UK Flood Risk
Flood Risk Consultants

Land off Elker Lane, Billington
Lancashire BB7 9HZ

Flood Risk & SuDS Assessment

Version 1.0
QFRA: 354

12 April 2016

Revision history

Version	Date	Amendments	Issued to
1.0	April 2016		Elker Devlopments `Ltd

Quality control

Action	Signature	Date
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Disclaimer

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Executive Summary

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of the development of the Continued Care Retirement Community (CCRC) located at the land off Elker Lane, Billington, Lancashire BB7 9HZ.

The main sources of information to undertake flood risk assessment are the flood maps and data of the Environment Agency and the past flood study reports of the Local Authority.

The proposed development is categorised as 'more vulnerable'.

The nearest Main River from the site is the River Calder which has a history of flooding. However, there were no records of flooding events at the site.

The Environment Agency's flood map indicated that the site lies within Flood Zone 1 (low probability flooding) and is located outside of the flood risk zone.

The flood risk from other sources including surface water, underground water, sewer and reservoir is 'low'.

There will be an increase in the surface water runoff as a result of the development. It is estimated that a total of 813m^3 of attenuation storage will be required for storing the excess runoff from the site.

It is recommended that the surface runoff will be managed within the site by implementing appropriate SuDS measures. Porous pavement and parking area can be considered, however, field infiltration tests will be required in order to assess the effectiveness of the infiltration measures. A surface water catchment pond can also be considered to attenuate the surface runoff from the site.

This report demonstrates that the proposal will be safe, in terms of flood risk, for its design life and will not impose any flood risk elsewhere.

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Abbreviations

Abbreviation	Definition
AOD	Above Ordnance Datum
DEFRA	Department for Environment, Food, and Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
PFRA	Preliminary Flood Risk Assessment
SuDS	Sustainable Drainage Systems

1.0 Introduction

1.1. Terms of Reference

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of the development of the Continued Care Retirement Community (CCRC) located at the land off Elker Lane, Billington, Lancashire BB7 9HZ.

The National Planning Policy Framework requires a Flood Risk Assessment to be carried out to ensure flood risk to the proposed development is considered as well as the impact the development will have elsewhere on people and property.

This FRA has been prepared in accordance with the Environment Agency's Flood Risk Assessment (FRA) Guidance Note 3 and best practices in flood risk management.

1.2. FRA Requirements

It is a requirement for development applications to consider the potential risk of flooding to a proposed development over its expected lifetime and any possible impacts on flood risk elsewhere, in terms of its effects on flood flows and runoff.

Where appropriate, the following aspects of flood risk should be addressed in all planning applications in flood risk areas:

- The area liable to flooding.
- The probability of flooding occurring now and over time.
- The extent and standard of existing flood defences and their effectiveness over time.
- The likely depth of flooding.
- The rates of flow likely to be involved.
- The likelihood of impacts to other areas, properties and habitats.
- The effects of climate change.
- The nature and currently expected lifetime of the development proposed and the extent to which it is designed to deal with flood risk.

This FRA follows government guidance on development and flood risk (National Planning Policy Framework).

1.3. Site Details

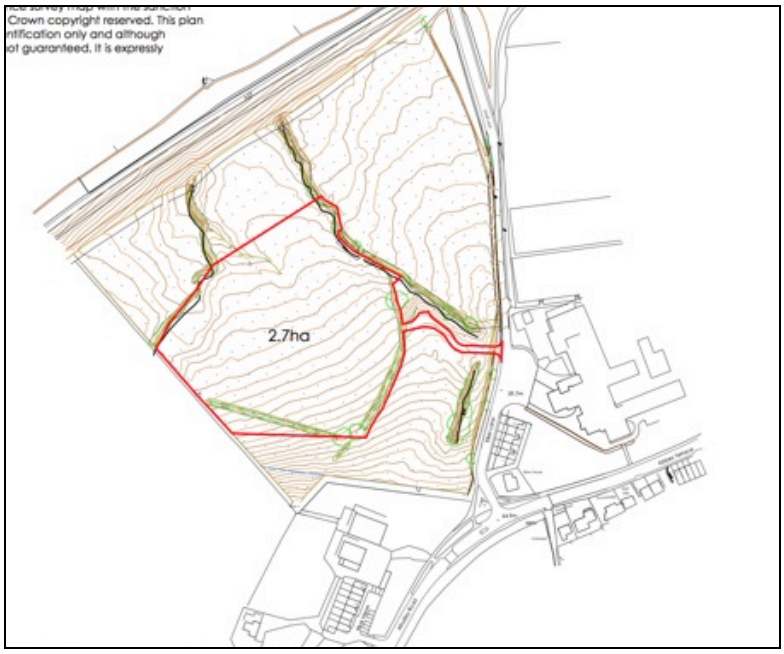
Figure 1 - Summary of site details (Source: Streetmap)

