PROPOSED DEVELOPMENT OFF BECCLES ROAD, LODDON, NORFOLK

FLOOD RISK ASSESSMENT

APRIL 2018

REF: 1714/RE/10-16/02 REVISION A

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CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Mr R Holmes to carry out a Flood Risk Assessment for a proposed development off Beccles Road, Loddon, Norfolk.

This revised assessment has been carried out in order to include a revised site layout. It should be noted that the previous version of this flood risk assessment and flood modelling report was approved by the EA on the 28th November 2018 (ref: AE/2016/120859/02-L01). Therefore, the main changes to this document are in Chapters 4 and 5.

QUALITY ASSURANCE, ENVIRONMENT AND HEALTH AND SAFETY

Evans Rivers and Coastal Ltd operates a Quality Assurance, Environmental, and Health and Safety Policy.

This project comprises various stages including data collection; hydrological and hydrogeological assessments; surface water drainage designs; and reporting. Quality will be maintained throughout the project by producing specific methodologies for each work stage. Quality will also be maintained by initiating internal quality procedures including the validation of third party deliverables; creation of an audit trail to record any changes made; and document control using a database and correspondence log file system.

To adhere to the Environmental Policy, data will be obtained and issued in electronic format and alternatively by post. Paper use will also be minimised by communicating via email or telephone where possible. Documents and drawings will be transferred in electronic format where possible and all waste paper will be recycled. Meetings away from the office of Evans Rivers and Coastal Ltd will be minimised to prevent unnecessary travel, however for those meetings deemed essential, public transport will be used in preference to car journeys.

The project will follow the commitment and objectives outlined in the Health and Safety Policy operated by Evans Rivers and Coastal Ltd. All employees will be equipped with suitable personal protective equipment prior to any site visits and a risk assessment will be completed and checked before any site visit. Other factors which have been taken into consideration are the wider safety of the public whilst operating on site, and the importance of safety when working close to a water source and highway. Any designs resulting from this project and directly created by Evans Rivers and Coastal Ltd will also take into account safety measures within a “designers risk assessment”.

Report carried out by:
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DISCLAIMER

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1. INTRODUCTION

1.1 Project Scope

1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Mr R Holmes to carry out a Flood Risk Assessment for a proposed development off Beccles Road, Loddon, Norfolk.

1.1.2 This revised assessment has been carried out in order to include a revised site layout. It should be noted that the previous version of this flood risk assessment and flood modelling report was approved by the EA on the 28th November 2018 (ref: AE/2016/120859/02-L01). Therefore, the main changes to this document are in Chapters 4 and 5.

1.1.3 It is understood that this assessment will be submitted to the Planning Authority as part of a planning application. Specifically, this assessment intends to:

1) Consider the impacts of the 1 in 20 year, 1 in 100 year and 1 in 1000 year flood events (all inclusive of climate change), in accordance with NPPF;

2) Review any literature and guidance specific to this area;

3) Determine the extents of the aforementioned NPPF Flood Zones across the site, together with depths of floodwater and hazard;

4) Assess the risks to people and property and propose mitigation measures accordingly;

5) Review existing evacuation and warning procedures for the area;

6) Carry out an appraisal of flood risk from any other sources such as groundwater as required by NPPF;

7) Report findings and recommendations.

1.1.4 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) dated March 2012. Other documents which have been consulted include:

- DEFRA/EA document entitled *Framework and guidance for assessing and managing flood risk for new development Phase 2 (FD2320/TR2)*, 2005;
- Communities and Local Government 2007. *Improving the Flood Performance of New Buildings*. HMSO.
- DEFRA/EA document entitled *The flood risks to people methodology (FD2321/TR1),* 2006;
- EA *Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose*, 2008;
- National Planning Practice Guidance – Flood Risk and Coastal Change.
- UK Government's climate change allowances guidance dated February 2016.
- South Norfolk Council Strategic Flood Risk Assessment Stage 2 dated 2007.

