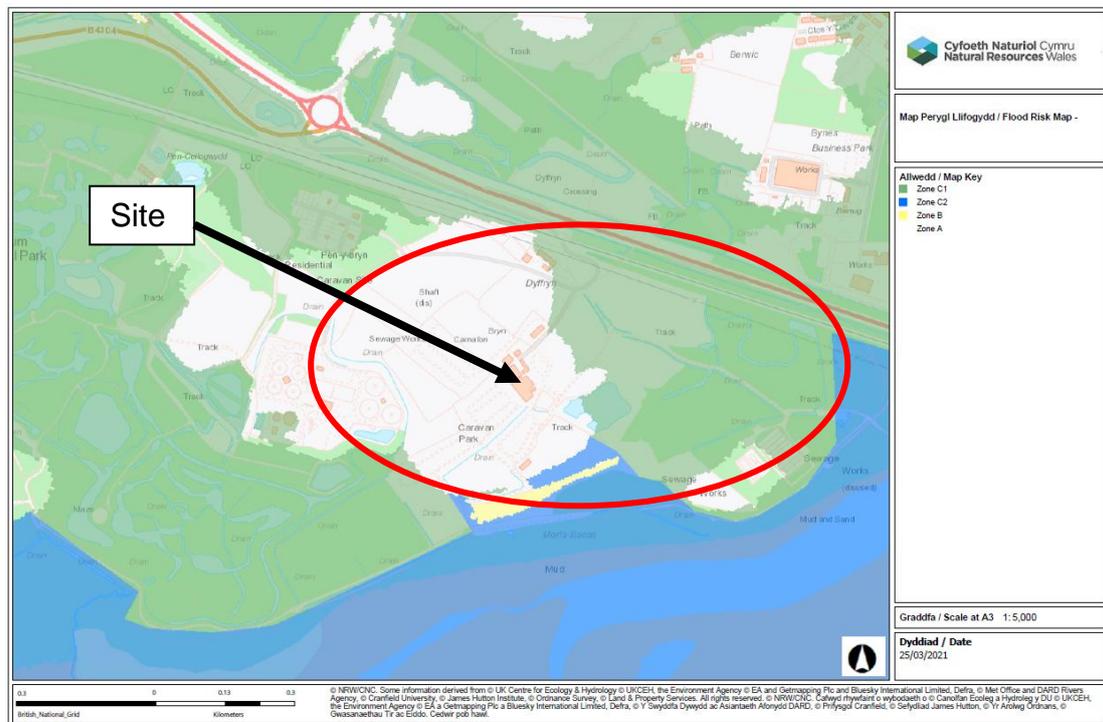


Proposed Developments At The Gateway Holiday Park Flood Consequence Assessment Report

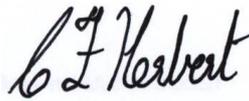


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Signed



DateApril 2021

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1 INTRODUCTION

The Gateway Holiday Park is a thriving business and popular destination to the east of Llanelli. It is proposed to further develop the site by:

- Constructing a Go Kart Track;
- Relocating a static caravan;
- Replacing 32 touring caravan pitches with 32 static caravan pitches;
- Increasing the number of touring caravans by 60;
- Constructing tennis courts;
- Constructing an Agricultural Shed;
- Constructing an Hotel.

One of the benefits of the site is its proximity to the coast, however, part of the Park is considered to be in Zone C1, as defined by the development advice maps (see Figure 1.1) referred to under Technical Advice Note 15, Development and Flood Risk (TAN 15). This means that the land could be at risk of flooding during at least a 1 in 1000 years flood return period but is afforded a degree of protection via recognised flood defences. The proposed developments, however, are in Zone A and are considered to have a low risk of flooding, although the access route lies within Zone C1.

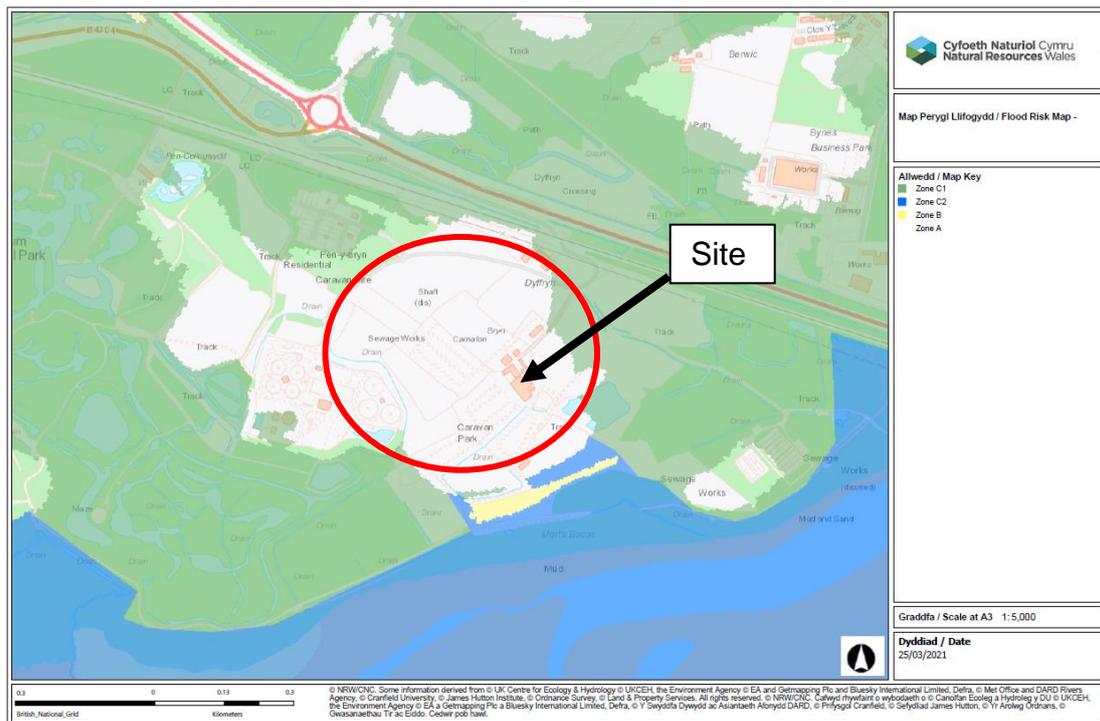


Figure 1.1 - Development Advise Map of the Area

The development advice maps are based on the Natural Resources Wales' Flood Risk Maps supplemented by sediment data, held by the British Geological Survey (BGS), of historical flooding. The maps adopt the precautionary principle and are based on the best known information available at the time. Detailed examination of a site can refine an areas risk of flooding.

Considering its proximity to the sea, the site could be affected by tidal inundation (see Figure 1.2) particularly when taking sea level rise into consideration. A Flood Consequence Assessment is, therefore, required to evaluate the implication of any

flooding on the proposed development, which should be undertaken in accordance with the requirements of Section 7 and Appendix 1 of TAN 15. Francis Sant have been employed, by the client, to undertake this task and prepare a report on the risk.

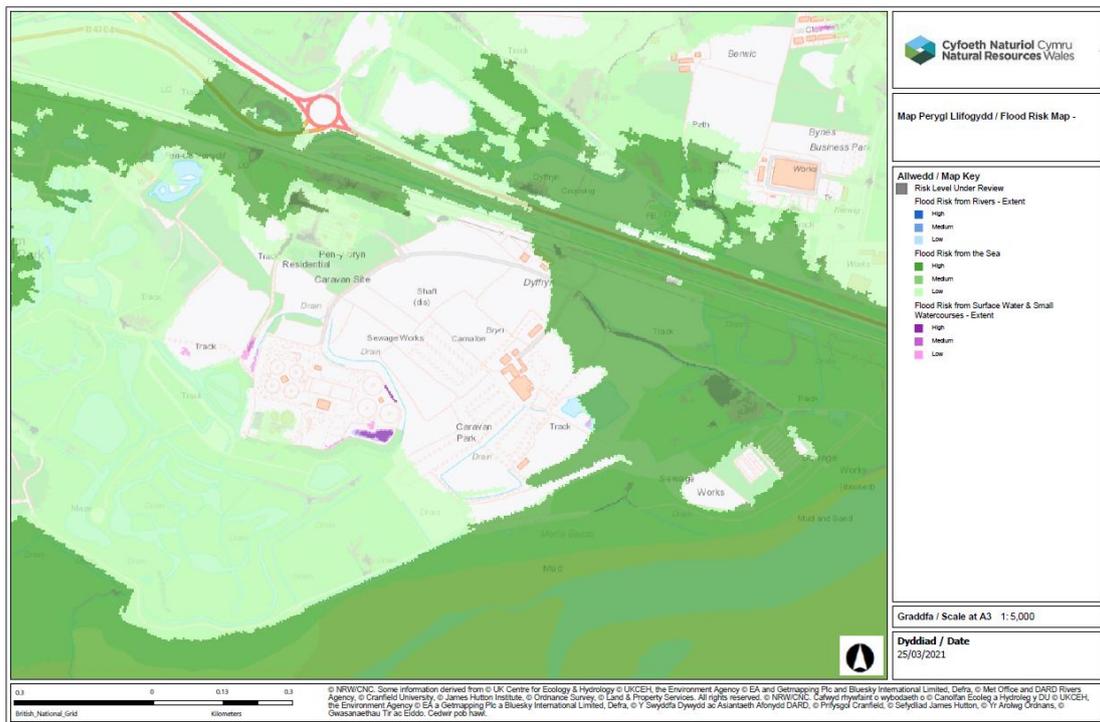


Figure 1.2 - NRW Flood Assessment Map

This document summarises the work undertaken as part of the study. Section 2 of the report gives a description of the development and the surrounding area while the risk of flooding from fluvial, tidal (T200 and T1000) and other sources is considered in Section 3. A discussion of some response measures is provided in Section 4 and the conclusions and the recommendations of the study are provided in Section 5.