Site name	Land off Elker Lane, Billington, Lancashire BB7 9HZ
Existing use, Area	Rough grass, 2.7 hectares
Purpose of development	Development of the Continued Care Retirement Community (CCRC)
Vulnerability of use	More Vulnerable
Nearest water body	River Calder
OS NGR	371848,435553
Country	England (NPPF applies)
Local planning authority	Ribble Valley Borough Council
Other authorities	Environment Agency Cumbria and Lancashire

1.4. Site Description

The proposal site is the land off Elker Lane, Billington, Lancashire BB7 9HZ (Figure 2). The access to the site is via Elker Lane. The area of the proposed site is approximately 2.7 hectares. The present land cover of the site comprises rough grass. Further details on the existing site and layout plan have been given in Appendix A.

Figure 2 – The Site Location



1.5. Development Proposals

The proposal consists of the development of the Continued Care Retirement Community (CCRC) with associated access road, car parking and communal garden areas. Further details about the proposed development proposals are given in Appendix A.

2.0 Development and Flood Risk Policy

2.1. Planning Context

2.1.1. Applicable Planning Policy

The National Planning Policy Framework (NPPF) was issued by the Department for Communities and Local Government in March 2012. The NPPF deals specifically with development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency Flood Map. The main study requirement is to identify the Flood Zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

2.1.2. Flood Zones

The Environment Agency has developed a Flood Map that shows the risk of flooding in England and Wales for different return period events. It should be noted that the Environment Agency's Flood Map is based on broad scale hydraulic modelling and is an indication of the potential flood risk to a site and the actual risk may differ. The Flood Zone Maps (without climate change) provide the information required by NPPF for planning purposes, as described in Section 3.2. The Flood Zones do not take account of the effect of flood defences.

2.1.3. Sequential and Exception Tests

The Sequential and Exception Tests should be applied when choosing the location of new development and the layout of the development site. The Sequential Test aims to promote development in areas with low flood risk. The Exception Test is used where no suitable development areas can be found in low risk areas, the risk of flooding is clearly outweighed by other sustainability factors, and the development will be safe for its lifetime, taking climate change into account. As the site is located in Flood Zone 1 (low probability flooding), the Sequential Test will not be required.

2.1.4. Vulnerability and Flood Risk Assessment

The proposed development is categorised as 'more vulnerable' development (Table 2). The site is located within Flood Zone 1 (low probability flooding). The proposed development is therefore appropriate at this location (Table 3).

The proposal should ensure that all types of flood risk have been considered as part of the flood risk assessment: *'A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall'.*

This FRA aims to demonstrate that the proposal will remain safe for its lifetime and not increase flood risk elsewhere.

2.2. NPPF Flood Zones

Table 1 shows how the Flood Zones relate to a sequential planning process.

Table 1 - NPPF Flood Zones and Requirements

Zone 1: Low Probability	
Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	**Appropriate uses** All uses of land are appropriate in this zone. **FRA requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. **Policy aims** Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 2: Medium Probability	
Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.	**Appropriate uses** The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table 2 are appropriate in this zone. Highly vulnerable uses in Table 2 are only appropriate in this zone if the Exception Test is passed. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a: High Probability	
Land assessed as having a 1 in 100 or greater annual probability of river flooding (<1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any	**Appropriate uses** The water-compatible and less vulnerable uses of land in Table 2 are appropriate in this zone. The highly vulnerable uses (Table 2) should not be permitted in this zone.

