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Flood Risk Assessment

COACH ROAD, WHITEHAVEN

23-C-16902

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CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 CONTEXT

A L Daines and Partners LLP have been instructed by PRIMA Homes Group to prepare a Flood Risk Assessment (FRA) for the construction of 35 dwellings at Coach Road, Whitehaven.

This FRA has been completed in accordance with guidance presented within the National Planning Policy Framework (NPPF) and its associated Planning Practice Guidance (PPG), taking due account of current best practice documents relating to assessment of flood risk published by the British Standards Institute (BS8533).

1.2 SITE LOCATION

The proposed development is located on an existing area of brownfield land to the north of Coach Road, Whitehaven as shown on red line bordered plan in *Figure 1*. The site is bounded by the culverted Pow Beck to the west and a section of the Coast 2 Coast cycle route to the east. The total site area is approximately 1.039ha in area with approximately 0.443ha covered in hardstanding. The remaining section, to the east of the site, is covered in scrubland.

The location details of the proposals are detailed below:

- Land to the north of Coach Road, Whitehaven. CA28 9BX
- National Grid Reference: Eastings 297358 Northings 517424

Figure 1: Aerial photo of site - Google Maps

1.3 TOPOGRAPHY

A topographical survey of the proposed development site was undertaken in October 2022 with the results located within *Appendix A*. A review of the topographical survey carried out at the site indicates ground levels range between 6.72m to 8.45m above Ordnance Datum (AOD). The lower elevations are present to the north of the site, and higher elevations to the west of the site bounded by Pow Beck. The existing levels are to be maintained post development except for the finished floor levels of the proposed dwellings protruding.

1.4 HYDROLOGY AND DRAINAGE

The nearest main river to the site is Pow Beck, located approximately 8m west of the site, which drains in a northerly direction into the Solway Firth approximately 800m north of the site. The site is located within the Pow Beck floodplain.

An existing connection from the brownfield site to the adopted United Utilities network beneath Coach Road is present for surface and foul water. Due to the demolition of several buildings on site this connection is redundant, with surface water ponding on site in small volumes prior to discharge via this method. The United Utilities sewerage network is illustrated within *Appendix B*.

1.5 GEOLOGY AND HYDROGEOLOGY

British Geological Survey mapping indicates that the bedrock geology of the site consists of Pennine Middle Coal Measures Formation - mudstone, siltstone, and sandstone. This is overlain by superficial deposits of alluvium - Clay, silt, sand, and gravel.

Soils at the site are described by the Cranfield Soil and Agrifood Institute, supported by the Department for Environment, Food and Rural Affairs (DEFRA), as loamy and clayey floodplain soils with naturally high groundwater.

As part of the site investigations undertaken as part of the previously approved planning application 4/14/2124/0F1, it was identified that the site sits over varying depths of contaminated made ground over alluvium clays, sands, and gravels. It was concluded that these ground conditions are not favourable for the use of infiltration techniques for the disposal of surface water.

The bedrock beneath the site is designated by the Environment Agency as a Secondary A Aquifer, these are described as:

"…secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers."

The site is not located within a Drinking Water Safeguard Zone (Groundwater) and is not within any groundwater source protection zone. However, it is noted that that the site is located within an area of medium to high vulnerability of groundwater contamination.

2.0 FLOOD RISK POLICY STATUS

2.1 DEVELOPMENT PROPOSALS

The proposals are for the construction of 35 dwellings on a brownfield site to the north of Coach Road, Whitehaven. A detailed description of the development proposal is included within the planning application documentation. The proposed site plan for the development is located within *Appendix C*.

2.2 FLOOD ZONE CLASSIFICATION

The definition of the Environment Agency Flood Zone is provided within PPG Table 1: Flood Zones and is included for reference below:

- Flood Zone 1 – Low probability. Is defined as land which could be at risk of flooding from fluvial or tidal events with less than 0.1% annual probability of occurrence (1:1,000 year).
- Flood Zone 2 – Medium probability. Is defined as land which could be at risk of flooding with an annual probability of occurrence between 1% (1:100 year) and 0.1% (1:1,000 year) from fluvial sources and between 0.5% (1:200 year) and 0.1% (1:1,000 year) from tidal sources.
- Flood Zone 3a – High probability. Is defined as land which could be at risk of flooding with an annual probability of occurrence greater than 1% (1:100 year) from fluvial sources and greater than 0.5% (1:200) from tidal sources.
- Flood Zone 3b – the Functional Floodplain. Is defined as land where water has too flow or be stored in times of flood. Local Planning Authorities should identify in their Strategic Flood Risk Assessment areas of functional floodplain in agreement with the Environment Agency. In the absence of definitive information, it is often defined as land that would flood with an annual probability of occurrence of 5% (1:20) or greater.

