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JOB NUMBER: **MD1376**

PROJECT: **CARLTON AVENUE, BLYTH**

CLIENT: MA UTILITIES

REPORT NUMBER: MD1376/rep/001 Rev C

REPORT TITLE: **FLOOD RISK & DRAINAGE ASSESSMENT**

Report Updated to include 2 additional dwelling to the north east. One New Build and one conversion.

Prepared with reasonable care and attention:

[redacted]

……………………………………………………………………………………..

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APPENDICES

EXECUTIVE SUMMARY

M Design were commissioned by MA Utilities to undertake a Flood Risk Assessment (FRA) in support of the proposed development at Carlton Avenue, Blyth.

The development was found to be in Flood Zone 2 of the watercourse to the south. Other sources of flooding have been investigated within this report.

The proposal for the site is to construct 27 dwellings in the first phase; these will be served from a new junction to the north. There is now a separate planning application submitted to convert the existing house to the north east and build an additional plot to the rear.

The existing site is a large open grassed field; as a result it is important to ensure that the drainage is designed in a manner that does not increase the likelihood of flooding either on site or elsewhere in the catchment area.

In summary the this report will ensure that the dwellings are not at risk of flooding and the drainage will be designed in a manner that does not increase the risk of flooding in the area.

Development of this site will be shown to be appropriate in relation to flood risk within the body of this report.

1 INTRODUCTION

M Design were commissioned by MA Utilities to undertake a Flood Risk Assessment (FRA) in support of the proposed development at Carlton Avenue, Blyth.

The planning process requires an assessment to be made of any flood risks related to proposed developments. In particular this involves two key issues; whether the development itself would be at risk of being flooded or whether the development would increase the risk of flooding elsewhere. This assessment is contained within this report which has been prepared for submission with the planning application.

The study also assesses the potential requirements for any surface water storage within the on-site infrastructure design.

1.2 Scope of Report

The following tasks were undertaken in the preparation of this report:

- A site visit was carried out in order to identify any risks of flooding to the site, identify drainage patterns, receiving watercourses, and to identify any constraints to the drainage system that may restrict the proposed development;
- Liaison with the Environment Agency was undertaken to establish occurrences of flooding in the area;
- Calculations were undertaken to establish the current surface water runoff from the site
- An evaluation was made of how the proposed development would affect the existing surface water runoff.

1.3 Consultations and Data Sources

The following tasks were undertaken in the preparation of this report:

- Environment Agency Flood Maps;
- Landmark Information Group Maps;
- Institute of Hydrology (1994) Report 124 – Flood Estimation for Small Catchments;
- CIRIA Document 624 'Development and Flood Risk'
- Environment Agency;

2 Site Description

2.1 Site Location

The site is located to the south of Carlton Avenue in Blyth. The site area is approximately 0.8 hectares and the centre of the site is at NZ 301 794. The site elevation is approximately 16.8m A.O.D. The conversion to the existing property is shown in blue and the additional dwelling shown in green.