year.	The more vulnerable and essential infrastructure uses in Table 2 should only be permitted in this zone if the Exception Test is passed. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** Developers and local authorities should seek opportunities to: • reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; • relocate existing development to land with a lower probability of flooding; • create space for flooding to occur by allocating and safeguarding open space for flood storage.
Zone 3b: Functional Floodplain	
Land where water has to flow or be stored in times of flood. (Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the local planning authority and the Environment Agency, including water conveyance routes).	**Appropriate uses** Only the water-compatible uses and the essential infrastructure listed in Table 2 that has to be there should be permitted. It should be designed and constructed to: • remain operational and safe for users in times of flood; • result in no net loss of floodplain storage; • not impede water flows; • not increase flood risk elsewhere. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** In this zone, developers and local authorities should seek opportunities to: • reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; • relocate existing development to land with a lower probability of flooding.

Source: NPPF Technical Guidance Table 1

Table 2 - Flood Risk Vulnerability Classification

Essential Infrastructure	Essential transport infrastructure and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations and emergency dispersal points. Basement dwellings, caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent.
More Vulnerable	Hospitals, residential institutions such as residential care homes, children's homes, Social services homes, prisons and hostels. Buildings used for: dwelling houses, student halls of residence, drinking establishments, nightclubs, hotels and sites used for holiday or short-let caravans and camping. Non–residential uses for health services, nurseries and education. Landfill and waste management facilities for hazardous waste.
Less Vulnerable	Buildings used for shops, financial, professional and other services, restaurants and cafes, offices, industry, storage and distribution, and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities), minerals working and processing (except for sand and gravel). Water treatment plants and sewage treatment plants (if adequate pollution control measures are in place).
Water-compatible Development	Flood control infrastructure, water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel workings. Docks, marinas and wharves, navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation. Essential sleeping or residential accommodation for staff required by uses in this category, subject to a warning and evacuation plan.

Source: NPPF Technical Guidance Table 2

Table 3 - Flood Risk Vulnerability and Flood Zone 'compatibility'

Vulnerability Classification (Table 3)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (Table 2)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test	✓	✓
	Zone 3a	Exception Test	✓	×	Exception Test	✓
	Zone 3b	Exception Test	✓	×	×	×

Source: NPPF Technical Guidance Table 3

Key:

✓ Development is appropriate
× Development should not be permitted

3.0 Assessment of Flood Risk

3.1. Flood History

The Ribble Valley Borough Council's Strategic Flood Risk Assessment (Level 1 SFRA, May 2010), hereafter referred to as SFRA, has provided a brief overview of the flooding history in the area. A record of the major floods that have affected the Ribble catchment since 1600 has been put together from the British Hydrological Society's "Chronology of British Hydrological Events" and from the Environment Agency Section 105 – River Ribble Survey in 1998. The Environment Agency study found major flood events that had been reported in local newspapers. The major flood events occurred in 1771 (Ribble), 1775 (Ribble), 1866 (Ribble Calder), 1881 (Ribble, Calder, Hodder), 1923 (Ribble, Calder), and in 1936, 1995, 2000 and 2002. Despite these events, there were no records of flooding at the site.

3.2. Fluvial Flood Risk

The nearest Main River from the site is River Calder. The Environment Agency's Flood Map around the site is shown in Figure 3 which shows that the site lies within the Flood Zone 1 (low probability flooding). The Flood Zone 1 is defined as the land assessed as having less than 1 in 1000 annual probability of river flooding (<0.1%AEP). The flood map also shows that the site is located in an area not benefiting from any flood defences. Figure 4 below shows the Environment Agency's flood risk map which indicates that the site is located outside of the flood risk zone.