2. DATA COLLECTION

2.1 To assist with this report, the data collected included:

- Ordnance Survey 1:10,000 street view map (Evans Rivers and Coastal Ltd OS licence number 100049458).
- Filtered LIDAR data at 1m resolution (tile tm3698_DTM_1m downloaded from Data.Gov.Uk on 21/10/2016, Temporal Coverage 1/1/1998-30/09/2014) covering the site and surrounding area.
- British Geological Survey, *Online Geology of Britain Viewer*.
- British Geological Society, *Groundwater Flooding Susceptibility Map* obtained via Promap.
- Topographical survey of the site and watercourse carried out by BB Surveys Ltd (Drawing Numbers 2219-384-S01, 2219-384-S02 and 2219-384-S03).
- 1:250,000 *Soil Map of Eastern England* (Sheet 4) published by Cranfield University and Soil Survey of England and Wales 1983.
- 1:625,000 *Hydrogeological Map of England and Wales*, published in 1977 by the Institute of Geological Sciences (now the British Geological Survey).
- 1:125,000 *Hydrogeological Map of Southern East Anglia* published in 1981 by the Institute of Geological Sciences (now the British Geological Survey).
- Flood modelling report carried out by Evans Rivers and Coastal Ltd (ref: 1714/RE/10-16/01 Rev A).

2.2 All third party data used in this study has been checked and verified prior to use in accordance with Evans Rivers and Coastal Ltd Quality Assurance procedures.

3. SITE CHARACTERISTICS

3.1 Existing Site Characteristics and Location

3.1.1 The site is located to the south of Beccles Road, Loddon, Norfolk. The approximate Ordnance Survey (OS) grid reference for the site is 636450 289278 and the location of the site is shown on Figure 1.

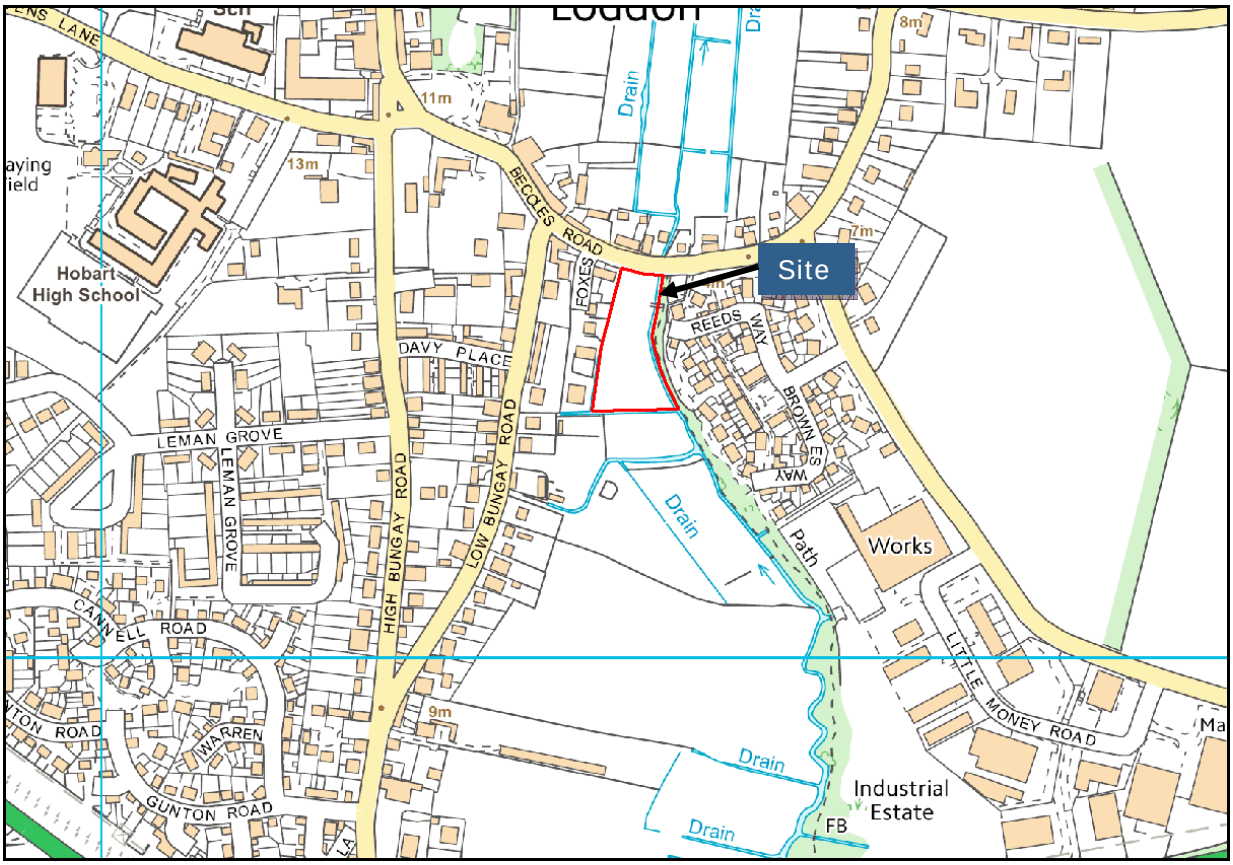

Figure 1: Site location plan (Source: Ordnance Survey)