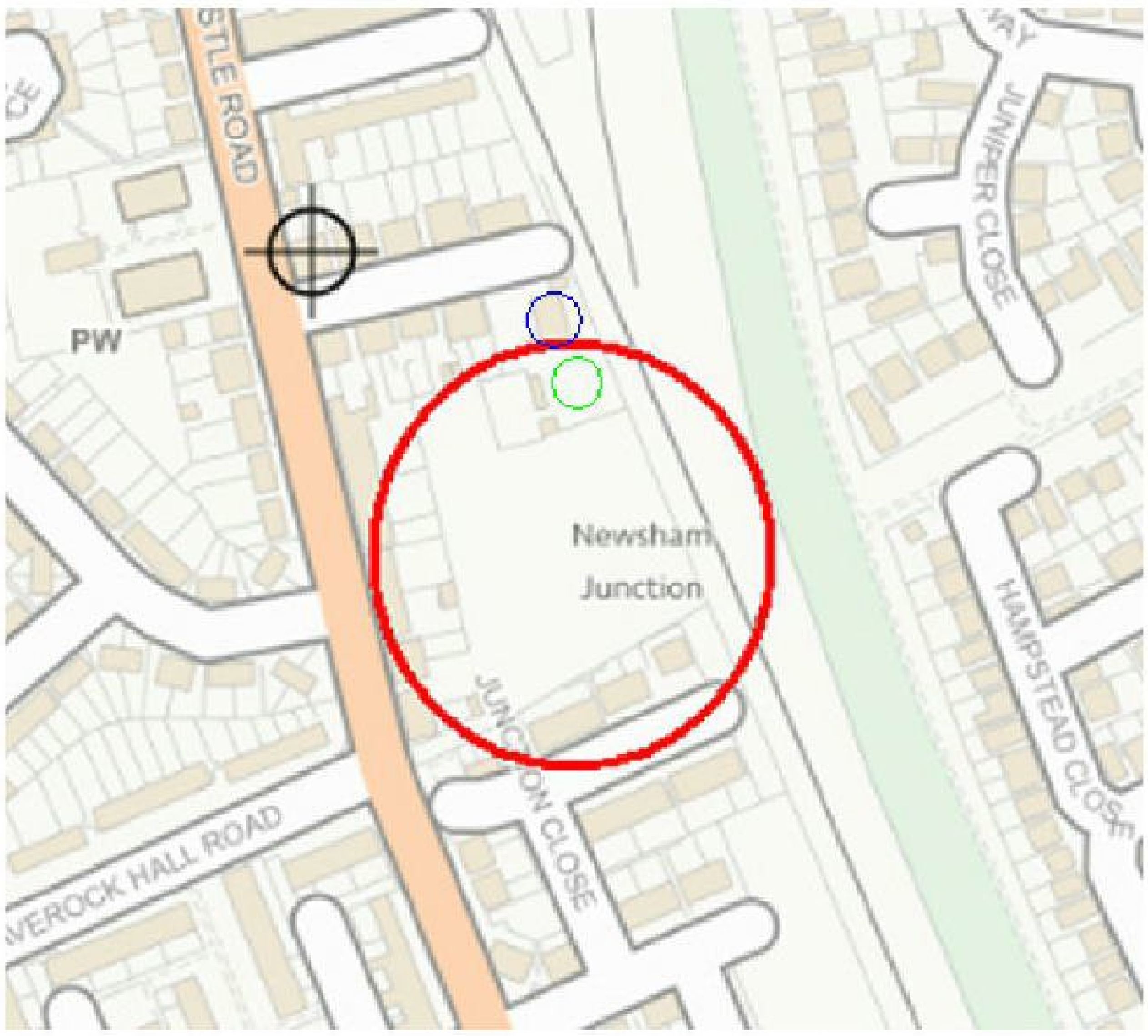
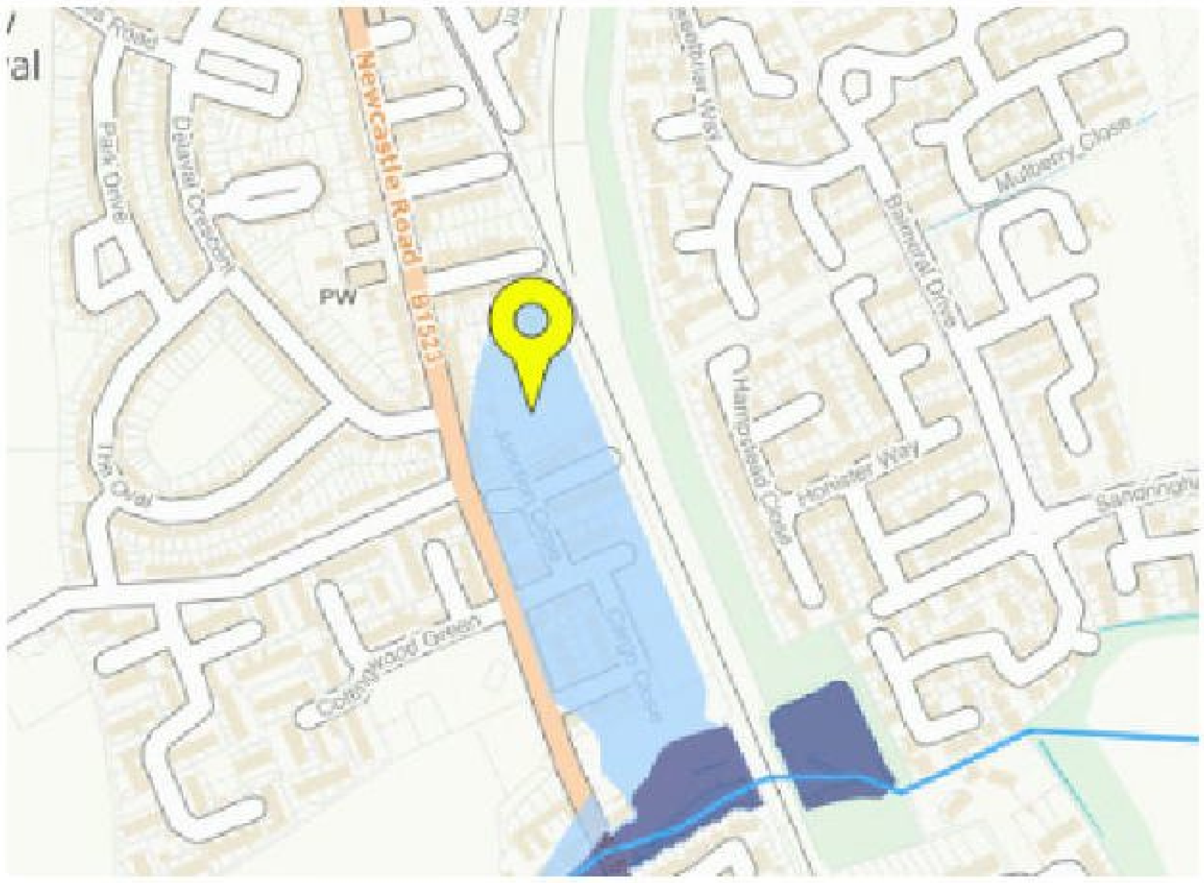