In assessing the Flood Zone, the protection offered by any flood defence structures, and other local circumstances, is not considered by the Environment Agency.

Based upon the Environment Agency Flood Map for Planning (illustrated in *Appendix D*), the site lies within Flood Zone 2 (Medium probability) with a small area of Flood Zone 3a (High Probability) at the frontage of the site with Coach Road. It is noted no properties are to be constructed within Flood Zone 3a.

2.3 NATIONAL PLANNING POLICY

The FRA has been completed in accordance with the guidance presented within the NPPF and with reference to the PPG.

2.3.1 Flood Risk Vulnerability

With reference to paragraph 66 of PPG Table 2: Flood Risk Vulnerability Classification, the proposed development relating to 'Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels' is considered 'More Vulnerable' in terms of flood risk classification.

2.3.2 Flood Risk Compatibility

As discussed in Section 2.2, the site lies predominantly within Flood Zone 2. With reference to PPG Table 2: Flood risk vulnerability and flood zone compatibility (reproduced as Table 2-1) confirms that the development use is appropriate, and the Exception test need not be applied.

2.3.3 SEQUENTIAL TEST

With reference to the NPPF the sequential test gives preference to locating new developments in areas at lowest risk of flooding (i.e., Flood Zone 1). Strategic Flood Risk Assessments (SFRAs) are geared to providing the basis for applying this test.

The Sequential Test requires developers to:

"…. demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed."

Moreover, the Copeland Borough Council Strategic Flood Risk Assessment states that:

"It is recognised that only a relatively small proportion of the Borough is situated within Zone 3a High Probability. Prohibiting future residential development in these areas is unlikely to have a detrimental impact upon the economic and social welfare of the existing community, however there may be pressing planning 'needs' that may warrant further consideration of these areas. Should this be the case, the Council and potential future developers are required to work through the Exception Test (PPS25 Appendix D) where applicable. For the Exception Test to be passed:

- *It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the Development Plan Document (DPD) has reached the 'submission' stage, the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal 9.*
- *The development should be on developable, previously developed land or if it is not on previously developed land, that there are no reasonable alternative sites on previously developed land; and*
- *A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall." 174. The first two points set out in the Exception Test are planning considerations that must be adequately addressed. A planning solution to removing flood risk must be sought at each specific location in the initial instance, seeking to relocate the proposed allocation to an area of lower flood risk (i.e. Zone 1 Low Probability or Zone 2 Medium Probability) wherever feasible."*

As discussed in Section 2.2 the proposed development lies predominantly within Flood Zone2 and is classified as 'More Vulnerable'. A Sequential Test report, attached within *Appendix E*, has been prepared by SRE Associates and this has been submitted as part of the planning application documentation. The report finds that there are no Sequentially preferable sites suitable of accommodating the proposed development in alternative sites located in or adjacent to the town centre.

2.4 LOCAL PLANNING POLICY

2.4.1 Copeland Borough Council Local Plan

The Copeland Local Plan (2013 – 2028) was adopted in December 2013 and is the principal document within the Local Development Framework (LDF). It sets out Copeland Borough Council's (now Cumberland Council) vision and policies for future development in the former Copeland area until 2028. It is noted that the Copeland Local Plan 2021 – 2038 was submitted for independent examination on the 16 September 2022; however, this document has not been adopted and as such the previous Local Plan remains the relevant document.

Managing flood risk is a core priority within the Copeland Local Plan which states that:

Policy ENV1 – Flood Risk Management

It states that development should:

"Policy ENV1 aims to ensure that new development is located outside areas at risk from flooding and that development does not contribute to an increased risk of flooding elsewhere. This policy supplements that approach to provide clarity for development proposals in areas which are considered to be at risk of flooding or for those where development is likely to increase the risk of flooding elsewhere."

