# CHAPTER 13: DRAINAGE AND FLOOD RISK

## Introduction

13.1 This chapter assesses the impact of the proposed development on drainage and flood risk. In particular, it considers the potential effects from construction and operation of the development with respect to:

- Changes in surface water runoff rates and volumes affecting off site and downstream receptors
- Generation of foul sewage
- The risk and consequences of tidal, fluvial and other flooding sources
- Coastal Protection

13.2 The chapter describes the methods used to assess the impacts, the baseline conditions currently existing at the site and surroundings, the potential direct and indirect impacts of the development arising during the construction stage and following completion. It identifies mitigation measures required to prevent, reduce or offset the impacts and the residual impacts. It has been written by Capita Symonds.

## Planning Policy Context

### National Planning Policy

#### *TAN15: Development and Flood Risk*

13.3 Technical Advice Note 15: Development and Flood Risk (TAN 15), was issued by the Welsh Government (WG) in 2004. It advises caution in respect of new development in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions. The document recognises that positive planning has an important role in delivering sustainable development and applying the Government policy on flood risk management.

13.4 A sequential, risk based approach to determining the suitability of land for development in flood risk areas is central to the technical note. Where development cannot be located in areas at low risk of flooding it is necessary to undertake the Justification Test. Development, including transport infrastructure, will only be justified if it can be demonstrated that:

- Its location in Zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy to sustain an existing settlement; or
- Its location in Zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners to sustain an existing settlement or region;

And,

- It concurs with the aims of Planning Policy Wales (PPW) and meets the definition of previously developed land; and
- The potential consequences of a flooding event for the particular type of development have been considered and, in terms of the criteria contained in sections 5 and 7 and TAN15 Appendix 1, found to be acceptable.

The TAN also requires that consideration should be given to flooding from other sources, i.e. groundwater, pluvial, etc., and their potential to increase flood risk elsewhere.

**Local Planning Policy**

13.5 Policy statements relating to drainage and flood risk from Chapter 17 of the stopped UDP are set out below.

***Infrastructure Policy SG2 - Development and flooding***

*SG2. Development (including the raising of land) will only be permitted where:*

*(a) it would not result in risk to human life and damage to property within the Areas of Indicative Flood Risk defined on the proposal Maps; and/or*
*(b) it would not result in flooding, including tidal inundation, either on or off site, or adversely affect flood management or maintenance schemes.*
*In areas of flood plain currently unobstructed, where water flows in times of flood, built development will only be permitted wholly exceptionally and will be limited to essential transport and infrastructure.*

***Infrastructure Policy SG3 - Controlled Waters***

*SG3. Development which may adversely impact upon the water environment and associated land will only be permitted where it:*

*(i) would not pose an unacceptable risk to the capacity, quality or flow of groundwaters, surface waters or coastal water systems and;*
*(ii) would have access to an adequate water supply which either already exists or will be provided in time to serve the development, without detriment to existing water abstractions, water quality, fisheries or nature conservation.*

***Infrastructure Policy SG4 - Foul Sewage Disposal***

*SG4. Planning permission will only be granted where the development can be served by public foul sewerage system or where this system is inadequate by providing satisfactory improvements prior to the development becoming operational.*

*Where such sewerage system is not available, consideration will only be given to use of private treatment facilities subject to criteria in order to ensure the proper management of development and the environment. The criteria to be observed can be found in Welsh Office circular 10/99.*

***Infrastructure Policy SG5 - Private Sewage Treatment Facilities***

*SG5. Where a public sewerage system is not available development will not be permitted unless satisfactory arrangements can be made for the disposal of sewage by means of private treatment facilities, subject to all the following criteria:*

*i) there shall not be any risk of possible damage to the environment and amenity, including contamination of groundwater or other controlled waters;*
*ii) there shall not be any risk of a public health hazard or nuisance;*
*iii) the existing capacity of the area shall not be overloaded to the extent that problems of ponding, sewage flooding, pollution or nuisance will arise;*

*iv) a suitable outlet must be available for disposal of effluent, such as a satisfactory water course or adequate land for soakage within the curtilage owned or controlled by the developer or being the subject of an easement with the developer;*
*v) local soil conditions must have suitable soakage characteristics;*
*vi) there shall not be any evidence of a locally high water table, rising ground water levels, or flooding.*

***Infrastructure Policy SG6 - Surface Water Run Off***

*SG6. Proposals for development which would result in an unacceptable adverse impact on the water environment due to additional surface water run-off will not be permitted. Proposals for development which include disposal of surface run off water by means of soakaway will only be considered subject to criteria.*

*Proposals for development which include disposal of surface water run off by means of soakaway will be evaluated in terms of satisfactory soil properties, geotechnology hydrogeology reviewed alongside the hydraulic design of the soakaway.*

13.6 Policy statements relating to drainage and flood risk from the Local Plan are set out below.

***Policy 28: Tidal Inundation and River Flooding***

*The Council will refuse applications for development:*

*i. In areas liable to tidal inundation or river flooding.*
*ii. Which would involve the loss of natural flood plain.*
*iii. Which would increase the risk of flooding to other areas.*
*iv. Which would harm or impair the maintenance or management of river and sea defences.*

***36. Development on the Coast***

*36. Development will not be permitted in the undeveloped areas on and adjoining the coast where the nature or scale of the development would harm the character of the coast. Proposals in such areas will be considered in terms of:*

*i. The need for a costal location.*
*ii. Effects on features of:*
*(a) landscape significance;*
*(b) nature conservation or historic value;*
*(c) tourism, recreation or general amenity value.*
*iii. Potential effects on the marine environment.*
*iv. Risk, including flooding, erosion and land instability.*

13.7 The Shoreline Management Plan 2 Policy relating to the site is:

*Coastal Area G Policy Development Zone 17 (Holy Island and West Anglesey), Policy Unit 17.17 (Penrhos Headland) Long term plan is No Active Intervention, which does not preclude local private defence works subject to normal approvals.*

## Approach

### Assessment Methodology

13.8 The study area extends to the whole of the planning application boundaries and the near adjoining land. In addition to a detailed assessment of the site, the likely zone of influence of the development beyond the site has been considered. The study area is therefore broadly defined by the approximate extents of the development and the watercourses emerging from the site.

13.9 Key third party information was reviewed for the FCA including the following:

- Environment Agency (EA) website and Flood Map
- EA Tidal flood maps and sea level data provided by email on 29/07/2011
- EA Mapping showing areas susceptible to Surface Water Flooding and Flood maps for Surface Water received by email on 03/08/2011
- Welsh Government's TAN15 Interactive Flood Maps
- West of Wales Shoreline Management Plan 2 (SMP2)
- Site specific Landmark Reports (Orders 33053063: Site 3 Trearddur (2011); 33052369; Site 1: Kingsland (2011) and 33052636: Site 2 Penrhos (2011)) providing key information on local water abstraction licences; wastewater discharge consents; geological maps; groundwater vulnerability maps; geological memoirs, landfill descriptions and distances and geology, hydrogeology and ground conditions
- UK Highways A55 highway drainage drawings
- Dwr Cymru Welsh Water (DCWW) Sewer Records

#### *Surface Water*

13.10 Over the period from August 2011 to April 2012 several visits to the site were made by staff when walk-over surveys were conducted, drainage routes identified. In addition, soakaway tests have been carried out at various locations, and trial pits dug and ground inspected.