2 DEVELOPMENT

2.1 Location

The Gateway Holiday Park is located on the site of Carnafon Farm, Llanelli (coordinates E254540 N198240) and lies about 4km east of the town centre (see Figure 2.1 to 2.3 and Plate 2.1). Access to the site is gained via 600m of minor road from the Berwick Roundabout on the A484, Swansea to Llanelli highway. The Fishguard to Paddington Railway line and an access road forms the site's northern boundary while the Loughor Estuary is along the south eastern boundary. A Dwr Cymru Welsh Water treatment works lies to the west and there is a traveller's camp to the north west.

The development lies along the Millennium Coastal path with the Penclacwydd Wildfowl and Wetlands Centre some 1km to the east.

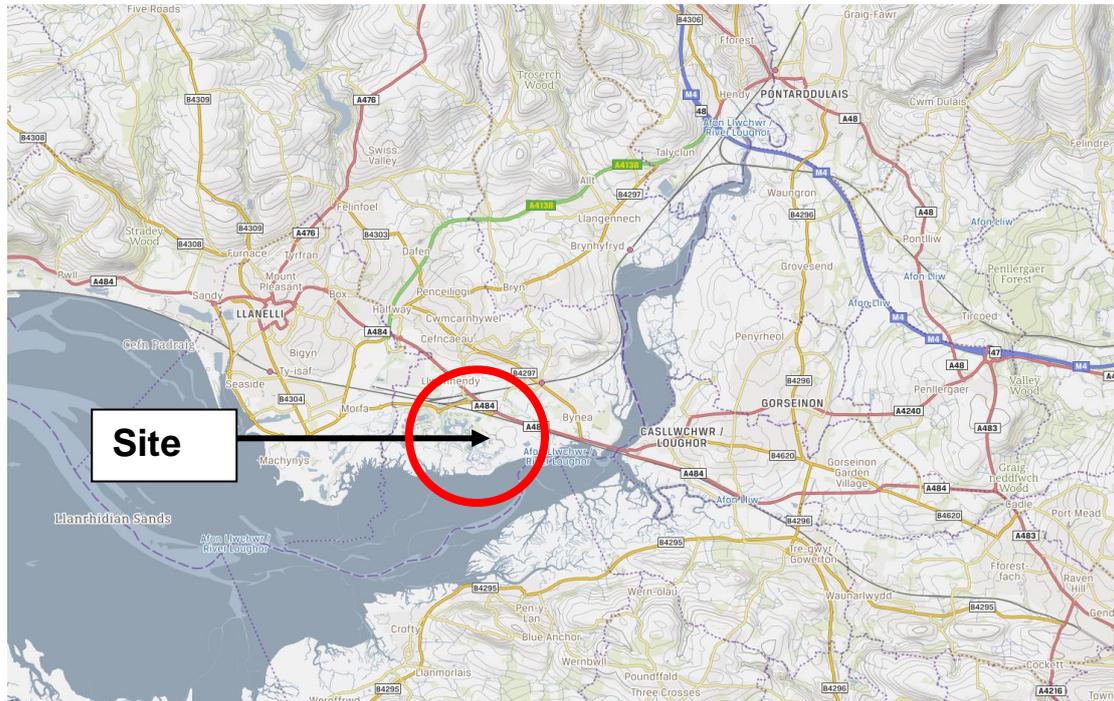


Figure 2.1 – Location Plan

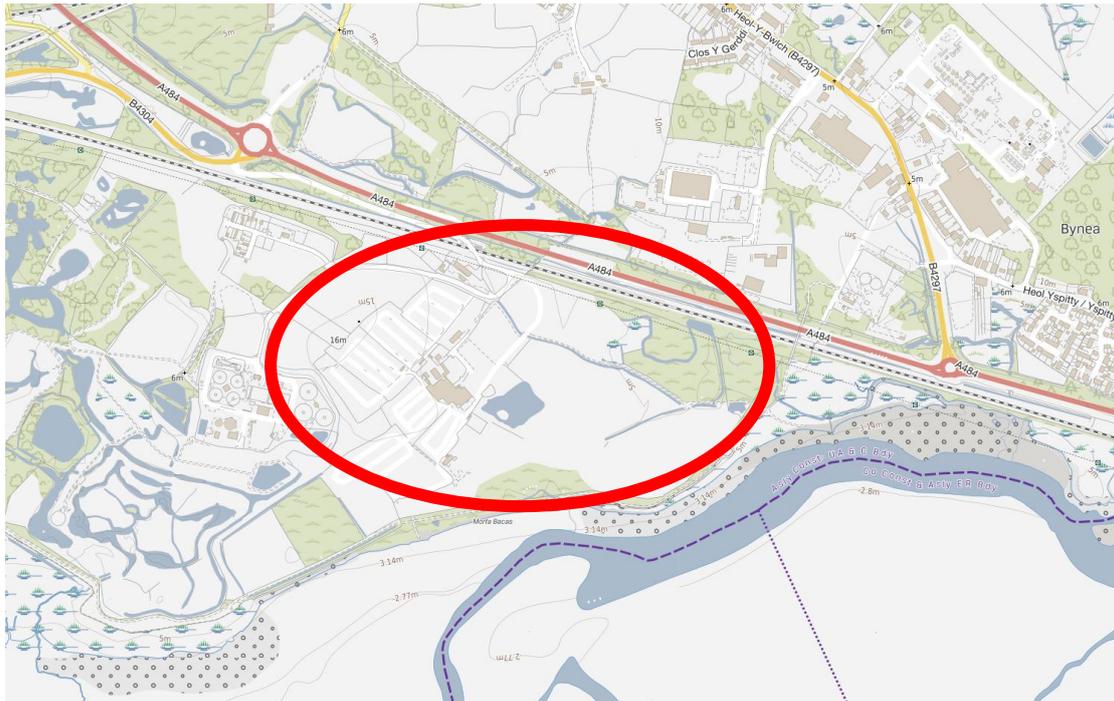


Figure 2.2 – Plan of Area

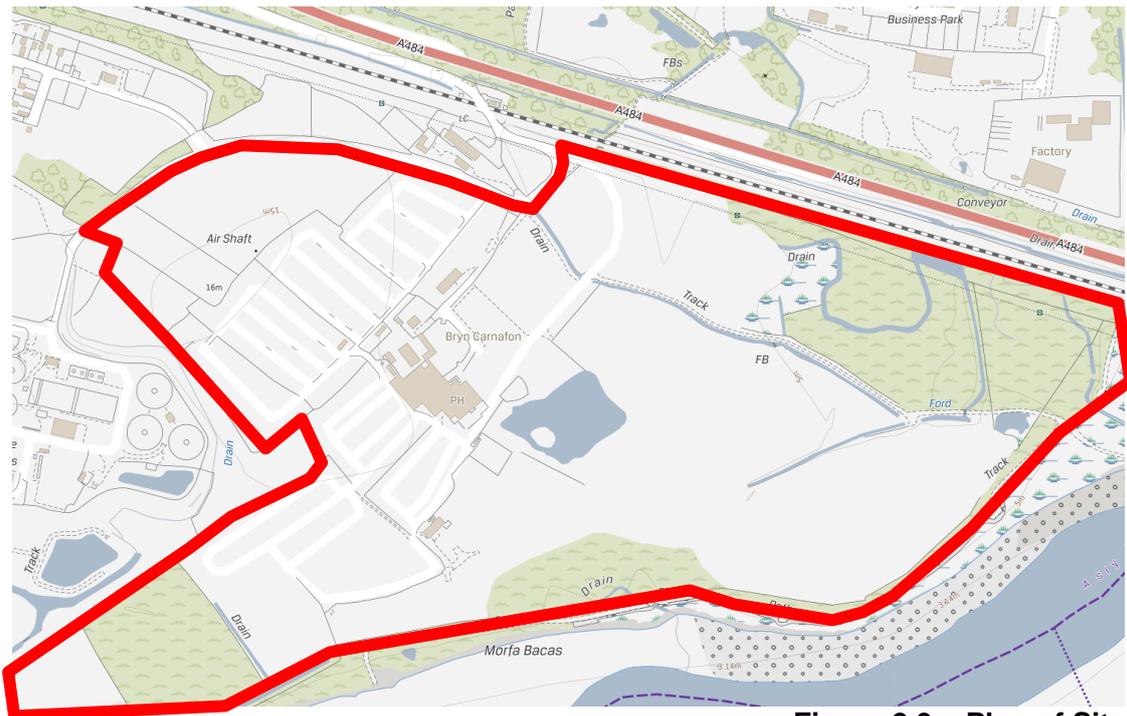


Figure 2.3 – Plan of Site



Plate 2.1 – Aerial Photograph of Site

2.2 Proposal

It is proposed to enhance and develop the Gateway Holiday Park by promoting several developments, including those identified on Table 2.1 (see Figure 2.4 to 2.11).