The Council will ensure that development in the Borough is not prejudiced by flood risk through:

A. Permitting new build development only on sites located outside areas at risk of flooding, with the exception of some key sites in Whitehaven.
B. Ensuring that developments on important regeneration sites in Whitehaven Town Centre and Harbourside and Pow Beck Valley are designed to address the existing levels of flood risk without increasing flood risk elsewhere.
C. Ensuring that new development does not contribute to increased surface water run-off through measures such as Sustainable Drainage Systems, where these are practical. Where they are not this should be achieved by improvements to drainage capacity.
D. Supporting measures to address the constraints of existing drainage infrastructure capacity and avoiding development in areas where the existing drainage infrastructure is inadequate.
E. Support for new flood defence measures to protect against both tidal and fluvial flooding in the Borough, including appropriate land management as part of a catchment wide approach.

Individual development proposals will be assessed with regard to Development and Flood Risk under Policy DM24.

3.0 POTENTIAL SOURCES OF FLOODING

3.1 Methodology and Best Practice

This report has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development published by the Construction Industry Research and Information Association (CIRIA), BS85333, and the Environment Agency's National Standing Advice on Development and Flood Risk.

A screening study has been completed to identify whether there are any potential sources of flooding at the Site which may warrant further consideration. If required any potential flooding issues identified in the screening study would then be considered in subsequent sections of the assessment.

3.2 SCREENING STUDY

There are several potential sources of flooding, and these include:

- Flooding from rivers or fluvial flooding.
- Flooding from the sea or tidal flooding.
- Flooding from surface water and overland flow.
- Flooding from groundwater.
- Flooding from sewers.
- Flooding from reservoirs, canals, and other artificial sources; and
- Flood from infrastructure failure.

The flood risk from each of these potential sources is discussed below.

3.2.1 Flooding from Fluvial and Tidal Sources

Mapping published by the Environment Agency indicates that the proposed development lies predominantly within an area where flooding is considered to have a 'medium probability of occurrence'. Flood Zone 2, which represents a risk of flooding from fluvial sources of between 1% (1:100 year) and 0.1% (1:1,000 year) and between 0.5% (1:200 year) and 0.1% (1:1,000 year) from tidal sources. As noted within the Copeland SFRA, flood risk at Coach Road can be attributed to both fluvial and tidal sources. Environment Agency investigations suggest that there is flooding at the Coach Road culvert with a frequency greater than once in every 25 years.

Information provided as part of the data request to the Environment Agency (*Appendix F*) confirms that there are historic flooding records of fluvial flooding at the site in August 2006, November 1999, June 2007, and December 2013. It is noted within the information provided that a flood defence is located to the northeast of the site on Midgey Gill through a constructed wall and embankment designed to a 1:20 year standard of protection.

The risk of fluvial flooding on site is considered to be high and is therefore discussed further in section 5 of this report.

3.2.2 Flooding from Surface Water and Overland Flow

Mapping published by the Environment Agency illustrates that areas considered to be at a low risk of flooding are located to the frontage of the site, flowing through the proposed access into the development site, and to the east along the Coast 2 Coast cycle network. A low risk of surface water flooding represents a risk of flooding of between 1% (1:100 year) and 0.1% (1:1,000 year). This corresponds to a flooding depth of less than 300mm in a low probability event from 1 in 1,000 (0.1% AEP) to 1 in 100 (1% AEP) each year.

As the risk of flooding due to surface water and overland flow is considered to be low, this risk factor is not considered further.

3.2.3 Flooding from Groundwater

Groundwater flooding can occur where sites are located on permeable ground, particularly where there are significant variations in local topography and geology. After a prolonged period of rainfall and groundwater recharge, a considerable rise in the water table can result in this intersecting the ground surface, resulting in flooding. Due to the slow response of groundwater systems any resulting flows and inundation could persist for an extended period.

As discussed in Section 1.5, the site is underlain with mudstone, siltstone, and sandstone and is designated as a secondary aquifer. The Copeland SFRA does not attribute the flooding which has occurred at Coach Road to groundwater sources.

Given the proximity of the Site to the surrounding watercourses, the probability of groundwater manifesting at the surface is low and therefore the resulting risk is also assessed to be low.

Flooding from this source is therefore considered to be Low and is not considered further.