Figure 3 - Environment Agency's Flood Map

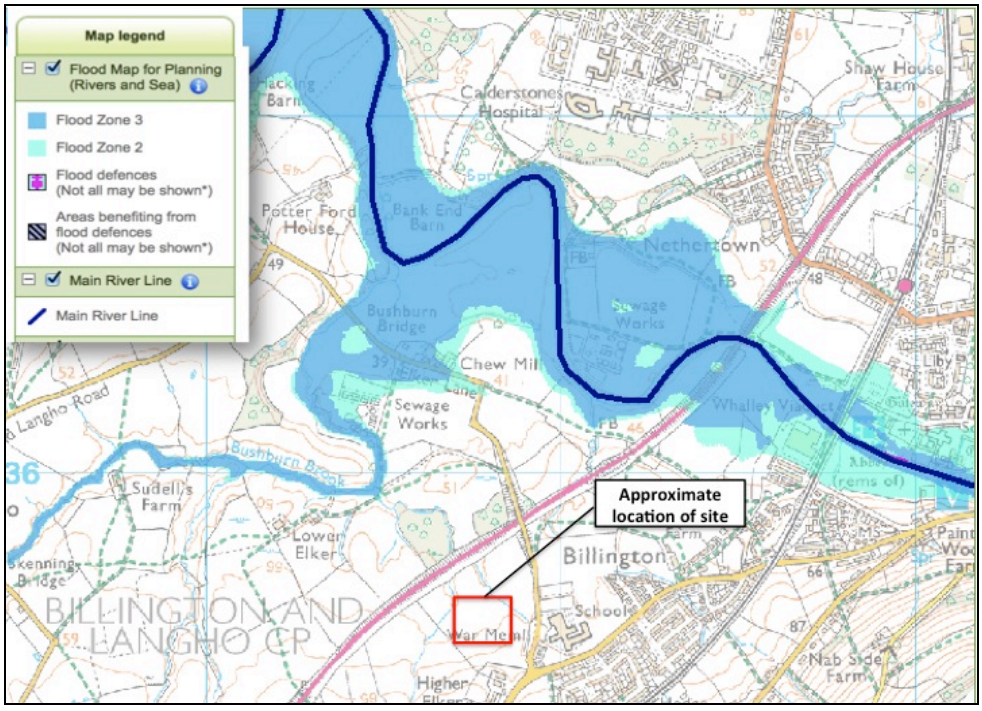
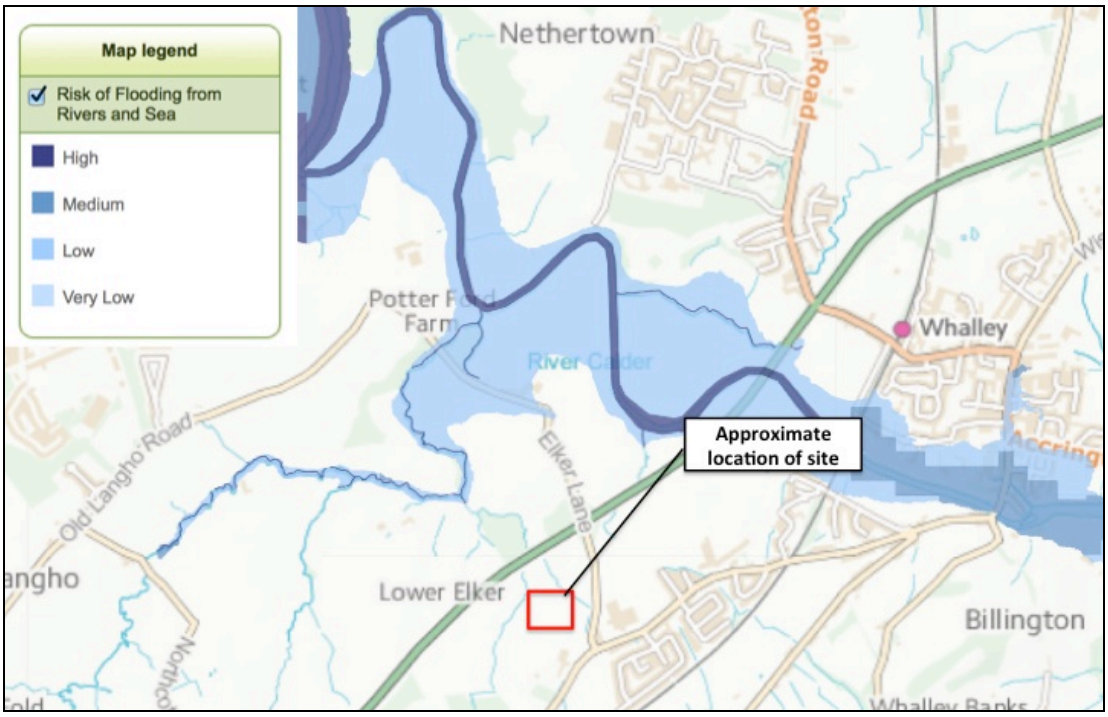


Figure 4. Environment Agency's Flood Risk Map



3.3. Tidal Flood Risk

The River Calder is located in an area not affected by tidal waves at this location. The risk of tidal flooding is therefore low.