Table 2.1 – Proposed Developments		
Ref	Development	Vulnerability
A	Go Kart Track	Less vulnerable / Recreational
B	Relocation of a static caravan	Highly vulnerable
C	Substitution of 32 touring caravans with 32 static caravans	Highly vulnerable
D	Additional 60 touring caravans	Highly vulnerable
E	Tennis courts	Recreational
F	Agricultural shed	Less vulnerable
G	Hotel	Highly vulnerable

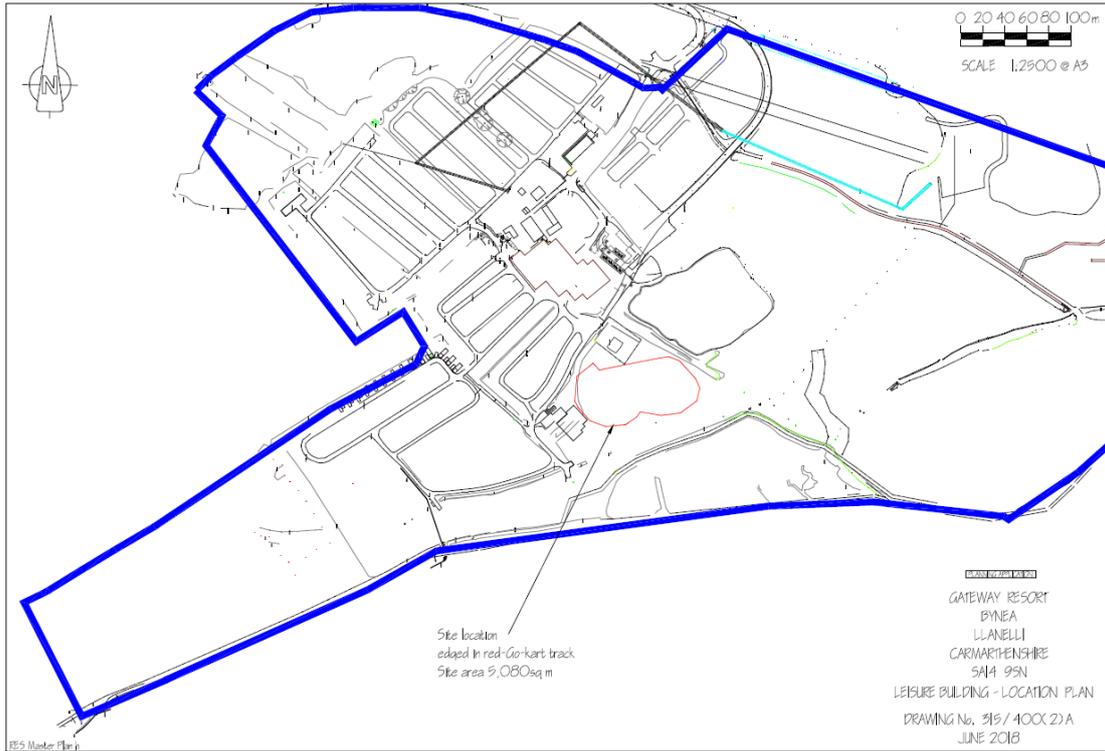


Figure 2.4 – Proposed Go Kart Track

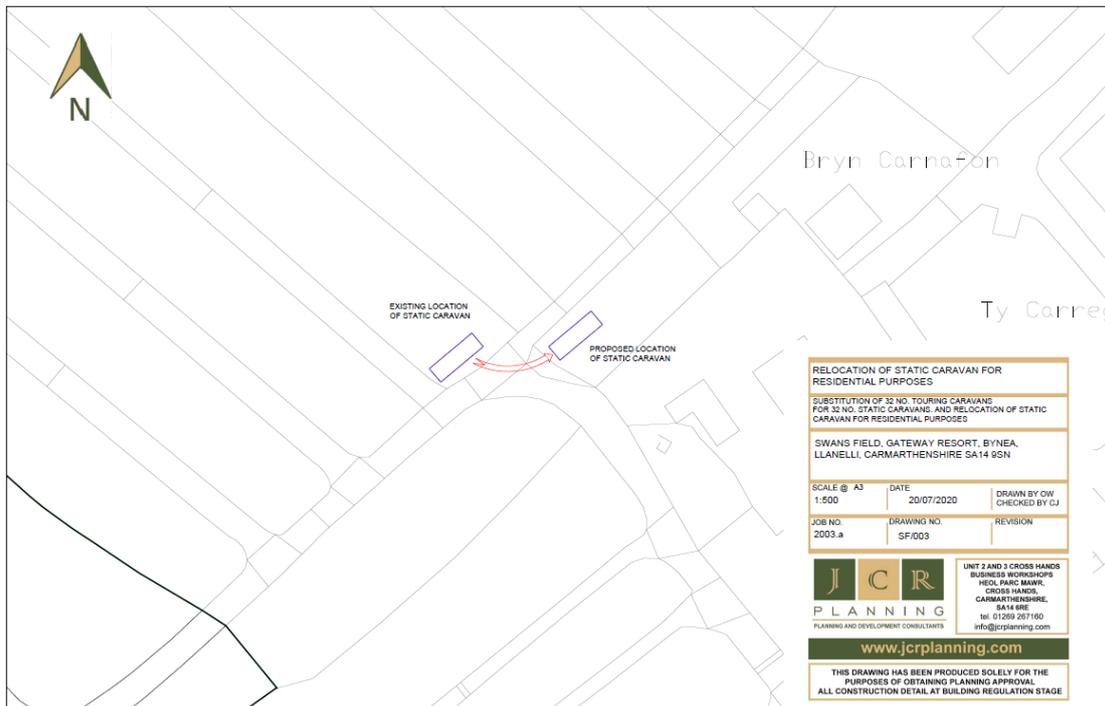


Figure 2.5 – Proposed Locational Change of a Static Caravan



Figure 2.6 – Area of Proposed Substitution of 32 Touring Caravans with 32 Static Caravans