3.2.4 Flooding from Sewers and Water Mains

According to sewer records received from United Utilities, there is a combined public combined sewer that runs to the south of the site through Coach Road and a surface water sewer flowing east to west across the site. The location of these sewers is shown on the topographic survey contained within *Appendix A* and United Utilities records contained within *Appendix B*.

Within the Cumbria Flood Risk Management Strategy 2022, it is acknowledged that flood risk associated with Coach Road is contributed by United Utilities combined sewers and highway sewers exceeding capacity during extreme storm events.

Flooding from this source is therefore considered to be high and has been considered further in Section 5. 0.

2.2.5 Flooding from Reservoirs, Canals, and Artificial Sources

With reference to the risk of flooding from reservoirs, mapping published by the Environment Agency shows that the Site is not at risk of flooding from reservoirs.

There are no canals or other artificial water sources located near the site.

Flooding from this source is therefore considered to be Low and is not considered further.

3.2.6 Flooding from Infrastructure Failure

The site is defended by Flood Defences along Midgey Gill. Environment Agency data sources confirm that the site does benefit from these formal fluvial flood defences in a 0.1% AEP event by 0.01m. Failure of these systems is therefore considered to only effect the flooding on site marginally and is not a major risk.

As such, flooding from this source is therefore considered to be low and is not considered further.

3.3 SUMMARY OF FLOODING

A summary of potential sources of flooding and the flood risk arising from them is presented in *Figure 5*.

Potential Flood Source	Potential Flood Risk of site
Fluvial and tidal sources	High
Surface water and overland flow	Low
Groundwater	Low
Sewers and water mains	High
Reservoirs, canals, and artificial sources	Low
Infrastructure failure	Low

Figure 5: Summary of potential sources of flood risk

4.0 CLIMATE CHANGE

4.1 ANTICIPATED LIFETIME OF DEVELOPMENT

PPG and best practice recommend that, in the absence of more specific information, a 100-year lifetime of development is assumed for a residential development.

4.2 CLIMATE CHANGE REVIEW

In May 2022, the Environment Agency issued updated guidance on the impacts of climate change on flood risk in the UK to support the NPPF. This advice sets out that peak rainfall intensity, sea level, peak river flow, offshore wind speed, and extreme wave heights are all expected to increase in the future because of climate change.

PPG recommends that considerations for future climate change are included in FRA's for proposed developments. The consideration of climate change for the proposed development site considers the possible changes in peak rainfall intensity and peak river flow.

The guidance acknowledges that there is considerable uncertainty with respect to the absolute level of change that is likely to occur. As such the document provides an estimate that reflect a range of different emissions scenarios.

4.2.1 Peak Rainfall Intensity Allowance

The recommended allowances for rainfall depths (the factor relevant to this assessment), are set out in *Figure 6*. For peak rainfall intensity the guidance states that flood risk assessments should assess both the 'central' and 'upper end' allowances to understand the range of impact. As detailed, these equate to uplifts of 35% and 50% respectively.

A 35% or 50% uplift in peak rainfall depths could cause an increased risk of surface water at the proposed development site and cause higher depths of surface water pooling within the lower elevations. For the purposes of this assessment the 1% annual exceedance rainfall event upper end allowance is to be utilised (50%) for all surface water drainage calculations.