3.1.2 The site is approximately rectangular in shape and currently comprises an open field which is in part overgrown with vegetation with other areas covered by short grass and unmade ground. The site is accessed from Beccles Road located adjacent to the northern frontage of the site. Residential dwellings occupy land to the west of the site and to the east of the site. A drainage ditch runs along the southern boundary of the site and part of the western boundary.

3.1.3 A watercourse flows in a northerly direction adjacent to the eastern frontage of the site flows through a brick arch bridge beneath Beccles Road at the northern frontage of the site. The watercourse continues north towards the River Chet located 820m downstream of the site. A footbridge which used to cross the watercourse has recently been removed as shown on the updated topographical survey.

3.1.4 A GPS topographical survey of the site and watercourse has been carried out by BB Surveys Ltd (Drawing Numbers 2219-384-S01, 2219-384-S02 and 2219-384-S03). Filtered LIDAR data at 1m resolution has also been obtained to determine and illustrate the topography of the site and surrounding area (Figure 3) and to supplement the topographical survey. It can be seen that ground levels across the site typically fall in an

easterly direction. There is a localised area within the vicinity of the former footbridge crossing which is set lower than surrounding ground levels.

Figure 2: Photo of site looking north (Source: BB Surveys)

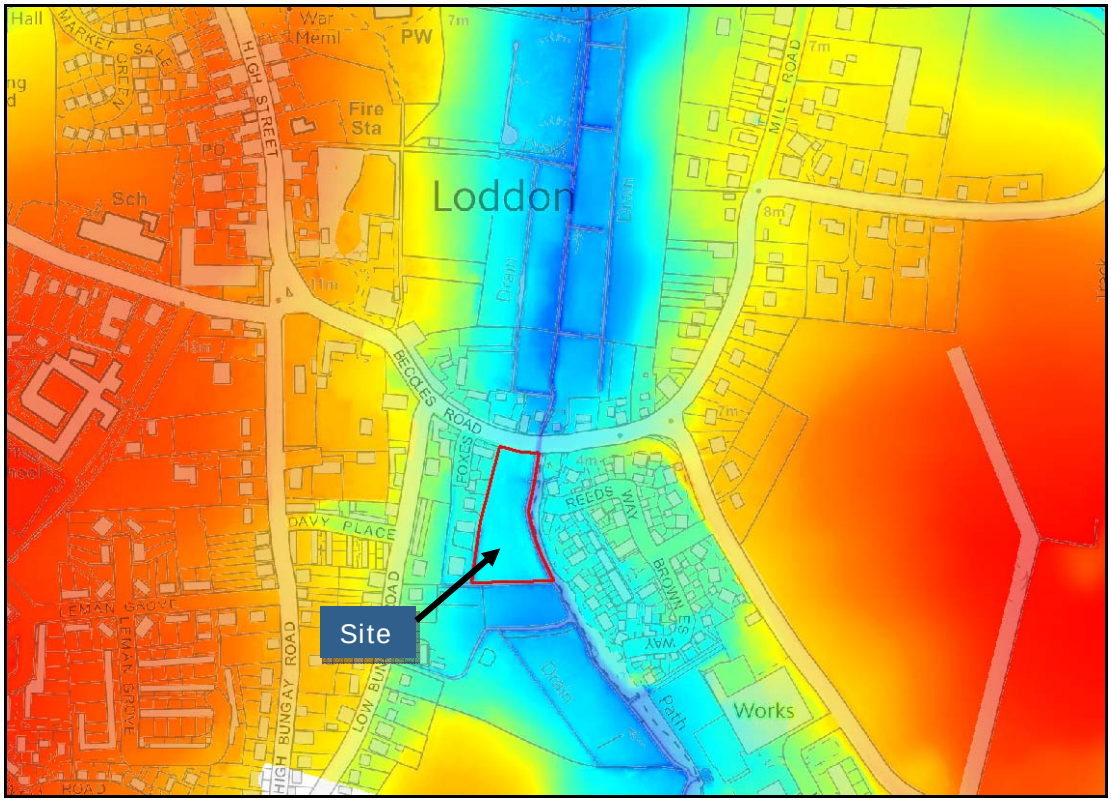

Figure 3: Filtered LIDAR survey of the site and surrounding area combined with OS (where low ground is denoted by blue colours and higher ground is denoted by green and yellow colours)