13.11 Outline drainage design has been completed for each site to demonstrate the principles proposed are practicable and suitable for taking forward to the detailed design stage. A review of the design in respect of the potential has been undertaken in respect of the criteria listed in Table 13.1

#### *Foul Drainage*

13.12 An assessment of existing foul drainage on and around the each of the sites has been made, and discussions held with DCWW. An assessment has then been made of the various impacts that were identified using the criteria set out in Table 13.1

#### *Flood Risk*

13.13 A Flood Consequences Assessment (FCA) has been completed because the application boundary extends into a tidal flood risk area as defined on the Welsh Government's Flood Risk Development Advice Maps. The approach taken to the FCA is detailed within the report, which is presented at Appendix 13.1. An assessment was then made of the potential impacts using the criteria set out in Table 13.1

**Significance Criteria**

13.14 Magnitude refers to the 'size' or 'amount' of an impact. It is a function of other aspects such as the 'extent' of an impact being the area over which the impact occurs, the duration i.e. the time for which the impact is expected to last prior to recovery or replacement of the resource or feature, the likelihood (i.e. the chance that the impact will occur) and reversibility. An irreversible (permanent) impact is one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. The level of 'Magnitude' is defined below.

Table 13.1: Assessment of Impact Magnitude

| Magnitude | General Impact |
|---|---|
| High | Significant, permanent loss / irreversible changes, to key characteristics, features or function of an environmental parameter. Impact may occur over a significant area . Significant Impact certain or likely to occur |
| Medium | Damaging significant changes to key characteristics or features or function. Over a moderate area. Likely to last for more than 2 years. Impact likely to occur. |
| Low | Noticeable but not significant changes (temporary / potentially reversible), over a partial area to key characteristics or features of an environmental parameter. Impact will possibly occur. |
| Very Low | Noticeable temporary / reversible, changes for less than 6 months, or barely discernible changes for any length of time, over a small area, to key characteristics or features of an environmental parameter. Impact unlikely to occur |

13.15 Where it is not possible to accurately estimate an impact, the assessment generally assumes the most likely impact scenario. In some cases mitigation can remove an impact. In others the impact can only be reduced. In these cases the significance of the residual impact is assessed.

13.16 The classification of significance aids in the identification of the main environmental effects of the proposed development and what weight should be given to these effects. There is no statutory definition of what constitutes a significant effect and guidance is of a generic nature. The significance criteria used in this report are set out below:

- Major Beneficial;
- Moderate Beneficial;
- Minor Beneficial;
- Negligible;
- Minor Adverse;
- Moderate Adverse; and,
- Major Adverse.

13.17 An explanation of each level of significance is presented in the table below.

Table 13.2: Significance Criteria

| Significance | Significance Ratings |
|---|---|
| Major | Very large or large change in environmental conditions. Effects, both adverse and beneficial, which are important considerations at a national to regional level because they contribute to achieving national / regional objectives, or, likely to result in exceedence of statutory objectives and/or breaches of legislation. |

| | |
|---|---|
| Moderate | Intermediate change in environmental conditions. Effects that are likely to be important considerations at a district to local level because they contribute to achieving local objectives, or, may result in exceedence of local statutory objectives and/or breaches of legislation. |
| Minor | Small change in environmental conditions. These effects may be raised as local issues but are unlikely to be of importance in the decision making process. |
| Negligible | No discernible change in environmental conditions. An effect that is likely to have a negligible or neutral influence, irrespective of other effects. |

### Assumptions / Limitations

13.18 In practice, and given the role of judgement in the assessment process, there may be some variation between subject areas in the significance rating process. This may be as a result of limited information on the sensitivity of features and / or the complexity of interactions that require assessment in determining magnitude of change.

## Baseline Conditions

### General Site Description

*Penrhos*

13.19 In respect of drainage and flood risk the site splits into three areas: the farm area, the upper woodland area, and the lower coastal zone and woodland forming the bulk of the Coastal Park. The site ranges in level from around 19mAOD in the vicinity of the cricket ground to around 4m AOD at the coast.

*Kingsland*

13.20 In the south west corner of the development site the ground level is around 27m AOD. The land is agricultural grazing land and slopes down generally northwards from here and at the northern boundary near the wetland the level is around 13m AOD. The average slope is in the order of 1 in 20.

*Cae Glas*

13.21 This is an extensive site with several drainage catchments. It is in the main agricultural or woodland, though the eastern most part of the site includes Cae Glas former landfill site.

13.22 The site as a whole is undulating with steep slopes in parts. The eastern section of the site slopes to the east and Kingsland Road and beyond to the Parc Cybi site. The land is highest in the west where the ground level is 22m AOD. It then slopes south towards the Inland Sea, and east towards A55.

### Surface Water Drainage

*Penrhos*

13.23 The upper area lacks significant drainage features by way of ditches, watercourse and ponds. There is a run of derelict drains that appear to service farm buildings and the cricket club house. The other properties are understood to drain to soakaway. Drainage is understood to be adequate in the main with no significant problems being identified by site managers.

13.24 The fields on the northern part of the site appear well drained and there are no ditches or other such water features evident. There is a small pond that has been created on the northern boundary which is presumably used for livestock watering. There appears to be no formal outfall from the pond, though water was noted to be seeping onto the foreshore at the horizon between the rockhead and overlying soils.

13.25 One area of concern that was highlighted was in respect of part of the site that drains towards the A5, where there is understood to have been a drain which has been severed / blocked. Consequently following heavy or prolonged rainfall water backs up and ponds beside the A5, causing nuisance before eventually soaking away. The precise extent of this is not known but has been approximated as shown on Figure 13.1.

13.26 The upper woodland area comprises channels and ditches cut around former field boundaries, some of which appear to be maintained and others that do not. These channels intercept surface water and direct flow towards ponds in the coastal section of woodland.

13.27 The numerous ditches suggest poor draining characteristics in the soils and this is confirmed by site managers who report a high ground water level with soils being a fine silt overlying clays.

13.28 The lower coastal zone and woodland is relatively flat. Grips are cut into the ground in many places at close (around 5m) centres. Some of these appear relatively recent due to the lack of vegetation, others are overgrown. Presumably the purpose of the grips is to provide a flow path away from the numerous tracks and footpaths in the woodland and into the ponds.

13.29 There are three ponds of significance in this area. One beside the car park appeared at times to be quite stagnant suggesting little inflow or outflow. There was no obvious evidence of any outfall pipe from the pond, or on the beach. The adjacent pond across the access road to the west is several times larger in area. This seemed in better condition but again there was no evidence of a formal outfall. The catchment area for these ponds is quite small. Judging from the vegetation the water level varies typically by 0.5m.

13.30 Towards the northern part of the lower coastal zone is another pond system to which much of the woodland drains and ditches are directed. This pond system is more engineered than the others. It drains into the sea via an outfall of circa 225mm diameter. On the outfall ditch is a concrete and stone pitching weir which it is assumed was intended to control the main pond water level. Before the outfall under the coastal access is a derelict feature which may have provided a secondary control and allowed flooding into an adjacent second pond.

13.31 The outfall pipe is concrete is of around 300mm diameter and emerges onto the rock and pebble beach. It is cracked and broken and only a small part of the pipe is visible above the pebbles.

13.32 The main pond extends west and terminates adjacent to the Pump House. Next to the pump house is a capped off chamber and hand pump and trough. It is assumed that water was directed towards this pond system from much of the woodland and former fields. The captured water was possibly then pumped from the pond to the disused water tower, from where it was used around the farm.