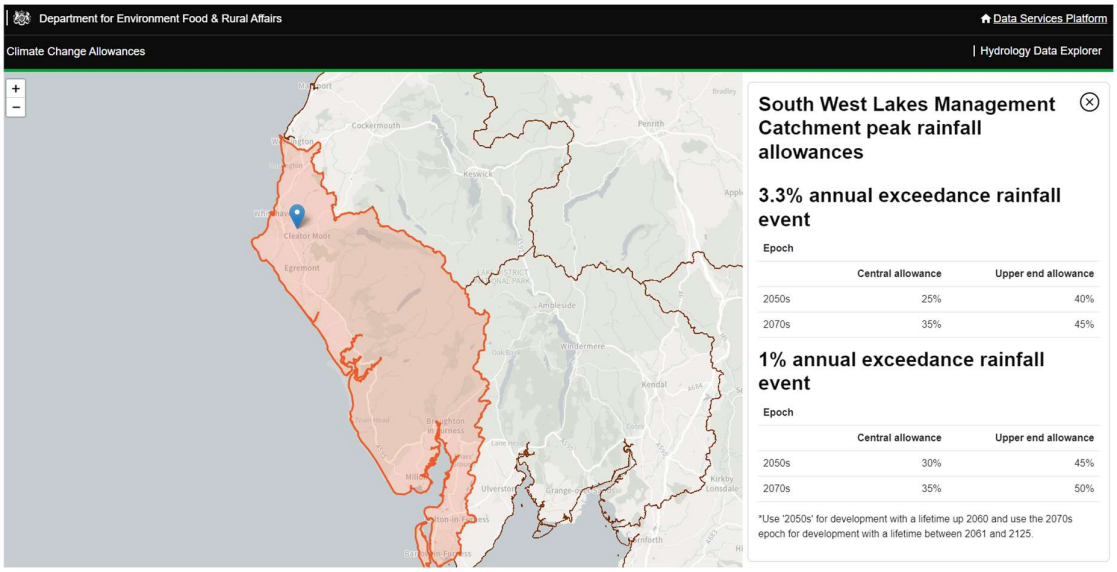

Figure 6: Peak rainfall intensity allowance

4.2.2 Peak River Flow Allowance

Peak river flow allowances show the anticipated changes to peak flow by management catchment. Management catchments are sub-catchments of river basin districts. The peak river flow allowances are for management catchments.

The allowances are based on percentiles from UKCP18 data. A percentile is a measure used in statistics. They describe the proportion of possible scenarios that fall below an allowance level. The:

- Central allowance is based on the 50th percentile.
- Higher central allowance is based on the 70th percentile.
- Extreme allowance is based on the 95th percentile.

An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it is exceeded by 30%. At the 95th percentile it is exceeded by 5%.

For the Southwest Lakes catchment, the guidance for peak river flow allowances is shown below within *Figure 7*.

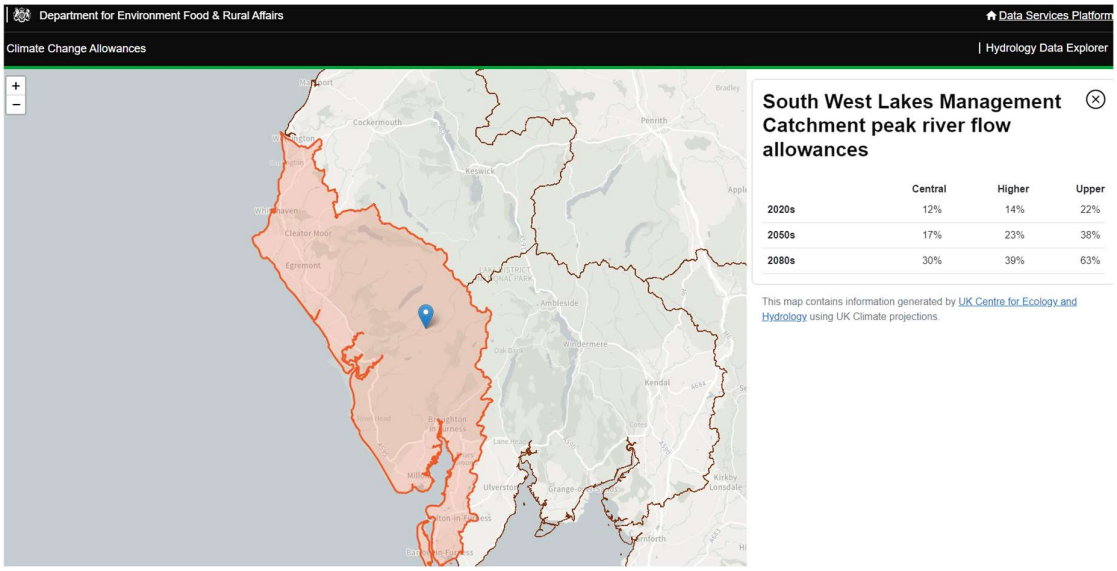

Figure 7: Peak River flow allowance

5.0 ASSESSMENT OF FLOOD RISK

5.1 POTENTIAL SOURCES OF FLOOD RISK

The flood screening assessment reported in Section 3.0 indicates that the development site could be at risk of flooding from fluvial, tidal and sewer sources. The flood risk to the Site from these sources are evaluated below.

5.2 HISTORICAL FLOODING

Information provided as part of the data request to the Environment Agency (*Appendix F*) confirms that there are historic flooding records of fluvial flooding at the site in June 2007, August 2006, and November 1999.