Fig 2.1 Proposed Development at Carlton Avenue, Blyth

The existing site is access via a track to the west. It is surrounded on 3 boundaries by existing housing development; a train track runs along the eastern boundary. An aerial photograph is included within this report as Appendix A.

2.2 Site Flooding Potential

The development is shown by the Environment Agency flood maps to lie within flood zone 2.



The Environment Agency's definition of this is stated below:

Flood Zone 2 - medium probability

Definition This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.

Appropriate uses Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in table 2, are appropriate in this zone. The highly vulnerable uses are only appropriate in this zone if the Exception Test is passed. Flood risk assessment requirements All development proposals in this zone should be accompanied by a flood risk assessment. Policy aims In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage systems.

To establish if the proposed development is appropriate within Flood Zone 2 the vulnerability of the site is to be assessed. Referring to the table below, the proposed works would be classed as "**More Vulnerable**".

Table D.2: Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, 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 required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.19
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; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste.20 • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.
Less Vulnerable	• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; 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 working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).

Table D.3: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification (see Table D2)	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	YES	YES	YES	YES	YES
Zone 2	YES	YES	Exception Test Required	YES	YES
Zone 3a	Exception Test Required	YES	NO	Exception Test Required	YES
Zone 3b 'Functional Floodplain'	Exception Test Required	YES	NO	NO	NO

As shown previously the site is within **Flood Zone 2** and is classed as **More Vulnerable**. Table D.3 confirms that the development is appropriate and no exception test is required.

M Design have also considered risk of flooding for other sources. The plan below shows that there is an area along the southern boundary which could be prone to surface water flooding in a 1 in 30 year storm event. The majority of this is shown to be below 300mm in depth.

The above plan shows the surface water flooding in a 1 in 100 year storm event, the extent and depth has obviously increased.

This area does correspond with a low spot on site which the topographical survey has highlighted. It is likely he result of water ponding as there is no positive outlet from the site. The proposed site will install a new drainage system which will collect all of the water and discharge it into the local sewer, this will therefore reduce the risk of this ponding occurring. The finished floor levels of the dwellings will also be raised in this area. It is therefore envisaged that the risk flooding for surface water is negligible.

The risk of flooding due to a reservoir in the area failing has also been considered. The below plan shows no risk of this.

3 Proposed Development

3.1 Proposed Development Description

The proposal is to construct 27 dwellings in the first phase and now 2 additional dwellings have been applied for with associated infrastructure such as access roads and parking areas. The proposed site will be accessed from the north, which is outside of the flood zone.