13.33 Based on the topographic information it seems likely the ponds were created when the coastal access was constructed. The associated land raising / bank construction would have affected the drainage trapping water behind.

*Kingsland*

13.34 Refer to Figure 13.2. On the fields adjacent to the Leisure Centre there is little in the way of drainage features. However, a strip of greener grass crossing the western field was identified during the site walkover, suggesting a line of sub surface water flow. Where this line approached the sports area reeds were evident suggesting the water was emerging to the surface. A partially blocked ditch runs between this point along the field boundary towards the wetland at the north of the site. Land drains would be expected in the fields to carry water more effectively from the area.

13.35 The natural receptor for surface water is wetland to the north of the sports facilities beyond the site boundary. OS plans indicate a flow from the wetland to the north under Mill Road and this has been verified on site.

13.36 The field abutting the B4545 drains to a low spot adjacent to the highway boundary, where there is a small wet area / pond. Although there are gullies in the highway here and a chamber suggesting a through pipe, there was no evidence of the route of the water from the wet area to the lower land east of the highway.

*Cae Glas*

13.37 Figure 13.3 shows the key features of the site. A large proportion of the central / east part of the site drains via a ditch around 1.5m deep towards a headwall constructed as part of the A55 works. The OS plans suggest this ditch continues beyond the A55 then passes under the railway and into Anglesey Aluminum Metals (AAM) factory site. The outfall under the A55 has been measured as 900mm diameter. Network rail has confirmed the culvert continues under the railway as twin 450mm square culverts and into AAM land from where it drains to Penrhos Beach.

13.38 There are several ponds along the line of the ditch, and at the upstream end the land it drains is flat and marshy. Towards the downstream end the land also flattens out and is likely to be poorly drained.

13.39 The northern part of the site again drains towards the A55, and again at the upper and lower ends of the ditch the land is flat and marshy. Vegetation prevented an inspection of the outfall under the A55, though Network rail advises a 1000mm diameter culvert passes under the A55, which connects downstream to an 1800mm wide x 1700mm high culvert under the railway (their bridge 228). From here the culvert runs through AAM to Penrhos.

13.40 The western site drains southwards through several marshy areas and into the Inland Sea.

13.41 The south eastern part of the site is woodland and is lacking any established surface drainage features. Water is expected to infiltrate and with direct runoff to the edge of the Inland Sea.

13.42 Away from the quite defined marshy area the land appears to be well drained. The agricultural land is likely to contain land drains connected to the ditches, though none were evident on site.

## Foul Drainage

### *Penrhos*

13.43 From inspection of the DCWW sewer records there is no evidence of the buildings on the site being connected to public sewerage. Indeed there is no sewerage in the vicinity of the site. The closest public sewer is north of the AAM main site entrance. Here there is a gravity sewer flowing towards Holyhead and a rising main carrying flow from Holyhead to the Penrhos Waste Water Treatment Works (WWTW).

13.44 The site managers indicate the buildings drain to septic tanks and then soakaways set within the building garden / property boundaries. The exception to this is the public toilets, which are owned by AAM, beside the Coastal Park car park. These are understood to drain to a cess tank. The septic tank is adjacent to the public toilet. It is understood the foul drainage performs adequately, with a normal amount of maintenance being required.

### *Kingsland*

13.45 There is no public foul drainage on the site. A DCWW 450mm diameter rising main carrying treated effluent from the Penrhos WWTW is laid in the wetland to the north of the football grounds.

13.46 The closest public sewer is on Kingsland Road, some 100m north of the Leisure Centre roundabout junction. Here a gravity combined sewer is shown to flow northwards towards Kingsland.

13.47 Following a conversation with Council staff we understand foul drainage from the Leisure Centre is pumped up to the Kingsland Road public sewer.

13.48 Some 600m south of the site there is a public sewer in Lon St Ffraid, flowing southwards towards Trearddur Bay.

13.49 Within Parc Cybi around 700m east of the site is a short section of gravity sewer that connects into the sewage rising main joining Trearddur Bay to the WWTW. There is foul sewerage as part of the Parc Cybi infrastructure extending towards the northernmost stub in the spine road.

### *Cae Glas*

13.50 There is no public sewerage within any of the area proposed for development, though there are sewers on the periphery that drain to the south and west towards Trearddur Bay.

13.51 Individual properties within the site are understood to have their own septic tanks and soakaways.

13.52 Individual dwellings close to but beyond the site boundary would be expected to drain to septic tanks and soakaways.

***General***

13.53 Discussions with DCWW have indicated that there is unlikely to be sufficient capacity in the sewerage network to accept anticipated flows from the development. However hydraulic modelling of the sewerage network would be required to confirm this.

13.54 DCWW has advised that the Penrhos Waste Water Treatment Works has sufficient capacity to accept the anticipated foul flows from the development.

**Flood Risk**

***Penrhos***

13.55 Communications with the EA and the Council indicate they are not aware of any flooding history on any of the site. A Flood Consequences Assessment (FCA) has been prepared for this site (Appendix 13.1). This should be referred to for a detailed review of flood risk and consequences for this development area.

*Tidal Flood Risk*

13.56 Tidal flood risk is identified on the EA and WG flood mapping. This indicates flood risk in the low lying coastal area, predominantly on the east (Coastal Park) coastline. Although flooding of land is indicated on higher land in the northern part of the site it is considered this is due to inaccuracies around steeply sloping cliff areas.

13.57 Following discussions with AAM it has been established that the Coastal Park car park is flooded by the tide perhaps every two years or so to a depth of around 1ft. Anecdotal evidence indicates this is understood to be due to high spring tides coinciding with low pressure and northerly winds that affect the estuary.

13.58 It is noted that a part of the earth structure supporting the access track at the edge of the Coastal Park has been repaired with rock filled gabion baskets and that some of these are failing.

13.59 The Shoreline Management Plan 2 Coastal Area G Policy Development Zone 17 (Holy Island and West Anglesey), Policy Unit 17.17 (Penrhos Headland) long term plan is No Active Intervention, which does not preclude local private defence works subject to normal approvals.

Table 13.3: EA Predicted Extreme Sea Levels for the Vicinity of Penrhos (Return Period T)

| Year | Sea Level Rise (m) | Extreme Event Sea Level (m AOD) | | | | | |
|---|---|---|---|---|---|---|---|
| | | T25 | T50 | T75 | T100 | T200 | T1000 |
| 2011 | 0.011 | 3.9 | 3.9 | 4.0 | 4.1 | 4.2 | 4.4 |
| 2061 | 0.369 | 4.2 | 4.3 | 4.3 | 4.4 | 4.5 | 4.7 |
| 2086 | 0.659 | 4.5 | 4.6 | 4.6 | 4.7 | 4.8 | 5.0 |
| 2111 | 1.022 | 4.9 | 4.9 | 5.0 | 5.1 | 5.2 | 5.4 |

13.60 The baseline estimations are for the year 2008, and so the predicted effect of climate change sea level rise is calculated relative to then. Note that the levels are assessed for the main Holy Island coastline and will not take into account any local estuarial variations in predicted sea level for specific weather conditions. As a result they may not accurately reflect the tidal flooding experienced at the site.

13.61 Survey data indicates that the ground level on the road near the entrance to the Coastal Park car park is 4m AOD and the level on the A5 near the junction is around 5m AOD.

13.62 By reference to these levels and the table above, it is evident that extreme sea levels could affect a strip of varying width on the eastern edge of the site. All of the ponds / lakes would be submerged and access from the A5 onto the site from the south would be flooded, though only when an allowance for future climate change predictions is included.