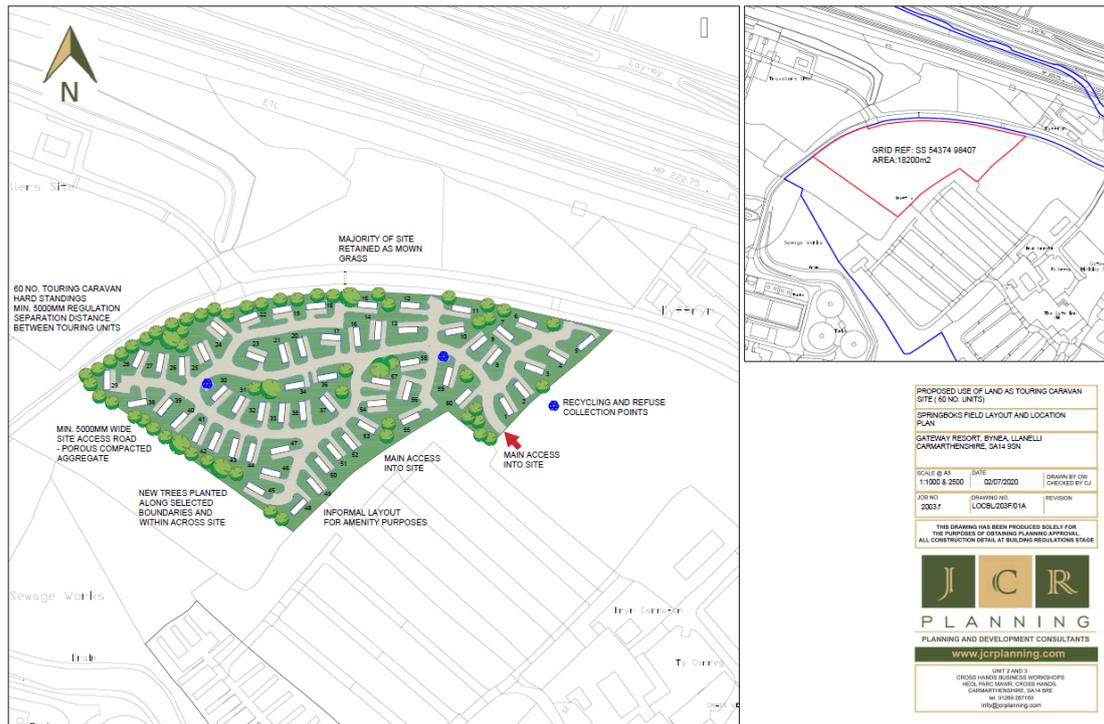


Figure 2.7 – Proposed Additional 60 Touring Caravans

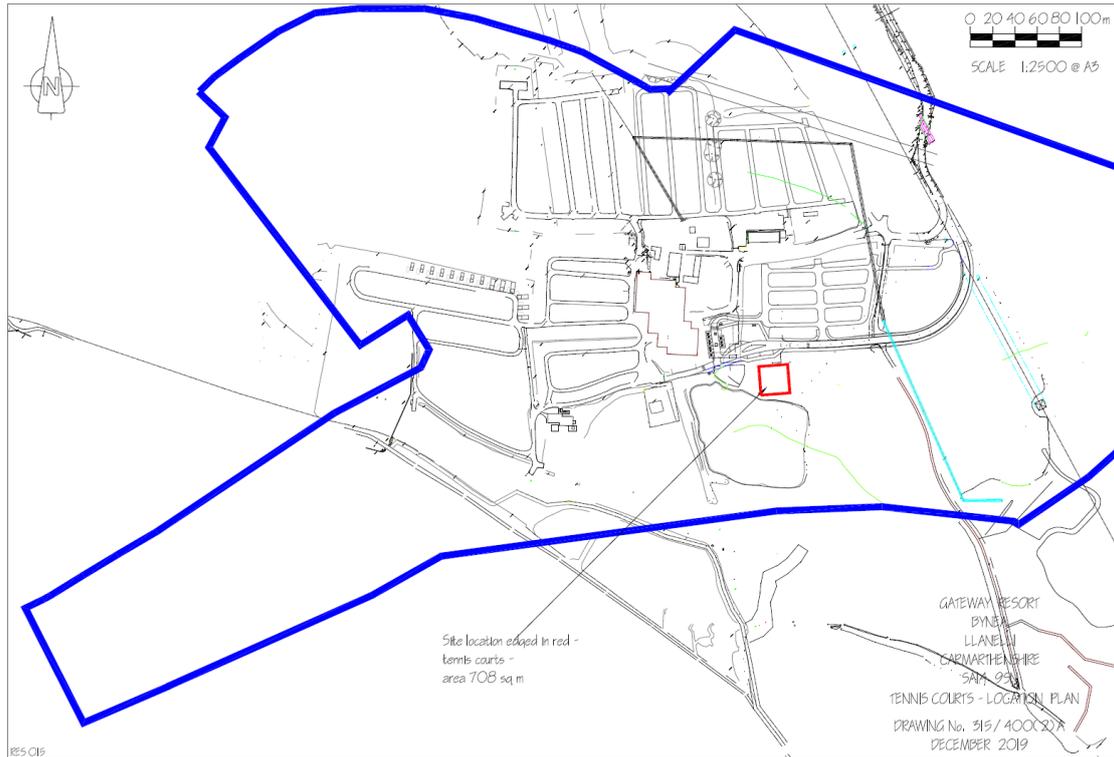


Figure 2.8 –Proposed Tennis Courts



Figure 2.9 –Proposed Agricultural Shed

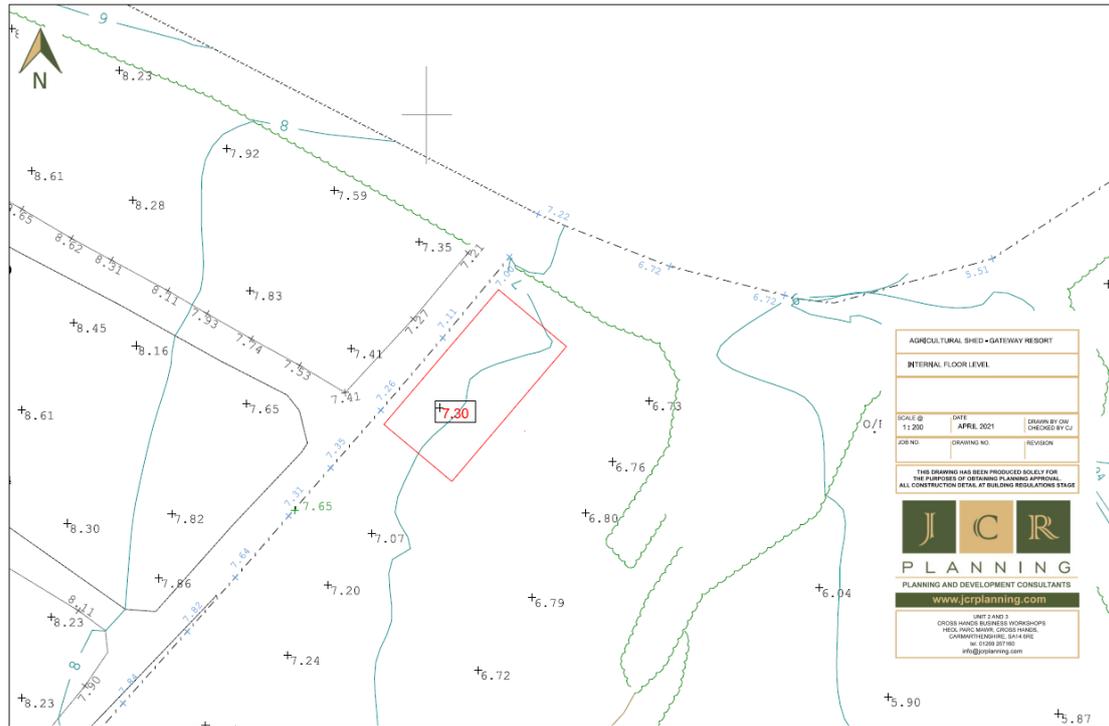


Figure 2.10 – Topography Around Proposed Agricultural Shed

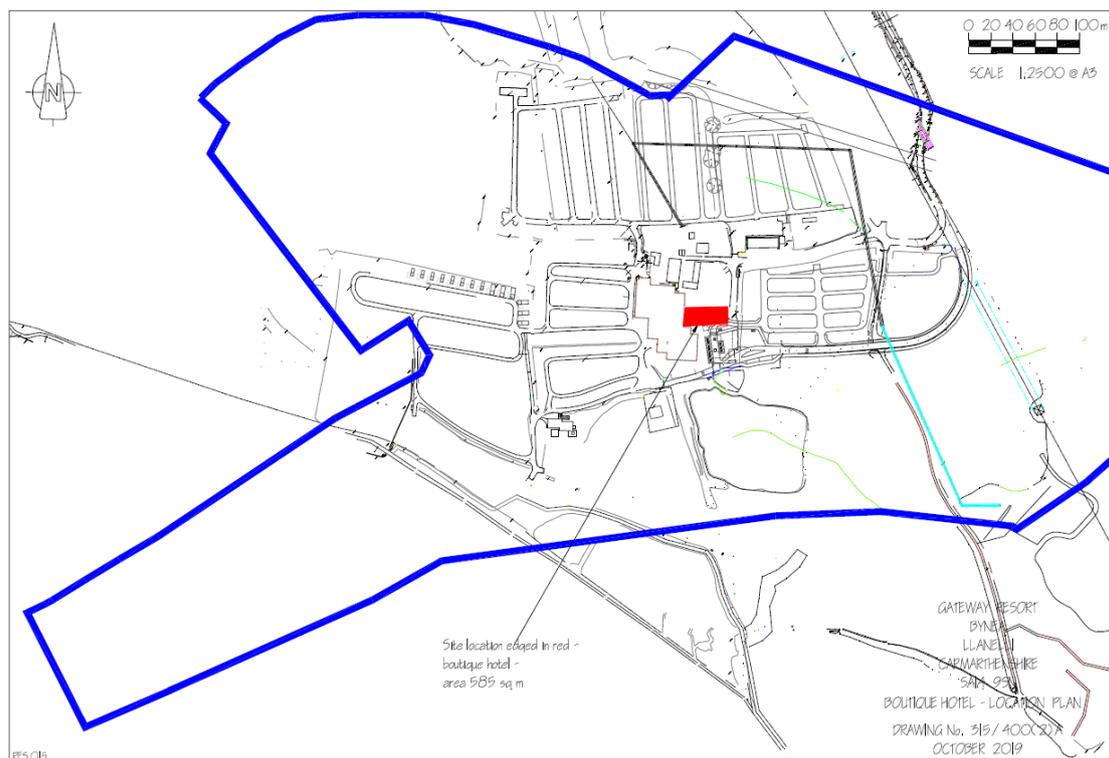


Figure 2.11 –Proposed Hotel

2.3 Defences

The area of the Park within the C1 zone have a degree of protection, against flooding, from recognised defences (see Figure 2.12).

There are coastal defences along the bank of the Loughor Estuary following the coastal cycleway from the Old Waste Water Treatment Works through Penclacwydd

to the docks in Llanelli. It is understood that the flood defences of the Llanelli Coast, in this area, are set at a level of 7.0m AOD and recent defence works in Bynea (Huntsman Chemical Works) are believed to have a defence level of 6.3m AOD.

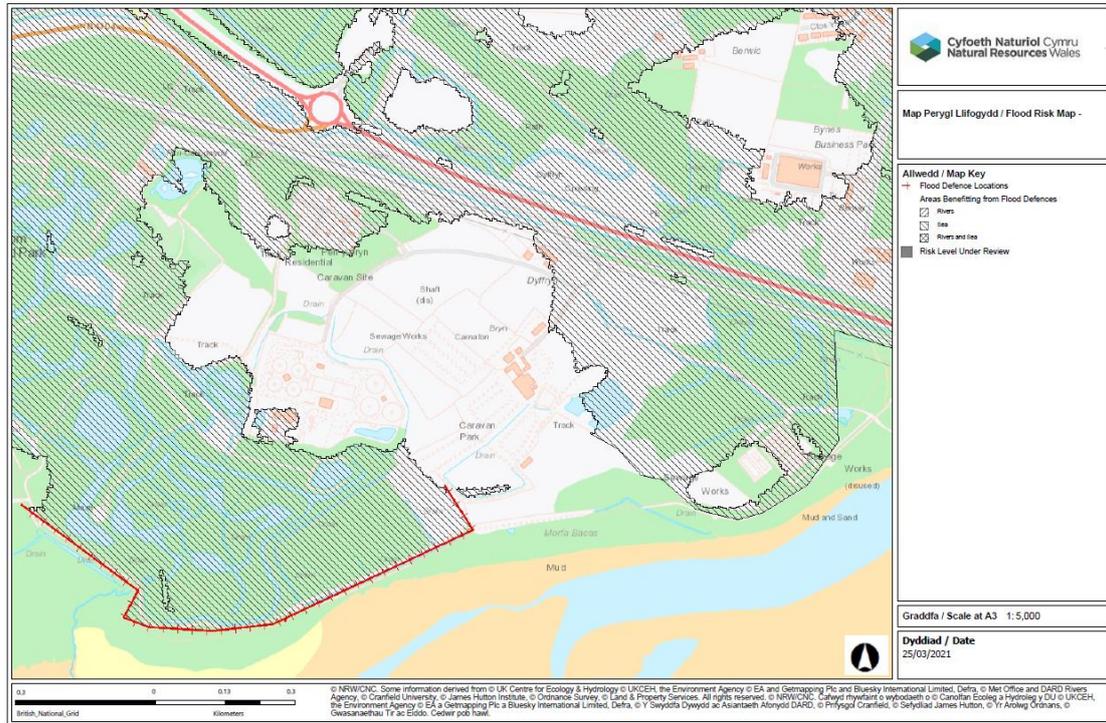


Figure 2.12 – Location of Defences and Area Afforded Protection

3 FLOOD RISK

NRW's flood risk map (see Figure 3.1) generally places the proposed developments outside the 1 in 1000 event flood zone. The map, however, does not take sea level rise into consideration.