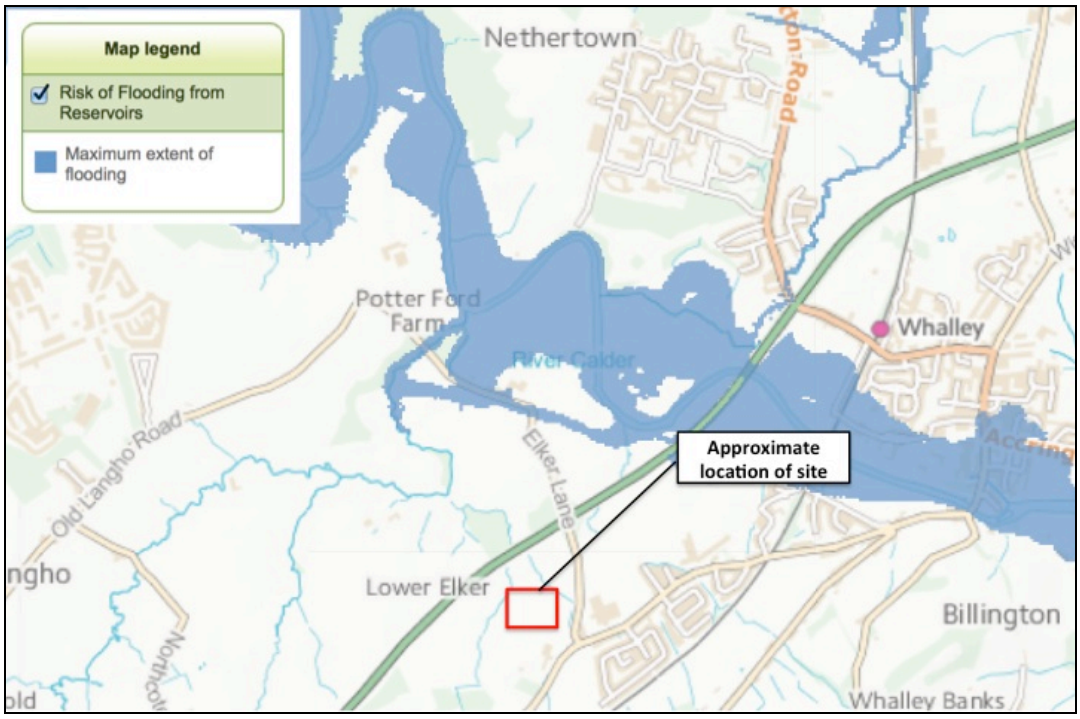
3.4. Flood Risk from Artificial Water Bodies

There are no known flood risks from any artificial water bodies.

3.5. Reservoir Flood Risk

According to the Environment Agency's reservoir flood map, the proposed development site is located within the maximum extent of flooding (Figure 5). According to the Environment Agency, the reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensure that reservoirs are inspected regularly and essential safety work is carried out.

Figure 5. Environment Agency's Reservoir Flood Extent Map



3.6. Groundwater flooding

Groundwater flooding usually occurs following a prolonged period of low intensity rainfall. In accordance with the SFRA, the groundwater flooding was not considered by the Environment Agency to be a significant flood risk factor in the RVBC area.

The risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time. There were no known incidents of groundwater flooding around the site. It is considered reasonable to assume that the potential risk of groundwater flooding is low. The landowner also confirmed that there were no records of any groundwater flooding incidents at the site.

3.7. Surface Water Flood Risk

When the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded, excess rainwater flows overland; this water will collect in topographic depressions and at obstructions, and can inundate development downslope. The severity of the rainfall event, the degree of saturation of the soil before the event, the permeability of soils and geology, hill slope steepness and the intensity of land use all contribute to and affect the severity of overland flow.