It is also noted that flooding occurred on Coach Road on the 30 December 2013 and 5 November 2022. The predominant source of flooding on site is surcharging from the highway and United Utilities combined sewer as described within section 3 of this report. It is noted that the flooding, as identified within the Cumbria Flood Risk Management Strategy, is also linked to high levels of Pow Beck to the West of the development site.

5.3 FLOOD DEFENCES

Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that is maintained by its respective owner, regardless of whether it is owned by the Environment Agency. An 'informal' flood defence is a structure that has often not been specifically built to retain floodwater and is not maintained for this specific purpose.

A formal flood defence has been constructed at Midgey Gill to prevent flooding to Park Road, Whitehaven. Information provided by the Environment Agency on the flood defence is detailed below in *Figure 8*.

Flood defences data

Label	Asset ID	Asset Type	Standard of protection (years)	Current condition	Downstream actual crest level (mAOD)	Upstream actual crest level (mAOD)	Effective crest level (mAOD)
1	94578	Wall	20	Fair	17.58	18.54	17.58
2	179305	Embankment	20	Fair	38.77	38.24	38.24

Figure 8: Environment Agency flood defence data for Midget Gill

5.4 FLOODING FROM FLUVIAL AND TIDAL SOURCES

Environment Agency flood mapping indicates that the proposed development lies within an area at risk of fluvial flooding which is associated with Pow Beck. As noted within the Copeland SFRA, flood risk at Coach Road can be attributed to both fluvial and tidal sources.

In response to a formal data request, the Environment Agency has provided site specific modelled flood extents extracted from the detailed fluvial modelling of Pow Beck (*Appendix F*). That study assessed the flood risk at the Site under both the defended and undefended scenarios for a range of AEP events. The data set out in *Figure 9* is based on the floodplain peak water levels modelled at the Site location. The results of the modelling are considered to represent the worst-case scenario in terms of potential peak flood water levels at the Site.

Site Location	Fluvial Water Level (m AOD)									
	Undefended					Defended				
	5% AEP	2% AEP	1% AEP	1% AEP + 20% CC	0.1% AEP	5% AEP	2% AEP	1% AEP	1% AEP + 20% CC	0.1% AEP
Peak Water Level	7.20	7.37	7.69	7.79	7.91	7.21	7.39	7.69m	7.79	7.92

Figure 9: Pow Beck modelled flood depths.

A review of the peak water depths at the site over a range of events show that flood water is likely to extend to the site from Pow Beck for all undefended scenario modelled below 2% AEP (1.33%AEP, 1% AEP, 0.5% AEP and 0.1% AEP). These could potentially flood the site to a significant depth. Potential depths of flooding on site have been assessed within Figure 7, which range from 0.37m to 1.05m that approximately corresponds to an undefended peak water level 7.91m AOD.

For the defended scenario, the site is shown to benefit from local flood defences for the 0.1% AEP event with no increase in flow. The site benefits in flood level by 0.01m in comparison to the undefended scenario modelled by the Environment Agency.

Model data provided by the Environment Agency includes flow rates and depths at different node points along Pow Beck. From the data provided, a residual risk of flooding is present for the site for both the defended and defences removed scenarios. As such the fluvial flood risk associated with the site is assessed to be high for events up to and including the 2% AEP for the life of the development. Measures set out in Section 6.0 will ensure that any risks from fluvial flooding are managed.

5.5 FLOODING FROM SEWERS AND WATER MAINS

Within the Cumbria Flood Risk Management Strategy 2022, it is acknowledged that flood risk associated with Coach Road is contributed by the United Utilities combined sewers and highway sewers. It is stated within the document that a scheme is to be developed to resolve flooding from the United Utilities combined sewers and highway sewers by 2027 – 2028. This is to be overseen by the Lead Local Flood Authority (Cumberland Council, formerly Cumbria County Council) and United Utilities.

The extents of the sewer flooding tie in with the topography of Coach Road. which has a low point to the east of the proposed development site. Footage and photographs of the flooding which occurred in 2014 shows a similar pattern and extent of flood waters to that shown on the EA maps although shallow flooding was also recorded further along Coach Rd. adjacent to the site. In addition, the previous use of the site discharged surface water into the adopted combined United Utilities network within Coach Road. It is proposed as part of the development that surface water discharge is to be into Pow Beck to the west, and not the sewer which is recognised as a source of flooding.