13.63 Due to the relatively sheltered estuarial location of the site, particularly the more vulnerable east part of the site, wave action is considered unlikely to be significant.

*Surface Water Flooding*

13.64 The EA have provided two Flood Maps for Surface Water. These provide a broad scale flood indication taking account of drainage and typical storms. This information supports the evidence gathered from other sources. However a further area at risk of flooding from surface water is identified on their plans in the vicinity of the property "Homewood".

13.65 There are several smaller and localised areas of flooding / standing water around the woodland and on the paths following prolonged or heavy rainfall, affecting the use of the footpaths in those parts of the Coastal Park. The ground in the woodland area is considered to be generally poor draining.

13.66 Subject to the proper maintenance of soakaways flooding would not be expected from these sources except potentially localised runoff if the capacity is exceeded in extreme rainfall. This would follow natural flow path and gather as ponding in localised depressions.

***Kingsland***

13.67 Flood risk to the development is limited and appears only to relate to the low land marsh at the north west of the site, which drains northwards.

13.68 A shallow depression bisects the site and is likely to form the below ground conduit for local rainfall towards the marshland. It would be expected that heavy rainfall may result in surface flow.

***Cae Glas***

13.69 The land abutting the Inland Sea is at risk of tidal flooding.

13.70 Beyond the development boundary is the B4545 Lon St Ffraid which is shown to be at risk of flooding as well as the south end of the unclassified road to the east and parts of the private access road. However it should be noted that the Inland Sea does not rise and fall to the same extent as the open sea as flow into it is limited by culverts through embankments at each end. The mapping does not take account of that.

13.71 There is no fluvial flooding shown on the Envirocheck mapping, neither is there shown to be a record of flooding.

13.72 Land draining via culverts under the A55 and railway to AAM land may be prone to flooding in the event of flows exceeding the capacity of the downstream culverts, or in the event of culvert blockage or collapse.

13.73 Output from the British Geological Society indicates a risk of groundwater flooding in the low lying central areas of the site that drain towards the A55.

13.74 There are isolated wells indicated on the OS maps. Where these have been identified on site are points where groundwater emerges as opposed to formal wells.

13.75 There is not considered to be a risk of flooding from sewerage or below ground drainage.

## Potential Impacts

### Demolition and Construction

#### *Surface Water*

13.76 During construction the activities on site are likely to compact the top-soil surface in some locations reducing the receptiveness of the soils to natural infiltration, resulting in localised increased run-off and flood risk.

13.77 Construction activities will disturb soils, increasing the risk of contamination of local watercourses and drainage ditches. Furthermore, the storage of fuels and other construction materials has the potential to result in accidental spillages.

Table 13.4: Surface Water Impacts from Demolition and Construction

| Action | Effect | Magnitude of Risk | Significance |
|---|---|---|---|
| Impacts of additional surface water runoff | Adverse | Low | Moderate |
| Surface water contamination | Adverse | Medium | Moderate |

#### *Foul Drainage*

13.78 Foul drainage from site worker facilities would be connected to temporary cess tanks prior to connections being made to the public sewer network. Consequently there would be no impact on the existing foul drainage network.

13.79 Construction of gravity pipes and rising mains within the sites may result in tree and root damage from trench excavations, more so at Penrhos in the areas of the lodges.

13.80 Construction of connections to DCWW sewerage would be under highways, roads or other disturbed routes. The connections would be requisitioned through Section 98 of the Water Industry Act 1991 and suitable routes would be appraised by DCWW at an early stage in their design.

Table 13.5: Foul Drainage Impacts from Demolition and Construction

| Action | Effect | Magnitude of Risk | Significance |
|---|---|---|---|
| Damage to trees and tree routes | Adverse | Low | Moderate |
| Off site trench construction | Adverse | Low | Moderate |

***Flood Risk***

*Penrhos, Kingsland and Cae Glas*

13.81 During construction of the development site facilities may be affected by surface water and groundwater flooding. This would be short term and would not result in any off site effects.

Table 13.6: Flood Risk Impacts from Demolition and Construction

| Action | Effect | Magnitude of Risk | Significance |
|---|---|---|---|
| Flooding of construction facilities | Adverse | Very Low | Negligible |

**Completed Development**

***Surface Water***

*Penrhos, Kingsland and Cae Glas*

13.82 Construction of the development will create an increased impermeable area that will increase the rate and quantity of run-off from the site. In the absence of appropriate mitigation and management there is an increased risk of flooding and changes to the receiving watercourses, ditches and wetlands.

13.83 Run-off from local roof areas and hard paving will either be harvested for re-use in toilet flushing, discharged to the ground using infiltration techniques, or discharged to existing watercourses and ditch drainage systems. There is a small risk of flooding due to overloading of local drains. This is considered to be a normal risk as piped drains are designed for limited storm events. The significance would be limited as any flooding would be a localised problem and its effects would be limited to the development site rather than the wider environment.

13.84 By changing the use of the site and increasing the impermeable area, some of which will be car parking areas there is an increased risk of surface water contamination which may impact in the aquatic ecology of the watercourses, ditches and marsh areas.

Table 13.7: Surface Water Impacts from the Completed Development

| Action | Effect | Magnitude of Risk | Significance |
|---|---|---|---|
| Increased runoff from the site | Adverse | Medium | Moderate |
| Surcharging and flooding from drainage | Adverse | Low | Minor |
| Contamination of water environment | Adverse | Low | Moderate |

### *Foul Drainage*

*Penrhos, Kingsland and Cae Glas*

13.85 The proposal is to construct connections to the DCWW sewerage network, either to the gravity network or the WWTW. To facilitate either option gravity sewers would be constructed within the development sites, flowing to pumping stations strategically placed within the sites. From these effluent would be pumped to the receiving network.

13.86 The potential effects to be considered include:

- Potential risk of ground contamination from leaks in sewers or pumping stations;
- Potential of connecting existing properties presently draining to septic tanks and soakaways to the proposed sewerage; and
- Impacts on sewerage infrastructure and WWTW.

13.87 It is possible that pipework could become damaged resulting in a leak of effluent into the surrounding ground. Blockages, restrictions or significantly increased flows may result in surcharging of the sewers, resulting in release of effluent from access chambers.

13.88 A number of properties on Penrhos and Cae Glas are presently not connected to the public sewerage network, and have individual arrangements for disposing of foul effluent. Provision of connections from the sites to the public sewerage network provides an opportunity to reduce or eliminate discharge of such effluent to the ground, thereby reducing the risk of ground water or surface water contamination.

13.89 DCWW has confirmed their Penrhos WWTW has sufficient capacity to accept the foul flows from all three of the sites. Prior to confirming their preferred method of connecting the development foul flow DCWW will undertake a detailed hydraulic assessment of their sewerage network and identify any improvements that may be required to facilitate connections.

Table 13.8: Foul Drainage Impacts from the Completed Development

| Action | Effect | Magnitude of Risk | Significance |
|---|---|---|---|
| Contamination from leaks or surcharges | Adverse | Very Low | Moderate |
| Reduced discharges of treated effluent to groundwater | Beneficial | Low | Minor |
| Impacts on sewerage infrastructure and WWTW | To be Confirmed | To be Confirmed | To be Confirmed |

### *Flood Risk*

*Penrhos*

13.90 The Flood Consequences Assessment (Appendix 13.1) examines the current and future flood risks for the Penrhos site. This section should be read in conjunction with that report.