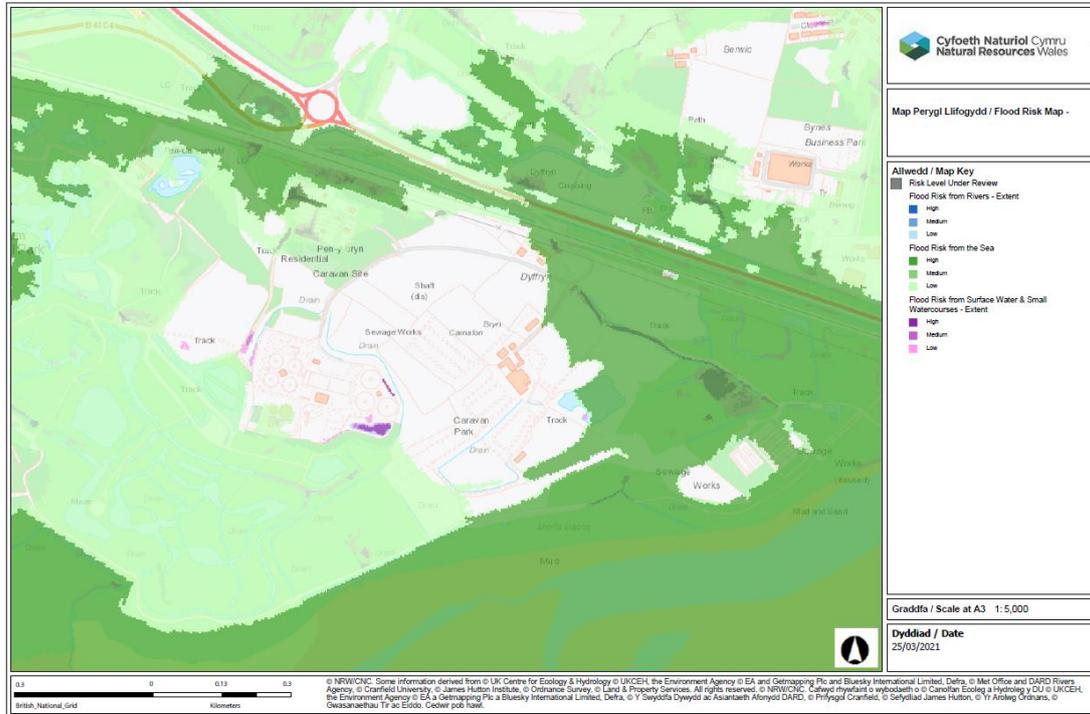


Figure 3.1 - NRW Flood Risk Map

3.1 Fluvial

Considering the width of the Loughor Estuary the risk of flooding from the Llwhwr is not considered likely. There are also no significantly sized streams or other rivers nearby although there are several small drainage channels and old tidal creeks.

3.2 Tidal

Considering the proximity of the site to the Loughor Estuary the development could potentially be at risk of flooding from tidal inundation. It is understood that there are tidal defences in place providing a degree of protection.

Table 3.1 Depth Key			
River Flooding	Tidal Flooding	Watercourse / Surface Flooding	Water / Depth
			0-0.15m
			0.15m-0.3m
			0.3m-0.9m
			>0.9m

NRW's new Hazard Maps shows that a significant part of the Park, including the proposed developments, is expected to remain flood free during both the T200 and T1000 flood events, although the north eastern corner would be affected with flood depths of over 0.9m (see Figures 3.2 and 3.3 and Table 3.1). The Hazard during the T1000 event could be a danger to most in areas (see Figure 3.4).

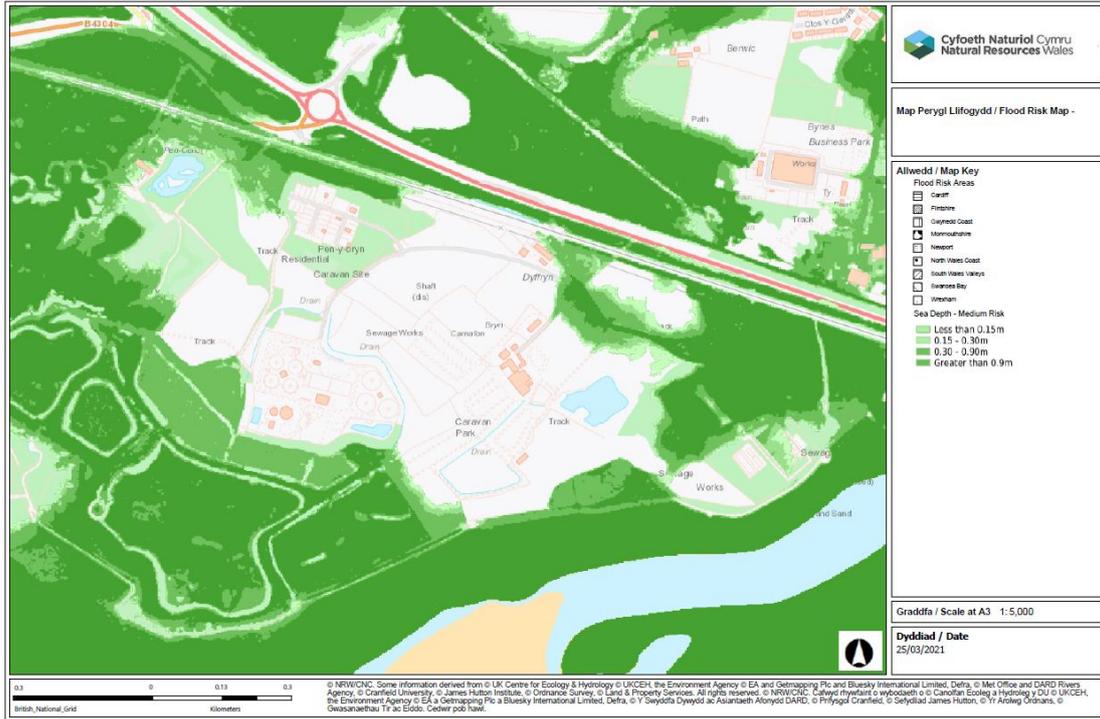


Figure 3.2 – T200 Depth (Key on Table 3.1)



Figure 3.3 – T1000 Site Depth (Key on Table 3.1)

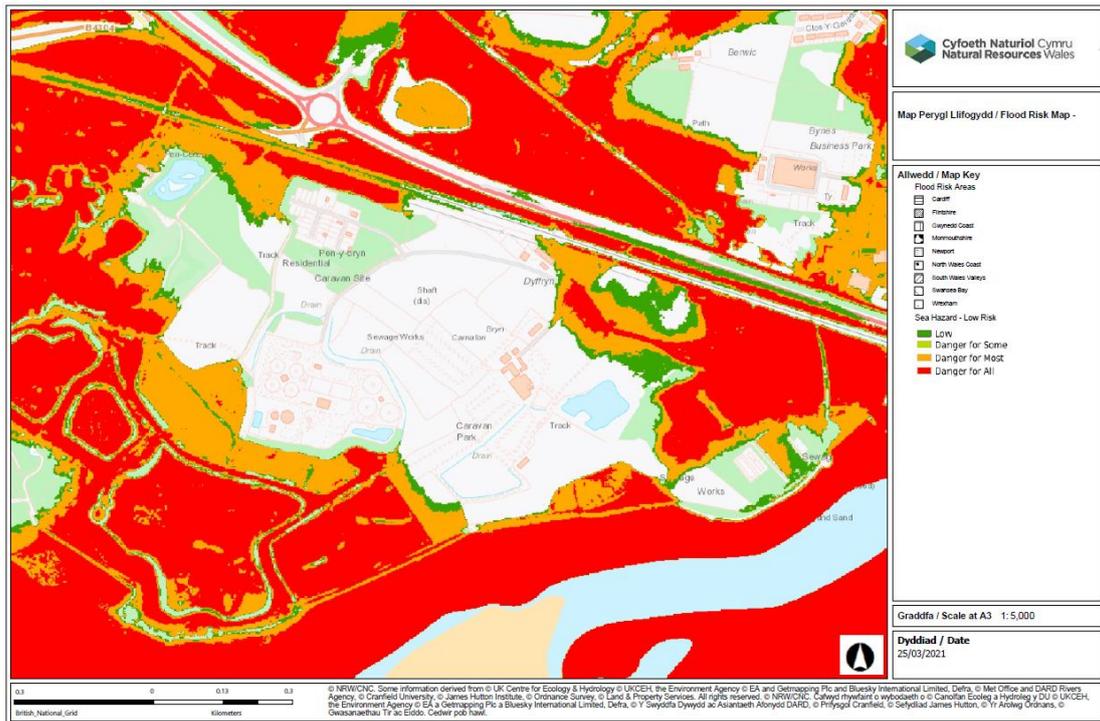


Figure 3.4 – T1000 Flood Hazard

However, the above tidal maps do not take sea level rise into consideration. NRW generally prefer the method promoted in the coastal flood boundary conditions (for UK mainland) research project, as amended (2018), to determine the T200 and T1000 high tide levels. This accounts for the joint probability of meteorological (surges etc) and astrological effects (the impact of the sun and the moon) on the tide. The levels for the adjacent coastline, with a 95% confidence level and the precautionary 97.5%, were obtained for the T200 and T1000 events and are provided in Table 3.2 (base year 2017).