Original Site Layout

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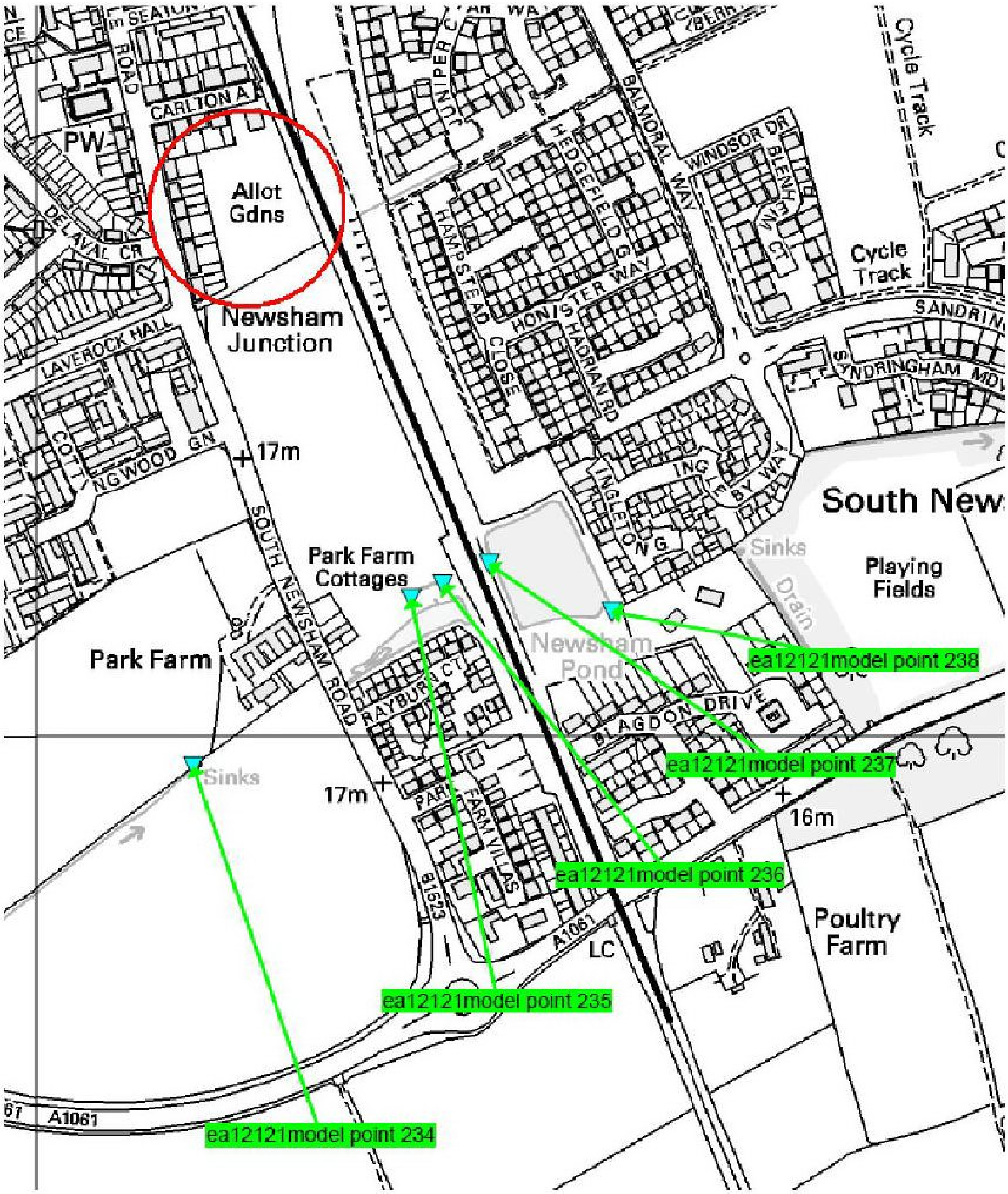
Additional Plots

Flood Mitigation

To assess the actual flood risk to the area M Design have requested the modelled flood levels in the area and also commissioned a topographical survey.



New Delaval Node Point Attributes Table

Modelled flood group code = ea121219

Node Point Name	Return Period (1:x years)	Level Value (mAOD)	Flow Value (Cumecs)
ea12121model point 234	2	16.1	0.24
	5	16.2	0.26
	10	16.2	0.27
	25	16.3	0.27
	50	16.4	0.27
	75	16.4	0.27
	100	16.5	0.27
	101*	16.6	0.27
	150	16.5	0.27
	200	16.6	0.27
	1000	17	0.27
ea12121model point 235	2	15.5	0.24
	5	15.9	0.26
	10	16.2	0.26
	25	16.3	0.26
	50	16.4	0.26
	75	16.4	0.26
	100	16.5	0.26
	101	16.6	0.26
	150	16.5	0.26
	200	16.6	0.26
	1000	17	0.26
ea12121model point 236	2	15.4	0.24
	5	15.9	0.42
	10	16.2	0.53
	25	16.3	0.63
	50	16.4	0.71
	75	16.4	0.73
	100	16.5	0.74
	101	16.6	0.75
	150	16.5	0.74
	200	16.6	0.75
	1000	17	0.84
ea12121model point 237	2	15.3	0.24
	5	15.8	0.42
	10	16.1	0.53
	25	16.1	0.63
	50	16.1	0.71
	75	16.1	0.73
	100	16.1	0.74
	101	16.1	0.75
	150	16.1	0.75
	200	16.1	0.75
	1000	16.1	0.84
ea12121model point 238	2	15.3	0.15
	5	15.8	0.16
	10	16.1	0.16
	25	16.1	0.16
	50	16.1	0.16
	75	16.1	0.16
	100	16.1	0.16
	101	16.1	0.16
	150	16.1	0.16
	200	16.1	0.16
	1000	16.1	0.16