The potential for flooding on site to any significant depth is high until a flood prevention scheme is implemented by Cumberland Council and United Utilities. As such, development of the site will take foul water drainage and surface water discharge into consideration. Measures set out in Section 6.0 will ensure that any risks from surface and foul water are managed.

5.6 FLOOD RISK FROM THE PROPOSED DEVELOPMENT

5.6.1 Increase in impermeable surfacing

Development of the site will result in an increase in impermeable area which could impact on flood risk to adjacent areas. To ensure that there is no risk to off-site areas from surface water, it is proposed that the development will introduce a new surface water drainage system which will manage all incidental rainfall and runoff from the site. Discharge from the site will be controlled to greenfield runoff rates with the discharge location being into Pow Beck, rather than the previous use of the site into the combined United Utilities sewer at an unrestricted rate.

To achieve the required discharge rate, it is necessary to attenuate surface water within the site boundary during extreme precipitation events. This attenuation will be managed through below ground storage within new drainage pipework. This system will be designed to provide attenuation to accommodate storm events up to and including a 6 hour 1 in 100 years plus 50% to account for climate change storm event.

Further details of the proposed drainage design are discussed in Section 7.0.

7.6.2 Floodplain compensation

As recognised within *Figure 7*, a residual flood risk is present on site, in both defended and undefended scenarios, during which significant flooding could occur on site (up to 1.05m at Plot 16). The proposed footprint of each house proposed is detailed below:

Plot Number	House Type	Area (m2)	Current Level (m AOD) APPROX	0.1% Flood Level - Current Level	Volume per house
1	E2	60	7.54	0.37	22.20
2	F	53	7.51	0.40	21.20
3	F	53	7.49	0.42	22.26
4	D	47	7.47	0.44	20.68
5	F	53	7.45	0.46	24.38
6	E1	62	7.43	0.48	29.76
7	F	53	7.20	0.71	37.63
8	D	47	7.23	0.68	31.96
9	F	53	7.26	0.65	34.45
10	F	53	7.29	0.62	32.86
11	E2	60	7.33	0.58	34.80
12	E2	60	7.24	0.67	40.20
13	F	53	7.25	0.66	34.98
14	F	53	7.26	0.65	34.45
15	E1	62	7.27	0.64	39.68
16	F	53	6.86	1.05	55.65
17	D	47	6.92	0.99	46.53
18	A	59.5	6.98	0.93	55.34
19	A	59.5	7.02	0.89	52.96
20	D	47	7.04	0.87	40.89
21	F	53	7.11	0.80	42.40
22	E2	60	7.09	0.82	49.20
23	D	47	7.07	0.84	39.48
24	D	47	7.06	0.85	39.95
25	F	53	7.09	0.82	43.46
26	E2	60	7.02	0.89	53.40
27	F	53	6.98	0.93	49.29
28	H	44.15	6.96	0.95	41.94
29	H	44.15	7.48	0.43	18.98
30	F	53	7.44	0.47	24.91
31	E1	62	7.40	0.51	31.62
32	E2	60	7.36	0.55	33.00
33	F	53	7.35	0.56	29.68
34	F	53	7.33	0.58	30.74
35	E2	60	7.44	0.47	28.20
Total		1890.3	7.23	0.58	1269.11

Figure 8: Footprint of the proposed dwellings.

Based on *Figure 8*, if flood water were to be kept out of the dwellings this would equate to a maximum loss of approximately 1,269.11m^3 of flood water during a 0.1% flood event. The surrounding driveways, access and landscaping areas will be set at an elevation that, at most, matches the existing ground levels.

To mitigate against the loss of 1,269.11m3 of floodplain storage, as identified within the proposed drainage plans (*Appendix E*), 1269.53m^3 of compensatory floodplain storage is to be provided on site. It is proposed to provide direct compensatory floodplain storage through the re-orientation of the land by lowering ground levels at two locations through the site.

The northern site basin provides 717.23m^3 of compensatory storage and the storage basin in the middle of the site provides 552.30m^3. This ensures that the same volume of flood storage is available at all levels of flooding. Flood water is to be directed to the storage basin areas through overland flows along the central carriageway which flows through the site with dropped kerbs to allow flood water to fill the basins.