The Environment Agency most recent flood map for surface water published in December 2013 is freely available online at their website and can be used to see the approximate areas that would experience surface water flooding from a variety of rainfall return periods.

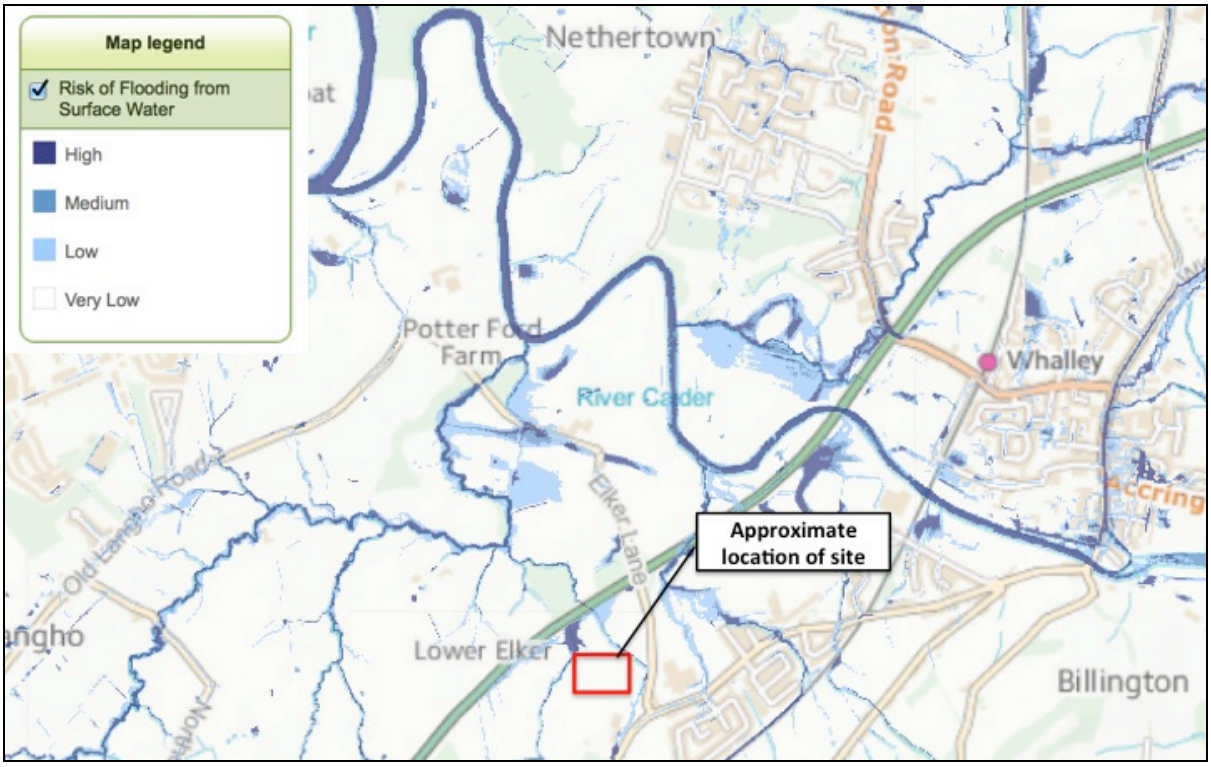
The risk is categorised based on annual probability of occurrence. The different risk categories are displayed in Table 4 below.

Table 4 - Environment Agency's Surface Water Risk Categories

Environment Agency Surface Water Risk Category	Surface water flooding annual probability of occurrence
Very Low	Less than 0.1% (1 in 1000 years)
Low	Between 1% and 0.1% (1 in 100 years and 1 in 1000 years)
Medium	Between 1% and 3.3% (1 in 100 years and 1 in 30 years)
High	Greater than 3.3% (1 in 30 years)

The Environment Agency's surface water flood map (Figure 6) indicates that the risk of surface water flooding to the site is ' low'.

Figure 6 - Environment Agency's Surface Water Flood Map



3.8. Sewer flooding

Sewer flooding is often caused by excess surface water entering the drainage network causing sewers to surcharge. There were no instances of flooding from sewers around the site.