*101 = 100 + Climate Change

Node points 236 and 236 which are adjacent to the site show a 1 in 1000 flood level of 17m AOD. The extract of the topo survey is shown below. The blue line is the 17m AOD contour line and this stretches along most of the southern boundary, in the south east corner the levels fall to approximately 16.92m AOD.

This shows that the 1 in 1000 flood level would only just reach the site, which is an extremely unlikely event. All the storm events up to a 1 in 200 year event would not.

The 1 in 100 year flood levels with an allowance for climate change is 16.6m AOD. The preliminary site strategy (Appendix C) shows that the lowest finish floor level is in the region of 17.3m AOD which is 700m above this level. As stated previously the floor levels of all of the dwelling are also raised above the existing ground levels. The finished floor levels are to be confirmed following the full design but all floor levels will be kept to a minimum of 16.9m AOD which is the 100 Year flood level, with allowance for climate change and an additional 300mm freeboard.

The site is therefore deemed acceptable in terms of flood risk.

Even though flooding on site is thought to be unlikely it is still recommended that the new houses are constructed in a manner that would reduce the damage to any properties should flooding occur.

CGL 2007 Improving Flood Performance of New Buildings document recommends that the construction should adopt a flood resilient approach and prevent water entering the building. The document shows a number of mitigation measures which have been shown below. The client will incorporate any that are feasible for this development.

Foundations

General advice for resilient design

Where concrete ground floor slabs are used, the blockwork substructure is often the weakest point in terms of water penetration from the ground into a dwelling. Whereas there is a general perception that water can ingress through the blockwork structure of the external face of a wall into the property, it is less apparent, but equally possible, that water will penetrate from the ground on the inside of the property. Figures 6.2 and 6.3 illustrate these flow paths for two types of ground floor (ground bearing floor and suspended concrete floor), and different types of foundation (typical for construction in England).

Concrete blocks used in foundations should be sealed with an impermeable material or encased in concrete to prevent water movement from the ground to the wall construction.

Floors

General advice for resilient design

Ground supported floors are the preferred option and concrete slabs of at least 150mm thickness should be specified for non-reinforced construction. Hollow slabs are not suitable if the elements are not effectively sealed.

Suspended floors may be necessary where ground supported floors are not suitable, namely in shrinkable/expanding soils (e.g. clay) or where the depth of fill is greater than 600mm. Uplift forces caused by flood water may affect the structural performance of a floor. Suspended floors are generally not recommended in flood-prone areas, for the following reasons:

- the sub-floor space may require cleaning out following a flood, particularly a sewer flood. In order to aid this process and where accumulation of polluted sediment is expected, the sub-floor space should slope to an identified area and be provided with suitable access
- if cleaning is required, floor finishes may need to be removed to provide access to the sub-floor space. Cheaper, sacrificial, finishes would be the best option.
- the steel reinforcement in the concrete beams of 'beam and block' floors may be affected by corrosion and its condition may need to be assessed following repeated or prolonged floods.

Suspended timber floors, particularly when including timber engineered joists, are not generally recommended in flood prone areas because most wooden materials tend to deform significantly when in contact with water and therefore may require replacement. Rapid drying can also cause deformation and cracking.

Reinforced concrete floors are acceptable but may be prone to corrosion of any exposed steel in areas of prolonged flooding.

Hardcore and blinding: good compaction is necessary to reduce the risk of settlement and consequential cracking.

Damp Proof Membranes (d.p.m.) should be included in any design to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are overlaps of 300mm, and also taping (mastic tape with an overlap of 50mm minimum). Care should be taken not to stretch the membrane in order to retain a waterproof layer. Experience in Scotland has indicated that welted joints in the d.p.m. are an effective jointing solution.