In addition, recommendations from NRW suggest that the current tide levels should be increased by 100 years of sea level rise for a new highly vulnerable development (eg hotel, caravans) or 75 years for a less vulnerable development (eg other commercial buildings). The derived T200 year and T1000 year levels, using the above approach, are provided in Table 3.3.

Table 3.2 - Water Surface Extreme Tide Elevation (m AOD)			
T200 (0.5%)		T1000 (0.1%)	
Level	97.5% Confidence	Level	97.5% Confidence
6.02	6.22	6.27	6.69

	2017	Current	50 years of sea level rise	75 years of sea level rise	100 years of sea level rise
T200	6.02	6.034	6.476	6.796	7.159
T200 Precautionary	6.22	6.234	6.676	6.996	7.359
T1000	6.27	6.284	6.726	7.046	7.409
T1000 Precautionary	6.69	6.704	7.146	7.466	7.829

The T200 and T1000, with 75 and 100 years of sea level rise, have been contoured on LiDAR data for the area, as can be seen on Figure 3.5. This assumes that the defences have been breached, or exceeded, and conservatively that the sea level is reached as far inland as possible before the tide recedes. A topographic survey of the area, particularly around the proposed agricultural building (see Figure 2.10), has also been carried out.

An assessment of each of the proposed developments is noted on Table 3.4.

Ref	Development	Assessment
A	Go Kart Track	Most of the track lies above the T200 flood level, with 75 years of sea level rise. Classifying the development as a commercial the finished level should be set above the line.
B	Relocation of a static caravan	Both the current and proposed locations are above the T1000 flood line, with 100 years of sea level rise, meeting TAN 15 requirement.
C	Substitution of 32 touring caravans with 32 static caravans	Located above the T1000 flood line, with 100 years of sea level rise, meeting TAN 15 requirement.
D	Additional 60 touring caravans	Located above the T1000 flood line, with 100 years of sea level rise, meeting TAN 15 requirement.
E	Tennis courts	Being a recreational development, it would be acceptable for it to be located within a tidal flood zone. Consideration could be given to setting the court levels above the T200 flood line. Any buildings associated with the courts must be located above the flood line.
F	Agricultural shed	The finished floor level of the building is set at 7.3m AOD which would allow it to be flood free during the T200 event, with 75 years of sea level rise and limits the flood depth to 166mm during the precautionary T1000 event.
G	Hotel	The building is generally located above the T1000 flood line, with 100 years of sea level rise, although a small section could lie below. It would be prudent to set the finished floor level above the line.

Access from the site during an event might be difficult should the defences be breached with the road between the site and the A484 potentially flooding. It is estimated that the flood depth could be over 3m. The flood velocities would depend on the location and the nature of the breach but considering the distance from the defences it is unlikely to be excessive. A previous study has estimated that the velocities along the access road will generally be less than 0.15m/s although a maximum velocity of 0.45m/s could occur in areas. The rate of rise of the water is again dependant on the nature of the breach otherwise it follows the tide.

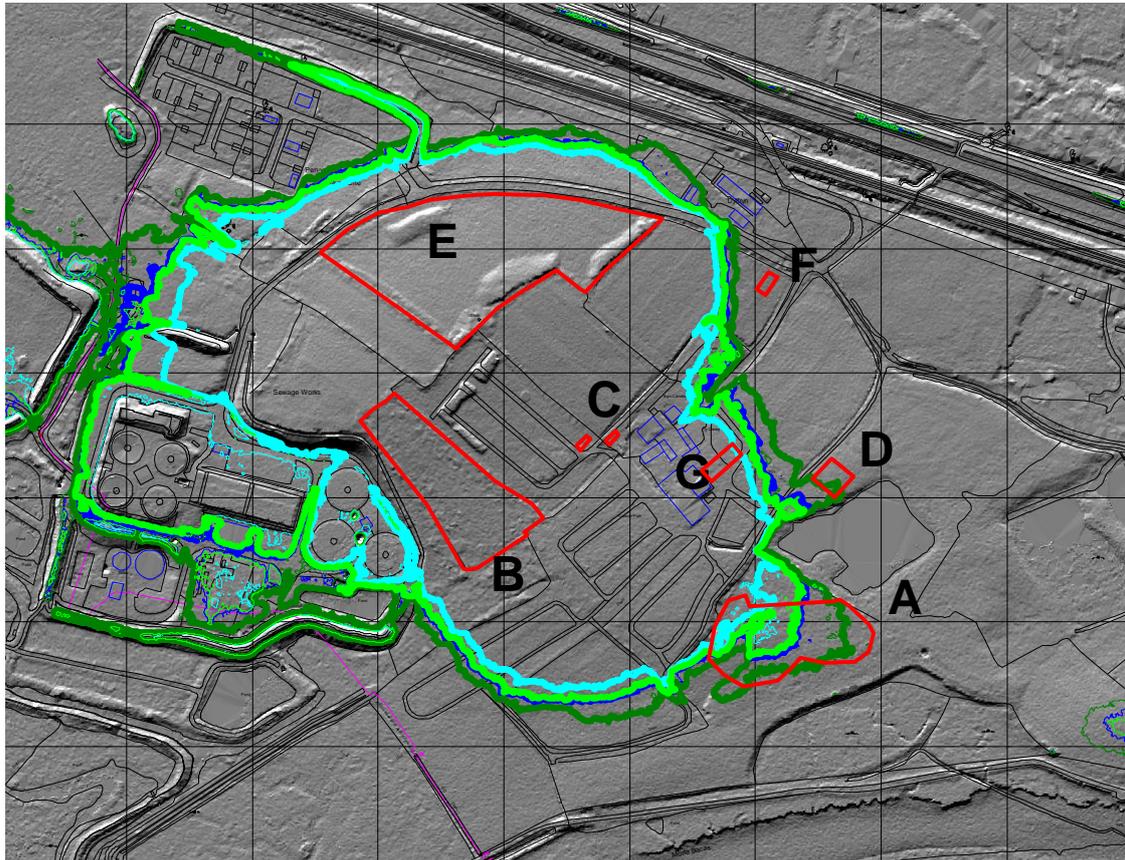


Figure 3.5 - 100 Year Flood Contour Map for Site

Considering that the risk of flooding is from a tidal source it is likely that sufficient warning would be obtained to close and evacuate the site. Nevertheless, if the access road is flooded the site is self contained with supplies and staff trained in first aid. A detailed flood response plan has been prepared to ensure that the risk of flooding to the access road can be dealt with appropriately.

Low lying areas behind coastal defences can be flooded due to waves overtopping the structures. In this instance over topping water will generally drain to the low land east of the site.

The wave heights reaching the site will be depth limited and considering the position of the proposed developments on the site they are generally expected to be protected against direct wave action. There a slight possibility that some waves could role onto the go kart track but considering the nature of the development people are not expected to be placed at risk and the track is not expected to suffer significant damage.

Surface Water

The proposed developments are not at risk from surface water flooding (see Figure 3.6) although some of the low lying areas on the site and part of the access road could be. Even for the areas at risk, the hazard is considered to be “low” or only “a danger to some” (see Figure 3.7). Any surface water flowing towards the proposed developments is likely to continue to lower land and subsequently to the estuary. Standard precautionary procedures should, therefore, be sufficient to protect the proposed developments from this source of flooding. It is also noted that the floor levels of the caravans are raised, by default, above the adjacent ground level.

Surface water could have an impact on the entrance and access road, however, the effect will only be for short periods with no anticipated damage.