Due to the proposed compensatory storage to be provided within the proposed development the impact on floodplain storage within the Coach Road vicinity is neutral. There would therefore be no adverse impact to other premises or property within the Coach Road area.

6.0 FLOOD RISK MANAGEMENT MEASURES

6.1 SITE PROFILE AND DWELLINGS

The development site will be predominantly hardstanding, with the dwelling houses located throughout the site. The proposed finished floor levels of the dwellings are to be 300mm above the 0.1% AEP flood level of 7.91m at 8.21m AOD. Construction of the dwellings and associated infrastructure should take the risk of flooding into consideration and include further resilience measures that would ensure the facility could return to operation relatively quickly following a flood event. Methods that could be applied to the development include:

- Non-return valves fitted to any drains and water inlet/outlet pipes to prevent wastewater from flowing into the property.
- Use of solid concrete (or similar) floors and impermeable wall and floor finishes.

6.2 SITE DRAINAGE

A drainage system will be provided to manage all potential rainfall and subsequent surface water flows at the Site. The site drainage strategy has been prepared in line with LLFA guidance. The strategy can accommodate all runoff on site from a 1% AEP rainfall event, including an appropriate allowance for climate change (50%). The strategy includes discharge to Pow Beck at a rate no greater than 3.1 l/s (greenfield runoff rate) with adequate attenuation provided within the drainage system to accommodate all flows on site prior to discharge. There will be no increase in flood risk within or to off-site areas from the proposed drainage strategy.

6.3 FLOOD ALERTS AND WARNINGS

It will be important to document the flood risk to the site and residents and, more importantly, the actions to take should a flood alert or flood warning be issued. This will be documented in the form of an Emergency Flood Plan. With reference to the Environment Agency's website, a general early notification of possible (fluvial and tidal) flooding, known as 'Flood Alerts', is available for the Site. More specific 'Flood Warnings' are also provided for the Site.

Under the Emergency Flood Plan, owners and operators of the Site will subscribe to the Floodline service which aims to provide a minimum 2-hour warning of an impending flood. Individuals at the Site would therefore have sufficient time to evacuate. Actual lead in periods between issuing of a flood alert or flood warning and the onset of flooding are likely to be far longer, as set out in Table 5- 1 for the 2015 flood event. As such, if the plan targets full implementation of the plan within 2 hours there will be significant margin for error.

The Emergency Flood Plan will detail actions to be taken by staff and operatives at the Site once a flood alert or warning has been issued. This includes securing of equipment or buildings on the Site, removal of sensitive equipment off Site or to a higher level and safe evacuation of all personnel and customers. The plan will include a safe evacuation route from the Site through the local area to higher ground away from areas of potential flood risk.

7.0 CONCLUSION

AL Daines and Partners has been appointed by PRIMA Homes Group to prepare a Flood Risk Assessment (FRA) for the construction of 35 dwellings to the north of Coach Road, Whitehaven.

With reference to the site-specific flood data provided by the Environment Agency, the Site is considered to lie predominantly within Flood Zone 2 with a small area of Flood Zone 3 at the frontage of the site. Planning Practice Guidance defines the proposed development as a 'More Vulnerable' use. This type of development is considered appropriate for the Flood Zone classification as all dwellings are to be located within Flood Zone 2.

The risk of flooding primarily relates to fluvial and sewer flooding in the vicinity of Coach Road. Mitigation measures have therefore been recommended to ensure that the development does not increase the risk of flooding at the Site or for off-site areas and to ensure that all personnel remain safe during operation of the development. These measures include:

- The proposed finished floor levels of the dwellings are to be 300mm above the 0.1% AEP flood level of 7.91m at 8.21m AOD.
- Drainage strategy to manage surface water runoff from roof and hardstanding across the development, prepared in line with LLFA guidance.
- The attenuation to be provided through underground pipes is to be resistant to floatation during flood events with the outfalls into Pow Beck fitted with non-return valves. and
- Compensatory Floodplain Storage to be provided (1,269.11m3) to mitigate against the loss of storage due to the construction of the 35 dwellings.

The technical assessment of risk presented within this flood assessment demonstrates that the flood risks present at the Site are manageable and that development on the site could be designed in a way that, subject to approvals and appropriate ongoing management, is 'safe' in flood risk terms throughout its lifetime without increasing flood risk elsewhere.