Insulation materials: Water will lower the insulation properties of some insulation materials. Floor insulation should be of the closed-cell type to minimise the impact of flood water. The location of insulation materials, whether above or below the floor slab, is usually based on either achieving rapid heating of the building or aiming for more even temperature distribution with reduced risk of condensation. Insulation placed above the floor slab (and underneath the floor finish) rather than below would minimise the effect of flood water on the insulation properties and be more easily replaced, if needed. However, water entry may cause insulation to float (if associated with low mass cover) and lead to debonding of screeds.

No firm guidance can be provided on best location for insulation where the primary source of flooding is from groundwater. For other types of flooding, placing insulation below the floor slab may be adequate but it is important to recognise that the characteristics of the insulation may be affected by the uplift forces generated by the flood water.

Floor finishes: suitable floor finishes include ceramic or concrete-based floor tiles, stone, and sand/cement screeds. All tiles should be bedded on a cement-based adhesive/bedding compound and water resistant grout should be used. Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material. Suitable materials for skirting boards include ceramic tiles and PVC. Ceramic tiles are likely to be more economically viable and environmentally acceptable.

Floor sump: provision of a sump and small capacity automatic pump at a low point of the ground floor is recommended in cases where the expected probability of flooding in any one year is 20% or a frequency of flooding of more than once in five years (see Section 4). This system will help the draining process and speed up drying but it may only be effective for shallow depth flooding. The dimensions of the sump and its operational procedure would be calculated and agreed with the planning authority based on the predicted volumes of water to be drained.

Services: under floor services using ferrous materials should be avoided.

Walls

General advice for resilient design

Ensure high quality workmanship at all stages of construction.

Masonry walls:

Ensure mortar joints are thoroughly filled to reduce the risk of water penetration. If frogged bricks are used, they should be laid frog up so that filling becomes easier and coverage more certain. Bricks manufactured with perforations should not be used for flood resilient design.

Where possible, use engineering bricks up to predicted flood level plus one course of bricks to provide freeboard (up to maximum of 0.6m depth above floor level); this will increase resistance to water penetration. Blocks (and dense facing bricks) have much improved performance when covered with render.

Aircrete blocks allow less leakage than typical concrete blocks but concrete blocks dry more quickly. Therefore, design of blockwork walls needs to take into account these two opposite types of behaviour and consider whether drying or resistance to water is most relevant in each situation. For a "water exclusion strategy", the expected amount of leakage is minimal and therefore, Aircrete blocks are recommended, although they may retain moisture for longer than concrete blocks, Compared with heavier blocks, Aircrete may offer less restraint to floor/slab edges which under the action of uplift forces could promote the opening up of floor/wall junctions.

Do not use highly porous bricks such as hand made clay bricks.

Solid masonry walls are a good option but will need to be fitted with internal or external wall insulation in order to comply with Building Regulations.

Clear cavity walls, i.e. with no insulation in the cavity, have better flood resilience characteristics than filled or part filled cavity walls as they dry more quickly. The requirements for insulation can be satisfied by external insulated renders or internal thermal boards.

There is evidence that thin layer mortar construction (or thin joint, as it is also commonly known) is a good flood resilience option.

Framed walls: Avoid timber framed walls containing construction materials that have poor performance in floods, for example oriented strand board and mineral fibre insulation. Timber framed walls are not recommended in a "water exclusion strategy". Steel framed walls may offer a suitable alternative option but specialist advice needs to be sought on how to incorporate resilient materials/construction methods in the design, in particular with regard to the insulation.

Reinforced concrete wall/floor construction should be considered for flood-prone areas, i.e. where the frequency of flooding is predicted to be high (see Chapter 4). This form of construction is effective at resisting forces generated by floodwater and will provide an adequate barrier to water ingress (provided service ducts and other openings into the building are adequately sealed). Design details for this type of construction are beyond the scope of this document.

External renders are effective barriers to water penetration and should be used with blocks (or bricks) at least up to the predicted flood level plus the equivalent of a course of bricks as freeboard. Structural checks may be necessary to ensure stability, because of the external water pressures that could occur for design flood depths above 0.3m. External cement renders with lime content (in addition to cement) can induce faster surface drying.

Insulation:

External insulation is better than cavity insulation because it is easily replaced if necessary.

Cavity insulation should preferably incorporate rigid closed cell materials as these retain integrity and have low moisture take-up. Other common types, such as mineral fibre batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).