In addition, according to the information obtained from the landowner, there were no records of any sewer flooding at the site.

3.9. Climate Change

There is clear scientific evidence that global climate change is happening now. In the UK sea level has risen and more winter rain has fallen in intense wet spells over the past century. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation; however the broad trends are in line with projections from climate models.

Looking ahead, greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

The Department for Environment, Food and Rural Affairs FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts (October 2006) provided information on sensitivity ranges for peak rainfall intensities and peak river flows (Table 5). This report also provides information on net sea level rise relative to 1990 (Table 6).

Table 5 - Defra recommended national precautionary sensitivity ranges for peak rainfall intensities and peak river flows

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak Rainfall Intensity	+5%	+10%	+20%	+30%
Peak River Flow	+10%	+20%		

On a more localised scale, if emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 15% (very likely to be between 2 and 32%);
- Precipitation on the wettest day in winter up by around 15% (very unlikely to be more than 31%);
- Peak river flows in a typical catchment likely to increase between 8 and 18%.

Table 6 - Defra recommended national precautionary sensitivity ranges for net sea level rises

	Net sea level rise (mm per year) relative to 1990			
	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability. Wetter winters and more of this rain falling in wet spells may increase river flooding. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected. Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. Even small rises in sea level could add to very high tides so as to affect places a long way inland.

4.0 Mitigation Measures

4.1. Recommended Finished Floor Levels

In order to afford a level of protection against flooding it is normally recommended that finished floor levels are set a nominal 600mm above the 1 in 100 year annual probability fluvial flood (1%) or 1 in 200 year (0.5%) tidal flood in any year.

However, as the site is located in Flood Zone 1 (low probability flooding), raising the finished floor on the ground of flood risk will not be required.

4.2. Flood Warning and Evacuation

As the site is located in Flood Zone 1 (low probability flooding), the flood warning and evacuation will not be relevant.

4.3. Surface Water Drainage Requirements

The proposal will result in an increase in the impermeable area due to the increase in the building footprint, access road and parking area. It is therefore likely that the surface runoff will increase from the site.

In order to manage the surface water runoff from the site, implementation of suitable Sustainable Drainage Systems (SuDS) have been proposed.

The Environment Agency suggests that the developers should demonstrate that the disposal of surface water from the site will not exacerbate existing flooding from new development within Flood Zones 3 and 2, development greater than 1 ha in Flood Zone 1 and within areas that are known to suffer from surface water drainage or sewer flooding.

A surface water drainage assessment should be undertaken to demonstrate that surface water runoff from the proposed development can be effectively managed without increasing flood risk elsewhere. A surface water drainage assessment should include the following:

- Assessment of whether the development will increase the overall discharge from the site by calculating the change in area covered by roofs and hard-standing.
- Details of how overland flow from the new development can be intercepted to prevent flooding of adjacent land.
- Details of how additional onsite surface water attenuation can be provided to mitigate against known flooding problems or as a result of incapacity on the drainage systems.
- Demonstration that overland flows will not increase flood risk to both existing development and receiving watercourses.
- Agreement that the rates of discharge from the development are acceptable to the Environment Agency and utilities authorities.

4.4. Greenfield Runoff Estimation

The estimation of the Greenfield Runoff rate has been undertaken using the HR Wallingford's Greenfield Runoff Estimation tool available on the website: http://www.uksuds-.com/greenfieldrunoff_js.htm. The aim of the tool is to provide flow rate information based on a minimum amount of data so that anybody can use the tool. The methodology is built around the concept that a flow rate discharge constraint is needed for storm water runoff from a site, resulting in attenuation volume being needed. In addition, current drainage criteria include the requirement for the 100 year 6hr volume to be controlled.

The tool is based on the results of simple model analysis and correlating the results against key known site parameters. As such the results need to be treated as providing indicative information only and should not be used to produce final designs of drainage systems without additional modelling being carried out.

The peak flow estimation can now be estimated using two different formulae.

1) The formula developed in IH124 (IH 1994) and use of the FSSR growth curve information for regions of the UK (FSSR 14),

2) The use of FEH statistical correlation equation revised in 2008.