13.91 The development will include construction of the following buildings, for which flood risk needs to be considered:

- Guest lodges
- Staff accommodation
- Main hub buildings

13.92 The principal likely sources of flooding comprise:

- Tidal flooding
- Fluvial flooding from existing ditches and ponds on the site
- Overland flow
- Springs and high ground water levels
- Surcharging of local drainage and sewerage systems

**Tidal Flooding**

13.93 The development will not increase levels of areas that are currently prone to tidal flooding. Access into the development will be from the A5 close to Stanley Embankment. This area is at risk of tidal flooding, but as this would be during the peak of extreme tides it would be expected to be of relatively short duration (circa 1 to 5 hours before standing water drains back to the sea). The impact to users outside the site will not change.

13.94 A second means of access to and from the site is available towards Holyhead along the A5, which is beyond the influence of tidal flood risk. This means that in the event of an emergency safe access will be available.

13.95 All built development is outside of the tidal flood zone.

13.96 Should the existing coastal protection in the area of the Coastal Park deteriorate and allow coastal erosion to take place, the risk of tidal flooding would increase.

**Fluvial Flooding from existing ditches and ponds on the site**

13.97 There are a number of ditches and short culverts on the site draining towards the sea and which carry footpaths and access tracks. Water levels in these ditches are dependent on ground water levels and natural run-off from higher ground within the site. Flood risk would increase in the event of maintenance neglect or blockage in the channels or culverts.

13.98 There is a small area of land that drains away from the sea towards the A5. A drainage connection under the A5 is considered failed or blocked. If not remediated this may result in localised flooding of a small part of the development land close to the A5.

**Overland Flow**

13.99 In general the site geology is not conducive to infiltration into the ground. In extreme rainfall surface water will follow natural and man made flow paths within the development site. There are several natural valleys and low area where water accumulates. Unless buildings are located away from valleys, low areas and natural and man made flow paths, localised flooding of individual or small groups of buildings may occur.

**Springs and High Ground Water Levels**

13.100 Ground water levels have not been determined through site investigation. The only built development taking place in low lying areas is the woodland lodges.

Parts of this area appear prone to high ground water and localised flooding from this source is a risk.

**Surcharging of Local Drainage and Sewerage Systems**

13.101 This has been dealt with in the Surface Water section

*Kingsland*

13.102 The development will include construction of domestic properties for which the principal likely sources of flooding comprise:

- Overland flow
- Springs and high ground water levels
- Surcharging of local drainage and sewerage systems

**Overland Flow**

13.103 Following extreme rainfall overland flow of surface water would be expected from land immediately adjacent to the south west of the site. Beyond the site the catchment extends to typically less than 50m and therefore depths and rates of overland flow water would be low and not give rise to a serious flood risk.

13.104 Within the site there are no pronounced valleys, undulations or low areas that would cause flood risk concern in respect of overland flow. However the development will create defined potential surface water flow paths along roads and SUDS swales, which if not carefully planned may direct overland flow to cause localised flooding to the development.

**Springs and High Ground Water Levels**

13.105 Ground water lies close to the surface in parts of the site as evidenced by reed growth. This is not expected to cause a significant flood risk and would be collected by land drainage typical of this sort of development.

13.106 In the marsh area at the north of the site the water level in the marsh is expected to reflect the ground water level and would vary seasonally. The positioning of the lowest properties will be above the seasonal high level.

13.107 The outlet watercourse from the marsh area flows north where there is a culverted crossing under Mill Road. In the event that the culvert becomes blocked water levels would rise in the marsh area, possibly resulting in flooding. Account should be taken of this risk in setting the lowest property floor level. The consequences are limited to the site.

**Surcharging of Local Drainage and Sewerage Systems**

13.108 There are no off-site sources of flooding, and on site has been dealt with in the Surface Water section.

*Cae Glas*

13.109 The development will include construction of the following buildings, for which flood risk needs to be considered:

- Guest lodges
- Hub Building

- Lakeside Bar
- Residential Block
- Hotel
- Visitor Centre

13.110 The principal likely sources of flooding comprise:

- Tidal flooding from the Inland Sea
- Fluvial flooding from existing ditches and ponds on the site
- Overland flow
- Springs and high ground water levels
- Surcharging of local drainage and sewerage systems

Tidal Flooding from the Inland Sea

13.111 The risk of tidal flooding from the Inland Sea is limited to parts of the development that are intended for private footpaths and nature reserves. High Spring tides may affect the footpath crossing to the nature reserve, but such tidal flood risk is normal and acceptable for such uses.

**Fluvial Flooding from Existing Ditches and Ponds on the Site**

13.112 Two main arterial ditches cross the site flowing in an easterly direction and under the A55 and railway through AAM site and to the sea at Penrhos beach. Built development will drain at greenfield rates into the watercourses. Existing ponds / marsh areas will be enlarged as part of the Sustainable Drainage solution to provide surface water attenuation, amenity and environmental benefits.

13.113 An initial outline assessment of the capacity of the culverts under the A55 and railway has indicated that the northern culverts have sufficient capacity to accept 1 in 100 year flows with an allowance for 20% climate change. An initial assessment of the southern culverts under the A55 and railway show they surcharge to a depth of around 1m for the present day 1 in 100 year flow (water depth from bed is 1.5m). This would result in some out of bank flow from the upstream ditch and ponding against the A55 embankment. The capacity within AAM land has not been quantified but would be expected to be at least equivalent to the upstream capacity. Impacts are limited to the site.

13.114 There is a risk that the downstream culverts beyond the site boundary become damaged or blocked. This would cause water to back up onto the development site. Whilst this would be considered a residual flood risk the setting of building floor levels should take this into account and flood relief measures considered. Impacts are limited to the site.

**Overland Flow**

13.115 The catchment beyond the site boundary is undulating, and natural shallow valleys lead into the development land. In extreme rainfall surface water would be expected to flow in these natural depressions and may result in a localised flood risk to an individual building if due account of the risk is not made in the siting of buildings.

13.116 Overland flow generated within the development site may result from extreme rainfall. This may result in a local flood risk to specific buildings if surface water flood routing is not accounted for in the detailed design.

### Springs and High Ground Water Levels

13.117 Springs are noted to emerge within the development boundary at the areas which are proposed for ponds / lakes. These are at low lying areas where ground water would be expected to be seasonally high.

Surcharging of Local Drainage and Sewerage Systems

13.118 There are no off-site sources of flooding identified. On site flood risk from this source has been covered in the Surface Water section.

Table 13.9: Flood Risk Impacts from the Completed Development

| Action | Effect | Magnitude of Risk | Significance |
|---|---|---|---|
| ***Penrhos*** | | | |
| Tidal flooding | Adverse | Very Low | Negligible |
| Fluvial flooding in Coastal Park area | Beneficial | Medium | Minor |
| Fluvial flooding from drain towards A5 | Adverse | Medium | Minor |
| Springs and high ground water | Adverse | Low | Moderate |
| Overland flow | Adverse | Medium | Minor |
| ***Kingsland*** | | | |
| Overland flow | Adverse | Medium | Minor |
| Springs and high ground water levels | Adverse | Medium | Minor |
| ***Cae Glas*** | | | |
| Tidal flooding | Adverse | Very Low | Negligible |
| Fluvial flooding from ditches and ponds | Adverse | Medium | Moderate |
| Overland Flows | Adverse | Medium | Minor |
| Springs and high ground water | Adverse | Low | Negligible |

## Mitigation Measures

13.119 This section describes the measures which are required to mitigate any significant environmental impacts.

### Demolition and Construction

#### *Surface Water Runoff*

*Penrhos, Kingsland and Cae Glas*

13.120 Construction works will be carried out in accordance with good practice. This includes the EA's Pollution Prevention Guidance PPG5 (Works and Maintenance in and Near Water) and PPG6 (Working at Demolition and Construction Sites), CIRIA Report C502 (Environmental Good Practice on Site).