Internal linings:

Internal cement renders (with good bond) are effective at reducing flood water leakage into a building and assist rapid drying of the internal surface of the wall. The extent to which render prevents drying of other parts of the wall is not currently clear. This may be important, particularly for solid wall construction. This applies also to external renders.

Avoid standard gypsum plasterboard as it tends to disintegrate when immersed in water. Splash proof boards do not necessarily offer protection against flood waters, which may remain for some time and exert pressure on the board.

Anecdotal evidence suggests that internal lime plaster/render can be a good solution. Lime plaster depends on contact with the air to set and harden. Because of this, full strength lime plaster, which typically requires over 6 months, was not possible to test. Consequently, no assurance can be given for its performance. Tests performed when young showed that it crumbles very easily under high water pressure.

Doors and Windows

General advice for resilient/resistant design

Doors: Raising the threshold as high as possible, while complying with level access requirements, should be considered as the primary measure. In addition, sealed PVC external framed doors should be used and, where the use of wooden doors is a preferred option, all effort should be made to ensure a good fit and seal to their frames.

Hollow core timber internal doors should not be used where the predicted frequency of flooding is high. Where sufficient flood warning is given, butt hinges, that allow internal doors to be easily removed and stored in dry areas prior to a flood, should be used. Where the frequency of predicted flooding is low or where there is no warning (e.g. overland or sewer flooding) it may be necessary to replace the doors after the flood.

Windows/patio doors: Windows and patio doors are vulnerable to flood water and similar measures to those used for doors should be taken. Special care should be taken to ensure adequate sealing of any PVC window/door sills to the fabric of the house. Of particular concern would be excessive water pressure on the glazing of patio doors. Double glazing conforming to the relevant standards would in principle adequately resist the pressures generated by flood waters; debris carrying flows may cause damage.

Air vents: special designs of air vent are available in the market to prevent water ingress in circumstances where the predicted flood depth is low (i.e. $< 0.3m$); e.g. periscopic air vent, see Figure 6.11. Careful consideration should be given to effectively sealing any associated joints.

Fittings

General advice for resilient design

The main principle is to use durable fittings that are not significantly affected by water and can be easily cleaned (e.g. use of plastic materials or stainless steel for kitchen units). The cost of these units may need to be balanced against the predicted frequency of flooding.

Place fittings (e.g. electrical appliances, gas oven) on plinths as high as practicable above floor so that they are out of reach of flood water.

Ensure adequate sealing of joints between kitchen units and surfaces to prevent any penetration of water behind fittings.

Ensure high quality workmanship in the application of fittings.

Services

General advice for resilient design

Where possible, all service entries should be sealed (e.g. with expanding foam or similar closed cell material).

Pipework: Closed cell insulation should be used for pipes which are below the predicted flood level.

Drainage services: Non-return valves are recommended in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging. Maintenance of these valves is important to ensure their continued effectiveness.

Water, electricity and gas meters: should be located above predicted flood level.

Electrical services: electrical sockets should be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation (see Figure 6.13. Note a dado rail which provides a limit for replacement of any wall covering). Electric ring mains should be installed at first floor level with drops to ground floor sockets and switches.

Heating systems: boiler units and ancillary devices should be installed above predicted flood level and preferably on the first floor of two-storey properties. Underfloor heating should be avoided on ground floors and controls such as thermostats should be placed above flood level. Conventional heating systems, e.g. hot water pipes are unlikely to be significantly affected by flood water unless it contains a large amount of salts. The less common, hot air duct heating would remain effective provided it is installed above the design flood level.

Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.

As the site is in a flood zone it is recommended that the owners sign up to the Environment Agency early flood warning system. This would ensure that they receive advanced warning of possible flooding and prepare for the event.

As the access to the site is to the north and outside the flood zone, if flooding was to occur then it gives a safe exit from the development.

3.2 Proposed Development Surface Water Runoff & Proposals

Following the Building Regulations hierarchy of surface water disposal methods, the first option to be in investigated will be via sustainable urban drainage techniques such as soakaways. However it is envisaged that the ground conditions will not be suitable for soakways.

The second option would be to discharge directly into a watercourse. There is a watercourse to the east of the development but access to this is blocked by the existing train tracks which run along the eastern boundary.

There is however and existing adopted sewer which runs beneath the tracks and discharges into the watercourse. This sewer accepts the flows from a highway drain and the restricted flows from the development to the south.

This is the most logical location to discharge the surface water flows. The manhole has been buried on site and the client has been unable to uncover it, however NWL have supplied the invert

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levels of the drainage within the southern development to allow M Design to carry out the drainage design.