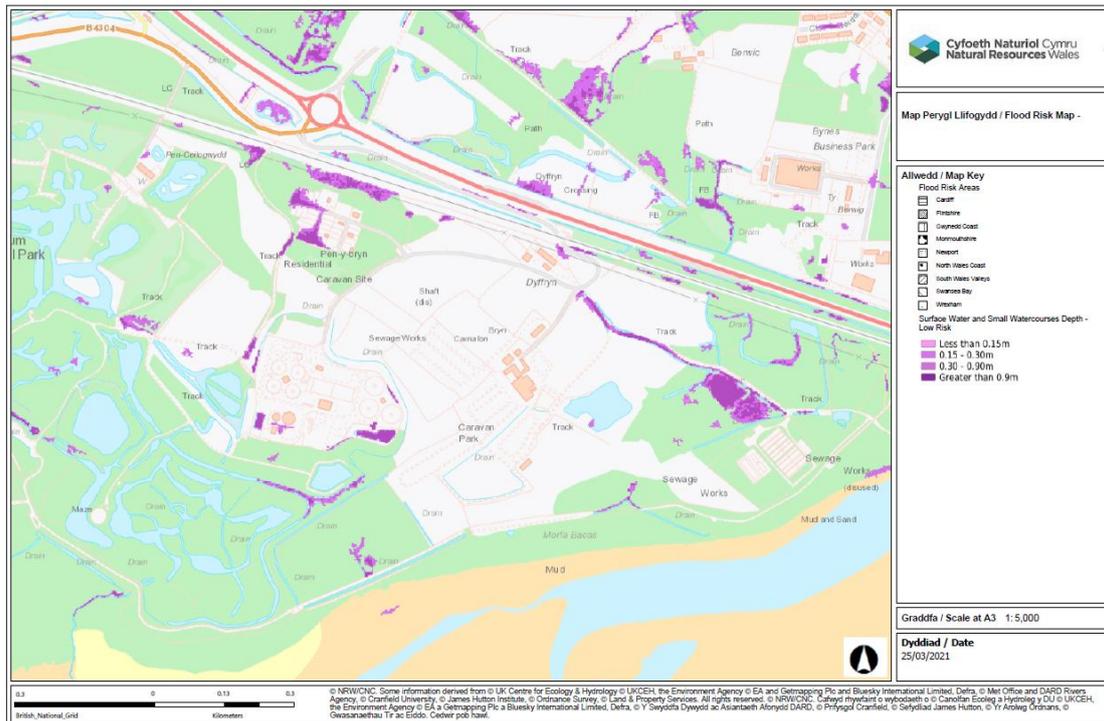


Figure 3.6 – Q1000 Surface Water Flooding Depth

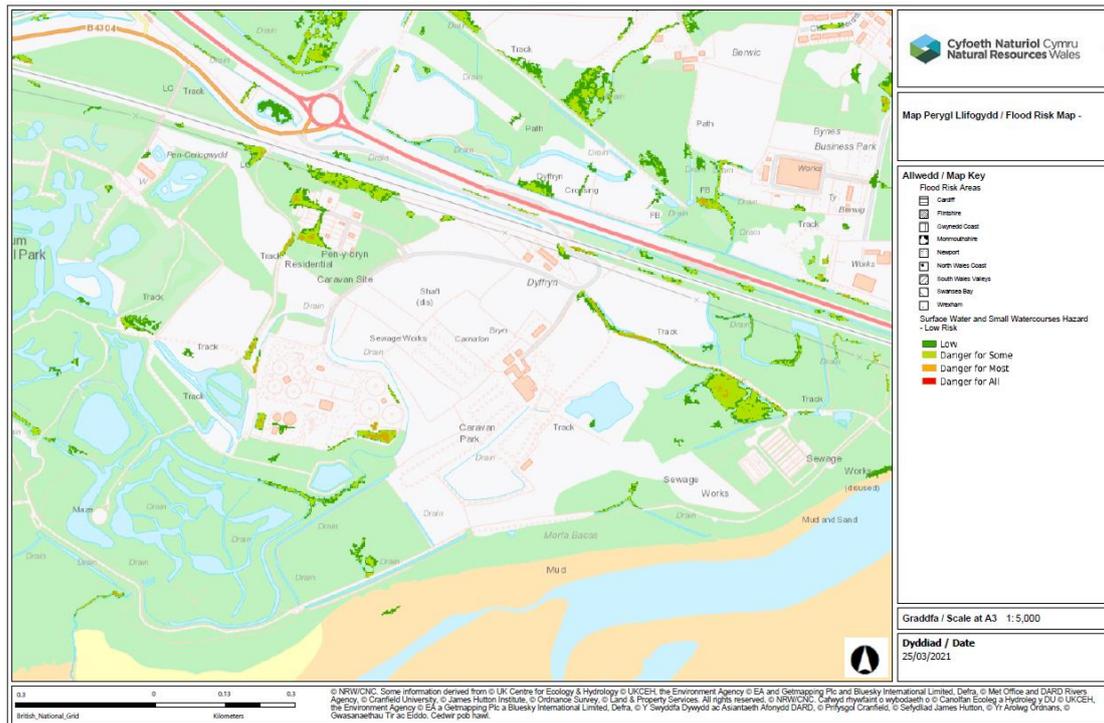


Figure 3.7 – Q1000 Surface Water Hazard

Sustainable Drainage

A sustainable drainage system, in accordance with the Welsh Government Standards and the SUDS manual, may be required for the new development although the discharge from the site generally discharges into tidal waters. As the development exceeds 100m², SAB approval may also be required.

Reservoir Failure

Should the Lliw Reservoirs fail then flood water is expected to flow into the Loughor Estuary but is not expected to flood onto the site (see Figure 3.8).



Figure 3.8 – Extend of Flooding From Reservoir Failure

Ground Water

The superficial geology for the site generally consists of Diamicton of Devensian Till with some Sand and Gravel from a Raised Storm Beach, at the lower end of the site, and possibly some Silt and Clay from Tidal Flat Deposits overlying the bedrock geology of Mudstone, Siltstone and Sand Stone of the Swansea Member and Hughes Member (see Figure 3.9 and 3.10). When also taking the terrain into account the risk of groundwater flooding for the proposed developments is considered to be low.

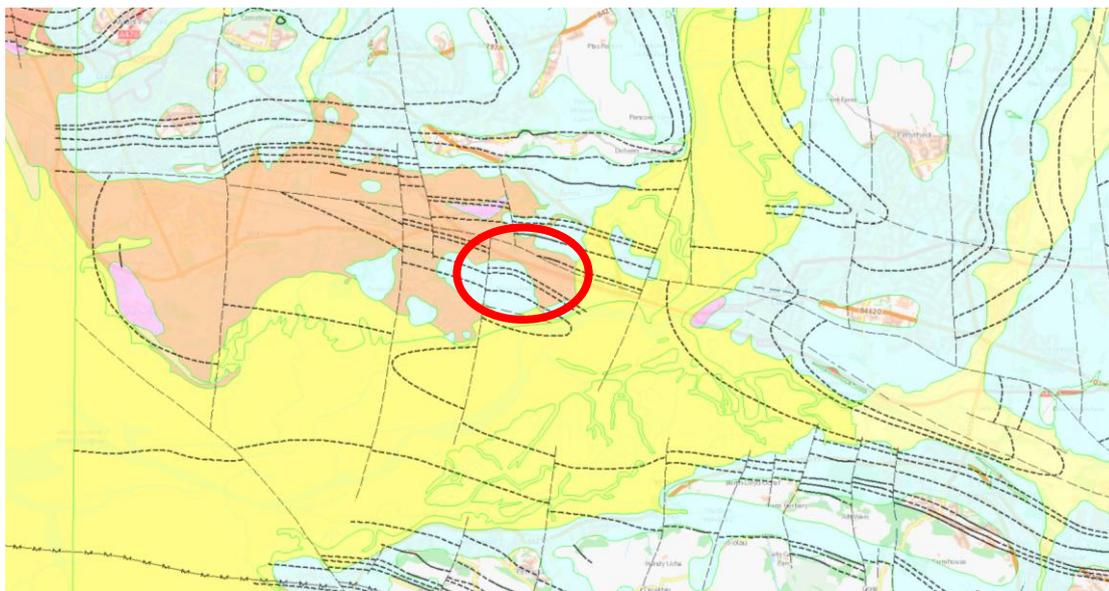


Figure 3.9 – Superficial Geology

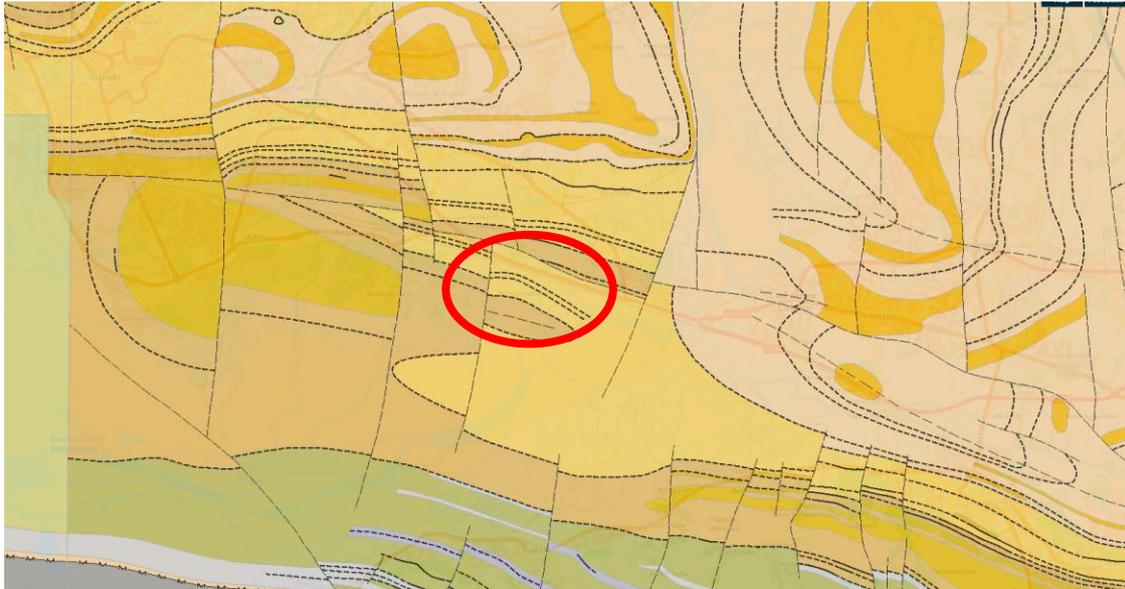


Figure 3.10 – Bedrock Geology

4 FLOOD RESPONSE

Other than the agricultural shed, the proposed developments will be located above the T1000 flood line or, in the case of the tennis courts and go kart track, will not be affected by flooding. In addition, the caravans, by nature of their construction, will be higher than the surrounding ground.

