBR) Value of 5% is likely to be acceptable for design purposes. It should be noted that the local Highway Authority will require field in-situ CBR tests to be carried out at formation level of the roads to be adopted.
- 9.7.20 Therefore it can be concluded that with appropriate mitigation any potential impacts can be addressed and are not considered to be significant or likely to have a significant environmental effect on receptors.