***Foul Drainage***

*Penrhos, Kingsland and Cae Glas*

Mitigation against Tree and Root Damage

13.121 Wherever practicable, foul drainage will be routed through the site via a shallow network of gravity sewers. The natural topography will be used to achieve this so far as possible.

13.122 Drains will generally be laid close to open areas or lodge clusters or follow road networks. Consequently tree loss or disturbance associated with drainage installation would be kept to a minimum.

13.123 The network of gravity drains will be supplemented by a number of low head pumping stations. These will be used to discharge foul water from isolated areas, depressions or where the topography would otherwise necessitate deep excavations.

**Mitigating the effects of off-site trench construction**

13.124 Trenches providing routes for off-site sewer rising main connections to DCWW sewerage will be routed so far as practicable within or alongside roads, tracks or highways. Trench width and depths will be kept to a minimum.

***Flood Risk***

*Penrhos, Kingsland and Cae Glas*

13.125 The positioning of site facilities, storage of materials and construction of temporary access routes will be away from areas at risk of flooding.

**Completed Development**

***Surface Water Runoff***

13.126 A range of sustainable drainage methods will be used throughout the sites depending on their uses, the prevailing ground conditions and receiving water features. A key feature of all of the development will be the inclusion where possible of permeable surfaces to limit the amount of surface water entering the drainage system.

13.127 In principal sustainable drainage is best provided by disposing of all incident rainfall as near as possible to its point of origin i.e. source control. Based on the ground conditions encountered or anticipated it is envisaged that limited areas will be suitable for discharge to the ground via soakaways or shallow infiltration trenches. In most of the site, drainage via pipes or swales to ditches and watercourses will be required. Rainwater harvesting will be used where beneficial and in addition suitable attenuation measures will be introduced so that flows into these existing features are kept within natural runoff rates.

*Penrhos*

13.128 The Hub, headland lodges and access roads will drain to a network of soakaways and infiltration trenches. Car parking will be formed from permeable surfaces and drain into the underlying sub base from where it will infiltrate into the

ground to maintain the existing natural regime. Storage will be provided so the time to empty is within the guidance recommended by CIRIA Report 365.

13.129 The estate lodges, spa and market place will drain into below ground attenuation in the form of tanks or cellular crates. It is not envisaged these tanks will be lined, so that infiltration into the ground will be encouraged to mimic the natural conditions. Hard-standing areas would be largely permeable construction, subject to pollution control measures in storage areas. Outfall connections from attenuation tanks will carry controlled flows at natural runoff rates towards the east and the existing network of ditches and ponds in the Coastal Park. Consequently there would be no increase in the rate of discharge.

13.130 The quillet lodges and woodland lodges will drain to a network of swales which will be designed to attenuate the flow to natural rates and carry it towards the ditch and pond network in the Coastal Park. In addition, shallow dispersed soakaways will assist in maintaining the natural drainage regime.

*Kingsland*

13.131 Ground conditions are expected to be unlikely to support the widespread use of soakaways. Sustainable drainage methods will be used to limit runoff at source, and further control runoff beyond the property boundaries. Individual property attenuation in the form of cellular crates is likely to form the basis of the source control, limiting the runoff from each property to natural rates. To inform the next stage ground investigations and infiltration testing would be carried out to determine if any extent of infiltration is feasible as part of the sustainable drainage solution and to provide design parameters.

13.132 Subject to highway adoption standards at the time of development swales will be used to carry surface water where feasible and highways, tracks and other shared areas will drain to these. Below ground attenuation in the form of oversized pipes may also be required to limit the combined discharge rate from the site to natural rates.

13.133 Discharge from the drainage system flowing to the north will be routed to the increased pond area forming part of the wetland habitat. A control will be formed on the pond outlet to the watercourse so the pond will form a part of the mitigation of increased surface water runoff from the site.

13.134 The location of the outfall under the B4545 Kingsland Road will be identified and if necessary reinstated or repaired to allow the eastern part of the development to continue to discharge at natural rates using the attenuation measures set out above.

*Cae Glas*

13.135 Ground conditions are expected to be unsuitable for significant use of infiltration methods in the limiting of runoff from the site. Nevertheless, investigations will be undertaken to determine if this is the case through out or if it could form part of the solution.

13.136 Runoff will be limited first by the use of permeable surfaces where possible. This will encourage the control of runoff at source and will primarily be employed for parking. Dependant on the outcome of infiltration testing on site the porous paving will be supplemented by attenuation and connected to the existing watercourses at natural flow rates.

13.137 A network of swales and detention areas formed within the lodge layout and access road network will be used to manage surface water and limit flows discharging to the watercourse to existing rates. Where appropriate these will be supplemented by below ground storage.

13.138 Creation of a defined pond on both the northern and southern outfalls provides the opportunity to use these to control the rates of surface water leaving the site. Following ground investigation and further hydraulic modelling the design of the ponds and the controls limiting discharge from them will be determined and agreed with the EA.

13.139 The southernmost buildings (park entrance building and visitors centre) fall outside the natural catchment of the southern watercourse. Mitigation of additional surface water runoff will follow the same sustainable principals as the remainder of the site. Infiltration tests will be carried out and permeable surfacing will be used to maximise water infiltration into the ground. Significant areas of ground are available for infiltration trenches and shallow swales to enable natural runoff rates to be achieved.

***Surcharging and Flooding from Drainage***

*Penrhos, Kingsland and Cae Glas*

13.140 Design of drainage to current standards will largely mitigate this risk. In addition, standard practice of raising finished floor levels a minimum of 150mm above surrounding ground levels will provide further mitigation.

13.141 Management plans will be prepared and implemented to ensure all drainage is kept fully functional and limit the risk of potential blockages.

***Contamination of the Water Environment***

*Penrhos, Kingsland and Cae Glas*

13.142 The proposed methods of surface water disposal are commonly used on modern development. Design will be carried out to CIRIA Design Guide for Sustainable Urban Drainage and Building Regulations Section H. Drainage in adoptable highways will be carried out to the standards set down by the adopting Highway Authority.

13.143 Areas required for the storage of chemical products, waste bins or recycling areas will be discharged via a petrol interceptor and vulnerable areas protected by a pollution shut off valve.

***Foul Drainage***

*Penrhos, Kingsland and Cae Glas*

Mitigation against Contamination from Leaks or Surcharges

13.144 The drainage system will be designed to meet the standards of the Building Regulations Part H and in accordance with BS-EN 752. In addition sewerage that will be adopted by DCWW will be designed to Sewers for Adoption standards.

13.145 On Penrhos and Cae Glas foul manholes would be clearly identified and gullies for the use of cleaners would be clearly indicated and located at strategic

locations to avoid accidental discharge and contamination of the surface water system.

13.146 Ongoing maintenance of both gravity and pumped systems will be required. Management plans will be put in place to ensure the ongoing maintenance of drainage assets thus minimising the risk of blockage or failure.

13.147 Foul drainage will be offered for adoption by DCWW where possible and such sewerage will then be maintained by them.