It is accepted, should the defences be breached the access road to the site could become flooded. However, the site is registered on NRW's flood warning scheme and staff and visitors are made aware of the flood risk (see Figure 4.1).

When a flood warning is received it will be disseminated to all staff and visitors. To facilitate this, a Flood Response Plan is in place. When receiving a flood warning the site will be closed and evacuated. As the main risk of flooding is from a tidal source, a long warning period is expected (in the region of 24hours).

Signs should also be erected warning people of the risk of flooding. In addition, it is recommended that leaflets are provided on entry to all visitors staying at the park advising them of the risk and the evacuation procedure.

If necessary, shelter could be sought at the resort which is stocked with food and water and has staff trained to provide first aid.

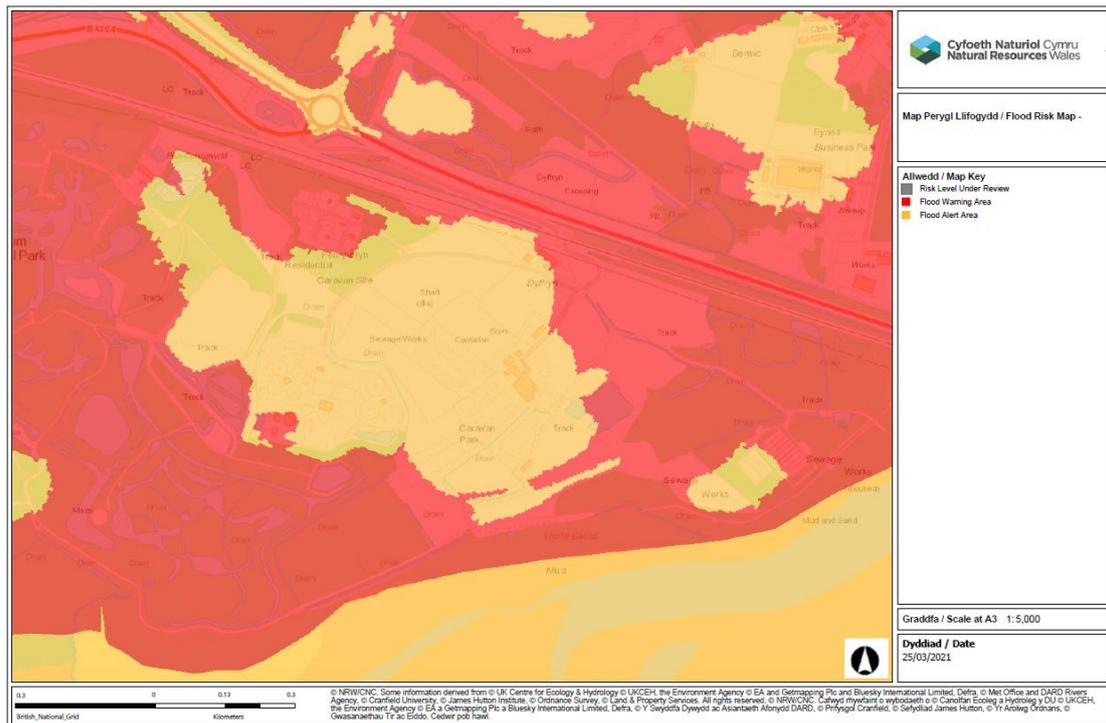


Figure 4.1 – NRW Flood Warning Areas

Although the proposed hotel is expected to remain flood free even during a 1 in 1000 year event it is not possible to completely remove the risk. The agricultural shed could also be at risk during the T1000 event. Flooding can result in the need for expensive repairs. As well as the direct damage caused to the buildings, flooding can impact in many other, and possibly more stressful, ways. The inconvenience of cleaning up a building and the loss of goodwill when closed can be immeasurable. There are methods, however, to limit and mitigate against the consequence of flood

damage. Some of these are discussed in this section and should be considered as part of the development where applicable.

Water can enter a building:

- Around the edges of closed doors;
- Through airbricks;
- Backflow through overloaded sewers;
- Seepage through walls especially cracks;
- Seepage through the ground;
- Around cable / services entrance into the building.

Dryproofing - Preventing the water from entering the building.

In the first instance it is possible to take measures to prevent the ingress of water (dryproof). However, as the finished floor level of the hotel is expected to be above the T1000 flood line and the agricultural building is expected to be flood free during the T200, additional dry proofing measures are not considered necessary.

Wetproofing – Limiting the impact once water has entered the building.

It may not be feasible to eliminate the risk of flooding, however, it is possible to limit the damage that the water can cause once in the building (wetproof). Where appropriate the following could be considered:

- Move valuable items to a higher level;
- Have solid concrete floors. Suspended floors are more difficult to clean and dry underneath;
- Use water resistant render for walls;
- Use non water absorbing insulation;
- Use corrosion resistant fittings such as galvanised or stainless steel;
- Ensure that the ground floor electrics of the hotel is on a separate circuit to the rest of the building and that the electric cables are fed from above (for the hotel and agricultural shed) with the ground floor sockets kept high;
- Use an appropriate damp proof course;
- Avoid timber frame construction;
- Consider freestanding movable equipment;
- Install equipment with motors high up from the floor;
- Install solid internal and external doors effectively sealed;
- Avoid storage heaters on the ground floor;
- Ensure boilers are off the ground.

5 CONCLUSION and RECOMMENDATIONS

Conclusion

The client wishes to further enhance the Gateway Holiday Park, Llanelli, by promoting the developments identified in Table 5.1.

Ref	Development	Vulnerability
A	Go Kart Track	Lesser vulnerable / Recreational
B	Relocation of a static caravan	Highly vulnerable
C	Substitution of 32 touring caravans with 32 static caravans	Highly vulnerable
D	Additional 60 touring caravans	Highly vulnerable
E	Tennis courts	Recreational
F	Agricultural shed	Lesser vulnerable
G	Hotel	Highly vulnerable

The main risk of flooding to the site is from tidal inundation, with part of the Park in a C1 Flood Zone.

Based on results of the coastal flood boundary conditions (for UK mainland) the tidal levels for the T200 and T1000 event were obtained. In addition to this 100 and 75 years of sea level rise was added to evaluate the risk to the highly vulnerable developments and the less vulnerable developments, respectively. The precautionary values are provided in Table 5.2 and the sea level contours, on Lidar data, are provided on Figure 5.1.

	75 years of sea level rise		100 years of sea level rise	
T200 Precautionary	6.996		7.359	
T1000 Precautionary	7.466		7.829	

Figure 5.1 shows that most of the go kart track lies above the T200 flood level, with 75 years of sea level rise, it would be prudent, however, to ensure that the tracks finished floor level is set entirely above this level. This would ensure that the flood depth during the T1000 event (with 75 years of sea level rise), at 470mm would be manageable in accordance with TAN 15.

The relocation of the static caravan, the substitution of o 32 touring caravans with 32 static caravans along with the additional 60 touring caravans would all occur above the T1000 flood line (with 100 years of sea level rise) and are not directly affected by flooding.

The proposed tennis courts are recreational and, therefore, it would be acceptable to locate them in a flood zone, however, and buildings associated with the courts (eg changing rooms etc) should be located above the T200 flood line (with 75 years of sea level rise). Consideration should also be made to raising the finished floor level of the courts above the T200 flood line.

The agricultural shed will have a finished floor level of 7.3m AOD which makes it flood free during a T200 flood event, and a flood depth of less than 600mm (depth of 166mm) during the precautionary T1000 event, meeting the requirement of TAN 15. Although Lidar data would suggest that the area of the proposed shed is at risk of flooding a detailed topographic survey shows the land to be much higher.

The proposed hotel is generally located above the T1000 flood line (with 100 years of sea level rise) and completely above the T200 line. It would be prudent for the finished floor level for the building to also be set above the T1000 flood level.



Figure 5.1 - Precautionary Flood Contour Map for Site

The access road to the Park could be at risk of flooding during a T200 event, should the defences be breached. As such the Park has a flood response plan in place and is registered on the Natural Resources Wales flood warning scheme. As the risk of flooding is tidal it is expected that ample time will be provided for the site to be closed and evacuated, although it would be self contained if access from the site was prevented for whatever reason.

Standard precautionary measures should be sufficient to protect the developments against surface water flooding. The developments are also not considered to be at risk from fluvial or ground water flooding or from reservoir failure.

As the rainwater discharge from the site drains directly into the adjacent estuary the need to regulate the discharge rate is not strictly necessary. However, the new Welsh Government Standards requires other aspect of the drainage, such as pollution, biodiversity and amenity, to be taken into consideration potentially requiring SAB approval to be obtained.

Recommendations

In developing the site it is recommended that:

- The finished floor level of the go kart track be set above the T200 flood level.
- Any buildings associated with the tennis courts to be located above the T200 flood line and consideration be given to setting the finished level of the court also above the T200 flood level.
- The finish floor level of the proposed agricultural shed is set above the T200 flood level.
- Consideration be given in setting the finished floor level of the hotel above the T1000 flood line.
- Flood proofing measures are incorporated into the design where appropriate.
- A surface water drainage report be prepared.
- The flood response plan is updated.