3.2 Site Proposals

3.2.1 It is the Client's intention to develop the site with up to 4 dwellings together with garages, driveways, garden areas and access road from Beccles Road. The site proposals can be seen on Drawing Number 1471/2/A.

3.2.2 All dwellings and garages will have a finished ground floor level set 150mm higher than existing ground levels and at 3.75m AOD.

4. BASELINE INFORMATION

4.1 Flood Zones

4.1.1 The Environment Agency's Flood Zone Map (Figure 4) shows that the site is located within the NPPF defined Flood Zone 3, 2 and 1. However, Figure 7293D/21/541 of the SFRA shows that the site is located mainly within the Flood Zone 2.

4.1.2 The Flood Zone 3 is divided into two sub-categories, the Flood Zone 3a and Flood Zone 3b. The extent of the Flood Zone 3a 'High Probability' is defined as the 1 in 100 year return period fluvial event in this case.

4.1.3 The maps do not show the extent of the functional floodplain (Flood Zone 3b). Flood Zone 3b functional floodplain is defined in Table 1 of the NPPG as the area where water flows or is stored during flood events. The functional floodplain is usually defined by the limit of the 1 in 20 year flood envelope.

4.1.4 The Flood Zone 2 'Medium Probability' floodplain is defined as having between a 1 in 100 year annual probability and 1 in 1000 year annual probability of flooding. The threshold of the Flood Zone 2 floodplain is the 1 in 1000 year extreme event.

4.1.5 The Flood Zone 1 'Low Probability' comprises land as having less than a 1 in 1000 year annual probability of fluvial flooding (i.e. an event more severe than the extreme 1 in 1000 year event).