***Flood Risk***

*Penrhos*

Mitigation against Tidal Flooding

13.148 The EA provides a Flood Watch Service which can be used to receive advanced warning of predicted tidal flooding. As this may impact on visitor movements to the site in extreme tides a management plan would be drawn up so traffic movements could be managed.

13.149 Damaged gabions will be repaired and subsequently retained in good condition. This is in accordance with the Shoreline Management Plan 2, which anticipates local private defence works being carried out subject to normal approvals. The most immediate benefit of improving such maintenance would be to the Coastal Park car park and adjacent areas which would be the first to be affected by coastal erosion.

Mitigation against Fluvial Flooding in the Coastal Park

13.150 A part of the development offering will be to provide a comprehensive management plan for the ditches and culverts, the majority of which are in the Coastal Park. All culverts and pipes will be inspected and repaired or replaced as necessary. The outfall under the coastal footpath will be reinstated and subsequently maintained in a serviceable condition.

Mitigation against Fluvial Flooding close to the A5

13.151 The area of the assumed outfall will be investigated and the outfall repaired / replaced as necessary.

13.152 The design of the nearby building floor level such that in the event of a further blockage of the outfall the flood risk is reduced.

Mitigation against Flooding from High Ground Water

13.153 A number of the woodland lodges are in an area prone to high ground water. These will be set above the existing ground at a typical height of 600mm. Boardwalks will be used for access where feasible, and vehicle access will be routed away from the more vulnerable lowest lying areas. Further investigations will be required to determine seasonal variations in ground water level.

Mitigation against Overland Flow (Penrhos, Kingsland and Cae Glas)

13.154 A detailed topographical survey of the site will be undertaken which will enable ground modelling to be carried out and existing overland flow paths of surface

water accurately determined. This will be used to locate buildings away from such flow paths or carry out local re-grading to mitigate the effects.

*Kingsland*

**Mitigation against Flooding from Springs and High Ground Water**

13.155 Ground investigations will be carried out to confirm the nature of the ground water emergence in the site. Land drainage will be constructed to route this around the site so as to mitigate the risk of it affecting properties on the site.

13.156 To reduce the risk of being affected by high groundwater from the marsh area it is anticipated housing will be set no lower than the floor level of the Leisure Centre. An assessment of the potential effects of a blockage in the culvert under Mill Lane will be made and the results of this used to agree with the EA a minimum floor level.

*Cae Glas*

**Mitigation against Tidal Flooding**

13.157 To reduce the risk of any visitors by foot to the nature reserve being cut off by high tides, information signs would be installed to alert the public to this possibility.

**Mitigation against Fluvial Flooding from Ditches and Ponds**

13.158 Earthworks on the site will include limited cutting and filling. Where this is carried out in areas which may flood, ground profile modelling will be undertaken and design carried out to ensure the there is no loss of potential volume for storage of floodwater.

13.159 In determining the finished floor levels of buildings to mitigate the risks of additional surface water runoff, the hydraulic assessment will take account of this risk and combined mitigation will be provided.

13.160 Building levels will be assessed following a detailed modelling assessment of the catchment upstream and downstream of the site, considering a range of return periods up to 1 in 100 plus an allowance for predicted climate change.

13.161 Access routes to and from the buildings will be designed so a safe route is always available in the event of flooding from the ponds or ditches.

13.162 An overflow connection will be made from the southern outfall to the northern outfall so that in the event of a blockage downstream of the site that causes water to back-up on the site it can be released to another outfall. The existing ditch between the two outfalls will be extended so far as the topography permits, following which a pipe will connect the two.

**Mitigation against Flooding from Springs and High Ground Waters**

13.163 The lowest lying parts of the site will be used for drainage and wetland habitat / amenity purposes rather than built development.

13.164 Local land drainage pipes will be constructed where necessary to replace those which are expected to exist and potentially be affected by the development.

13.165 Further investigations will be carried out to establish seasonal variations in ground water level. This will inform the detailed design of development floor level and infrastructure provision.

## Residual Impacts

13.166 The following paragraphs and Tables describe the anticipated scheme impacts with the proposed mitigation measures or appropriate industry standard protection measures in place during demolition and construction (Table 13.10) and operation (Table 13.11).

### Demolition and Construction

13.167 The residual adverse impact of additional surface water and surface water contamination is considered to be negligible during construction due to the application of the various good practice measures.

13.168 Careful choice of foul drainage route along with minimising trench width and depth is predicted to limit the residual impacts to adverse negligible.

13.169 Flood risk areas have been identified, and the positioning of site facilities and other process outside of these areas will not affect negligible adverse residual impact.

Table 13.10: Demolition and Construction Residual Impacts

| Action | Effect | Magnitude of Risk | Significance | Residual Impact Post Mitigation |
|---|---|---|---|---|
| **Surface Water** | | | | |
| Impacts of additional surface water runoff | Adverse | Low | Moderate | Negligible |
| Surface water contamination | Adverse | Medium | Moderate | Negligible |
| **Foul Drainage** | | | | |
| Damage to trees and tree roots | Adverse | Low | Moderate | Negligible |
| Off-site trench construction | Adverse | Low | Moderate | Negligible |
| **Flood Risk** | | | | |
| Flooding of construction facilities | Adverse | Very Low | Negligible | Negligible |

### Completed Development

13.170 The impact of potential increased surface water runoff from the site will be controlled to a great extent by the application of current day standard design and construction techniques as set out in the mitigation strategy. Further intrusive investigations to establish infiltration parameters and discharge rates through AAM culverts will be required to inform the detailed design process.

13.171 The adoption of current design standards and subsequent management practices is predicted to reduce the potential impact of contamination to the water environment to adverse negligible.

13.172 Design and construction of foul drainage to current standards along with the subsequent adoption of some drainage by DCWW will maintain the predicted adverse impact of contamination from leaks or surcharges to negligible.

13.173 Until DCWW has completed the modelling of their network to identify the appropriate means of connecting to the sewer the residual impact cannot be determined.

13.174 Completion of the proposed mitigation measures is expected to reduce the adverse impacts of tidal flood risk to the site to negligible.

13.175 The proposals to improve and subsequently manage the drainage in the Penrhos Coastal Park is predicted to benefit access around the park for recreational activities. The residual impact is considered to be beneficial minor.

13.176 The impacts to the Penrhos development of flooding from the culvert under the A5, and the impact to Penrhos and Cae Glas from springs, high ground water and overland flow are expected to be adequately mitigated such that the residual adverse risk will be negligible.

13.177 At Cae Glas the adverse impact of flood risk from fluvial sources is predicted to be reduced to negligible by the implementation of the overflow connecting the two catchments, along with further investigations into the AAM culverts and subsequent hydraulic modelling and selection of floor levels.