However, only the IH124 method can be used without providing specific parameter values. Therefore this method has been used for estimating greenfield runoff rate from the proposed development site.

Details about the parameters used in the estimation are provided in Appendix B and the results are summarised in Table 7 below. Any proposed development within the site should consider the greenfield runoff rates especially for addressing surface water discharge requirements from the developed site. The greenfield runoff rates should also be utilised while developing the detailed drainage strategy for the site.

Table 7 – Greenfield Runoff Rates

Events	Greenfield runoff rates (l/s)
Qbar	23.06
1 in 1 year	20.07
1 in 30 year	39.21
1 in 100 year	47.97

4.5. Estimation of Surface Runoff Attenuation

HR Wallingford's technique has been used for estimating surface water attenuation requirements for sites. The estimation is based on a 1 in 100 year rainfall event of 6-hour duration. The Greenfield Runoff rates have been used as shown in Table 11 and the volume control approach with the Long Term Storage has been used. Climate change has been considered in the design where a climate change allowance factor of 30% has been utilised.

The design parameters and the estimated attenuation of storage have been given in Appendix D. The estimated surface water storage volumes are summarised in Table 8 below. The table shows that a total of 813m^3 of attenuation storage will be required for storing the excess runoff from the site.

Table 8 Estimated Surface Water Attenuation (all units in m^3)

	Default
Interception storage	54.00
Attenuation storage	813.09
Long term storage	0.00
Treatment storage	162.00
Total storage	867.09

4.5.1. SuDS

Paragraph 1.3.2 from the SuDS manual (C697) discusses the SuDS 'management train' which is intended to mimic the natural catchment process as closely as possible. The hierarchy of techniques used to achieve the management train are shown in Table 9 below.

Table 9 Hierarchy of SuDS techniques

Technique	Description
Prevention	The use of good site design and housekeeping measures to prevent runoff and pollution (e.g. rainwater harvesting/reuse).
Source control	Control of runoff at or very near its source (e.g. soakaways, porous and pervious surfaces, green roofs).
Site control	Management of water in a local area or site (e.g. routing water to large soakaways, infiltration or detention basins)
Regional control	Management of runoff from a site or several sites (e.g. balancing ponds, wetlands).

There is an opportunity for the application of minimal SuDS techniques (Table 10):

Table 10 Feasible SuDS techniques for the site

Technique	Issues	Feasibility
Prevention Good site design and housekeeping/rainwater harvesting/infiltration devices/education.	Surface runoff can be improved by implementing rainwater harvesting using water butts.	Yes
Source Control Porous and pervious materials/soakaways/green roof/infiltration trenches/disconnect downpipes to drain to lawns or infiltrate to soakaway.	Feasibility of soakaways or porous pavement will require field infiltration tests.	Yes
Site and Regional Control Infiltration/detention basins/ balancing ponds/ wetlands/underground storage/swales/retention ponds.	There is a potential of surface water catchment pond to attenuate the surface runoff from the site	Yes

5.0 Conclusion

The proposal consists of the development of the Continued Care Retirement Community (CCRC) located at the land off Elker Lane, Billington, Lancashire BB7 9HZ.

The proposed development is categorised as ‘more vulnerable’.

The nearest Main River from the site is the River Calder which has a history of flooding. However, there were no records of flooding events at the site.

The Environment Agency’s flood map indicated that the site lies within Flood Zone 1 (low probability flooding) and is located outside of the flood risk zone.

The flood risk from other sources including surface water, underground water, sewer and reservoir is ‘low’.

There will be an increase in the surface water runoff as a result of the development. It is estimated that a total of 813m^3 of attenuation storage will be required for storing the excess runoff from the site.

It is recommended that the surface runoff will be managed within the site by implementing appropriate SuDS measures. Porous pavement and parking area can be considered, however, field infiltration tests will be required in order to assess the effectiveness of the

infiltration measures. A surface water catchment pond can also be considered to attenuate the surface runoff from the site.

This report demonstrates that the proposal will be safe, in terms of flood risk, for its design life and will not impose any flood risk elsewhere.

Appendix A Existing Site and Proposed Development Plans

Appendix B Greenfield Runoff Rates from the Site

Appendix C Surface Water Attenuation Requirements