In order to ensure the drainage is designed in a manor that does not increase the risk of flooding in the area it is proposed to restrict the surface water flows to 5 l/s prior to them being discharged into the system. As a result surface water attenuation will be required.

The manhole should be found and invert level confirmed prior to the detailed design stage and NWL consulted in the form of a developers enquiry to approve the flow rate.

The storage will be design to ensure that no flooding occurs within a 1 in 30 year storm event.

In addition to this the 1 in 100 year storm event plus an allowance for 20% climate change will be modelled. The site will need to be designed to ensure that any flooding from this event is safe, contained within the site and does not pose any risk to the users of the site or the dwellings.

The 1 in 100 year plus 40% climate change storm events will also require modelling. This is to ensure that the development does not increase the risk of flooding outside of the site boundary and mitigation measures put in place if required.

There will also be an additional allowance of 10% building area added to the impermeable area calculations to account for urban creep.

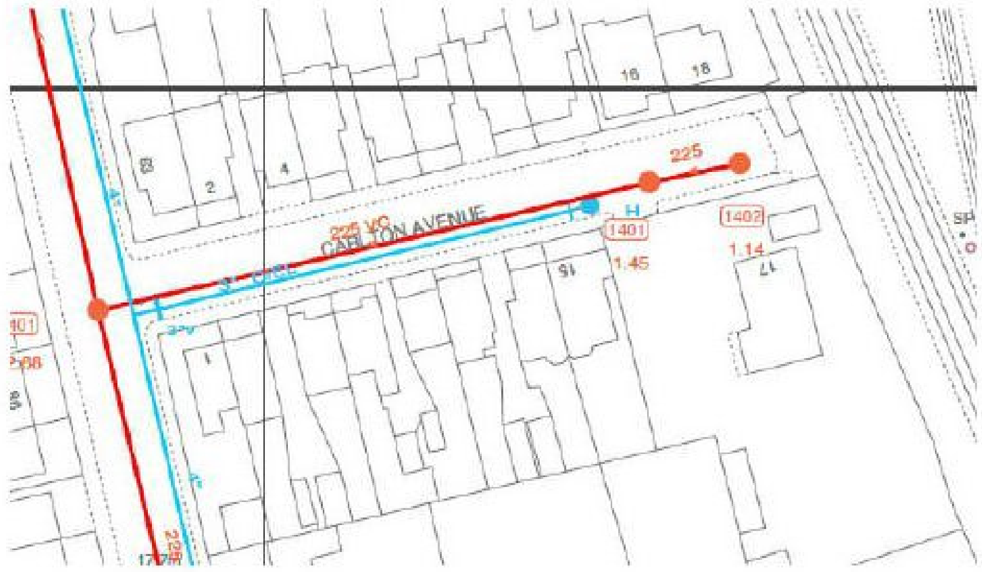
In a meeting with James Hitching on 9th July 2019 the site layout and the possible attenuation methods were discussed. It was agreed that attenuation ponds would not be required. This was due to the fact that the site was within flood zone 2, there was not enough open space to house the ponds and the surface water connection point was too shallow.

It was therefore agreed that storage crate would be provide on site to allow for the additional attenuation. To provide some SUDs features it was agreed that the parking areas would be installed in permeable construction.

In summary the drainage will be design to ensure it does not increase the risk of flooding in the area as shown in Appendix C. The development is therefore deemed acceptable in terms of flood risk.

Foul Water Connection

The foul water flows from the development will connect to the existing sewer to the north. The invert level will need to be confirmed and NWL consulted in the form of a developers enquiry.



4 Conclusions

4.1 Conclusions

This report has shown that the development will be carried out taking into consideration the flood risk on site and also elsewhere in the catchment area.

The possibility of using soakaways will be investigated. If it is found that the ground conditions are not suitable then the site will discharge its surface water flows into the sewer in the south east corner of the site. The surface water flows from the development will be restricted to 5l/s.

A full drainage design along with calculations have been carried out and submitted with this report.

As the site is in a flood zone it is recommended that the owners sign up to the Environment Agency early flood warning system. This would ensure that they receive advanced warning of possible flooding and prepare for the event.

The flood risk to the site has been assessed and the site use is acceptable within flood zone 2.

The drainage system on site the site will not increase the risk of flooding elsewhere in the catchment area. The site is therefore deemed to be acceptable in terms of flood risk.

Appendix A

Aerial Photograph of Site

Appendix B

See Additional PDF

Appendix C

See Additional PDF

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Appendix D