Table 13.11: Completed Development Residual Impacts

| Action | Effect | Magnitude of Risk | Significance | Residual Impact Post Mitigation |
|---|---|---|---|---|
| **Surface Water** | | | | |
| Increased runoff from the site | Adverse | Medium | Moderate | Negligible |
| Surcharging and flooding from drainage | Adverse | Low | Minor | Negligible |
| Contamination of water environment | Adverse | Low | Moderate | Negligible |
| **Foul drainage** | | | | |
| Contamination from leaks or surcharges | Adverse | Very Low | Moderate | Negligible |
| Reduced discharges of treated effluent to groundwater | Beneficial | Low | Minor | Minor |
| Impacts on sewerage infrastructure and WWTW | To be Confirmed | To be Confirmed | To be Confirmed | To be Confirmed |
| **Flood Risk** | | | | |
| ***Penrhos*** | | | | |
| Tidal flooding | Adverse | Very Low | Negligible | Negligible |
| Fluvial flooding in Coastal Park area | Beneficial | Medium | Minor | Minor |
| Fluvial flooding from drain towards A5 | Adverse | Medium | Minor | Negligible |
| Springs and high ground water | Adverse | Low | Moderate | Negligible |

| | | | | |
|---|---|---|---|---|
| Overland flow | Adverse | Medium | Minor | Negligible |
| ***Kingsland*** | | | | |
| Overland flow | Adverse | Medium | Minor | Negligible |
| Springs and high ground water levels | Adverse | Medium | Minor | Negligible |
| ***Cae Glas*** | | | | |
| Tidal flooding | Adverse | Very Low | Negligible | Negligible |
| Fluvial flooding from ditches and ponds | Adverse | Medium | Moderate | Negligible |
| Overland Flows | Adverse | Medium | Minor | Negligible |
| Springs and high ground water | Adverse | Low | Negligible | Negligible |

## Conclusions

13.178 The overall findings of the assessment indicate that the scheme will have a largely negligible impact in terms of Surface Water, Foul Drainage and Flood Risk with respect to the majority of the elements identified as of concern.

SEEPAGE ONTO BEACH

SURFACE WATER DRAIN

BOUNDARY DITCH

WATER TOWER

PUMP HOUSE

WEIR

OUTFALL

ERODING GABION COAST PROTECTION

CESS TANK

PUBLIC TOILET

COUNTRY PARK CAR PARK

PONDS WITH NO APPARENT OUTFALLS

N

## KEY

DITCH OR WATERCOURSE

APPROXIMATE EXTENT OF OCCASIONAL FLOODING

APPROXIMATE EXTENT OF POORLY DRAINING GROUND



# PENRHOS

## SITE PLAN

CAPITA SYMONDS
Penrhos Manor, Oak Drive, Colwyn Bay,
North Wales, LL29 7YW
Tel: 01492 539200
Fax: 01492 531333

| DRAWN BY | CHECKED BY | PASSED BY | DATE | SCALES @ A3 | ISSUING OFFICE | DRAWING NUMBER | REV |
|---|---|---|---|---|---|---|---|
| CR | JES | MBD | AUG. 2011 | 1:5,000 | COLWYN BAY | FIGURE 13.1 | P1 |

LEISURE CENTRE FOUL PUMPING STATION

FRENCH DRAIN

LEISURE CENTRE

Holy Island (Ynys Gybi)

KINGSLAND

Golf Course

B4545

## KEY

- COMBINED GRAVITY SEWER
- TREATED EFFLUENT RISING MAIN
- DITCH OR WATERCOURSE
- APPROXIMATE CATCHMENT BOUNDARY
- APPROXIMATE EXTENT OF OCCASIONAL FLOODING



# KINGSLAND

## SITE PLAN

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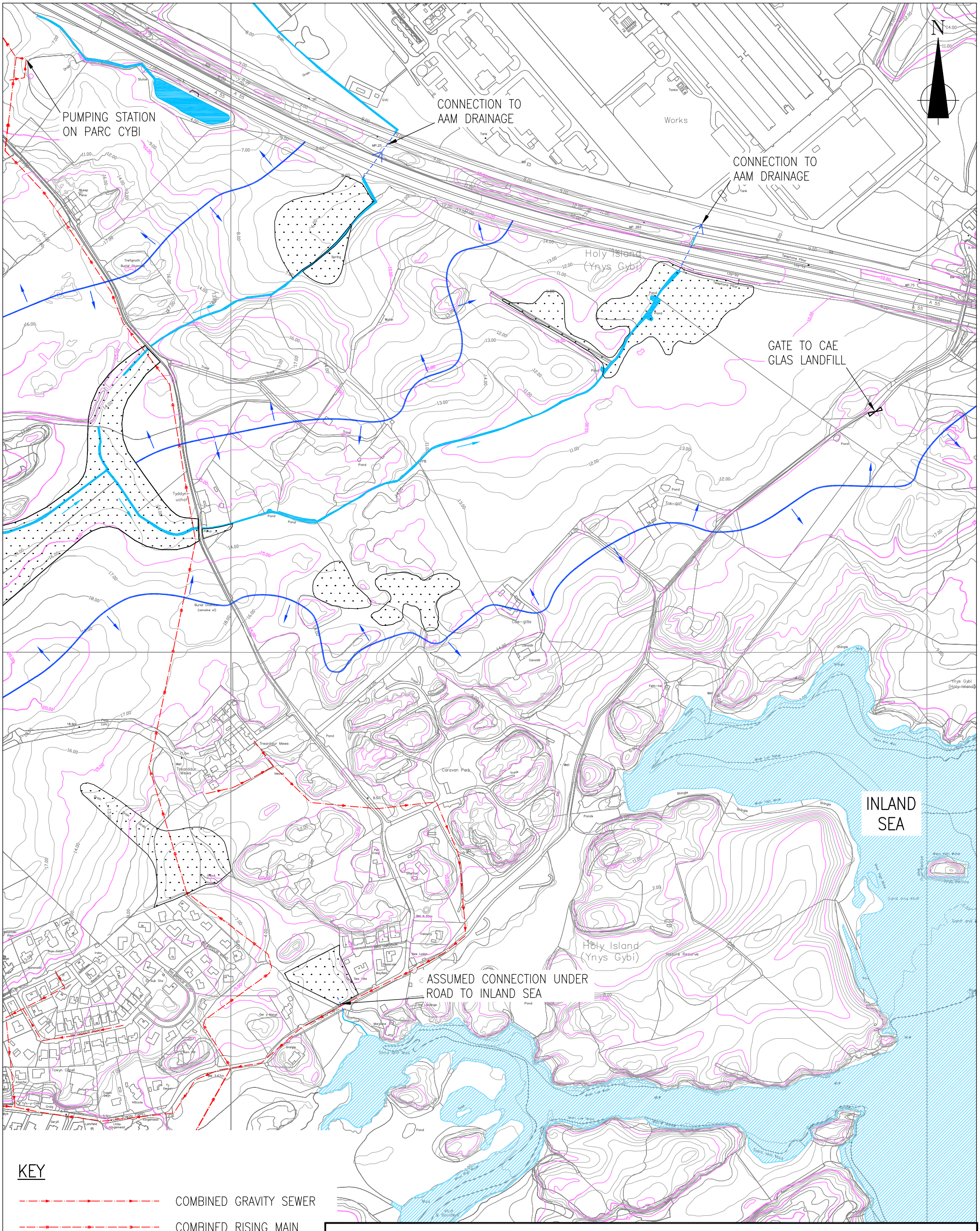
|---|---|---|---|---|---|---|---|
| CR | JES | MBD | AUG. 2011 | 1:5,000 | COLWYN BAY | FIGURE 13.2 | P1 |




## KEY

- COMBINED GRAVITY SEWER
- COMBINED RISING MAIN
- DITCH OR WATERCOURSE
- APPROXIMATE CATCHMENT BOUNDARY
- APPROXIMATE EXTENT OF OCCASIONAL FLOODING



# CAE GLAS

## SITE PLAN

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| DRAWN BY | CHECKED BY | PASSED BY | DATE | SCALES @ A3 | ISSUING OFFICE | DRAWING NUMBER | REV |
|---|---|---|---|---|---|---|---|
| CR | JES | MBD | AUG. 2011 | 1:5,000 | COLWYN BAY | FIGURE 13.3 | P1 |