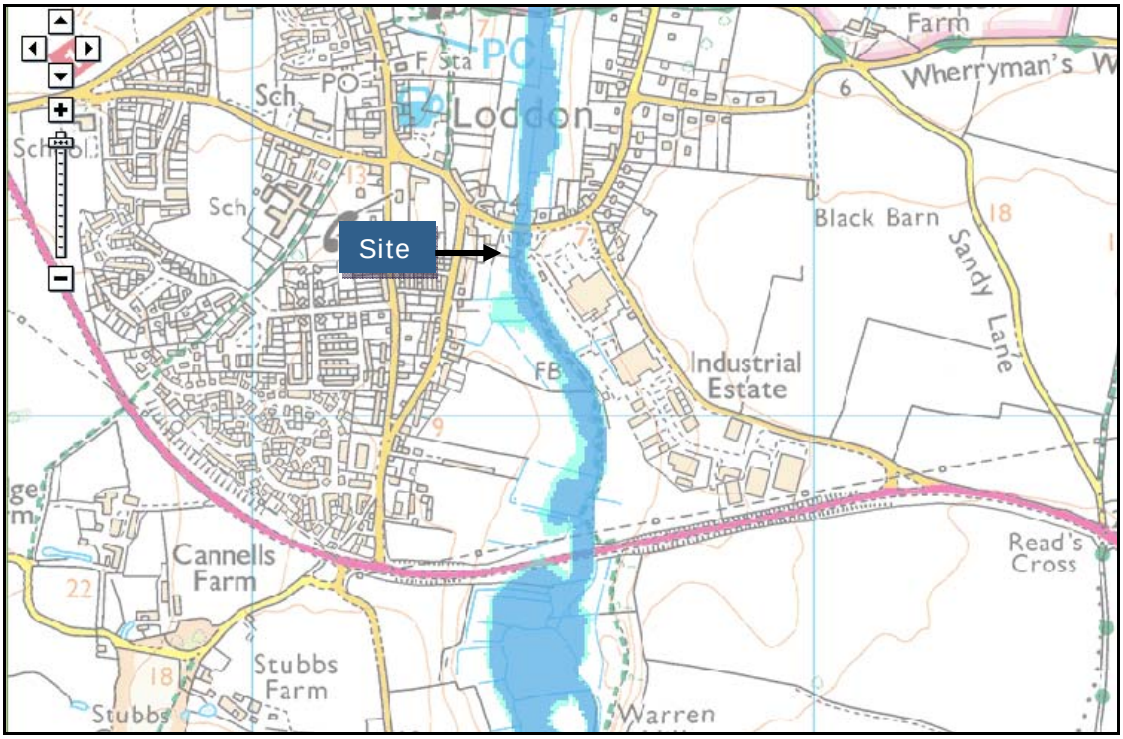

Figure 4: Environment Agency Flood Map (Source: Environment Agency)

4.1.6 The flood modelling report carried out by Evans Rivers and Coastal Ltd (ref: 1714/RE/10-16/01 Rev A), shows that the site is largely located within the present day and future Flood Zone 1, however, a small localised area of the site, likely associated with the former footbridge, is located within the present day Flood Zone 2 and future Flood Zone 2 and 3a (Figures 5 and 6).

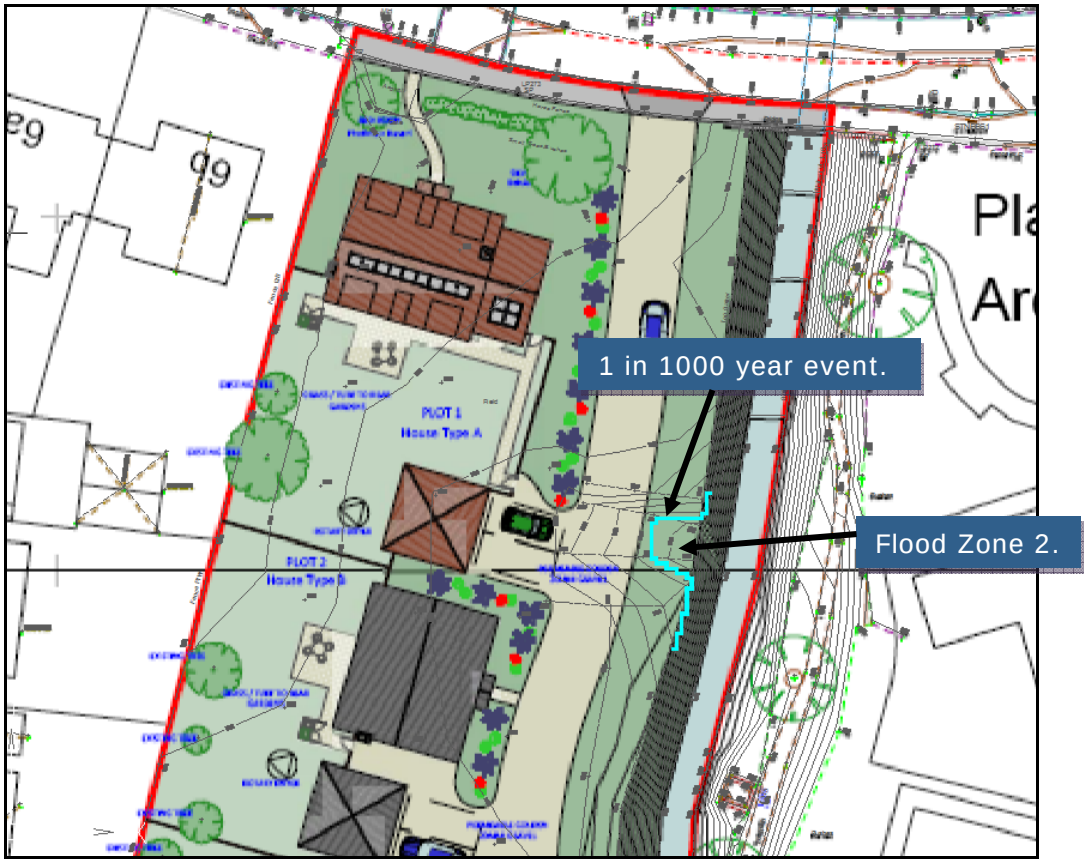

Figure 5: Present day flood zones in relation to proposed layout

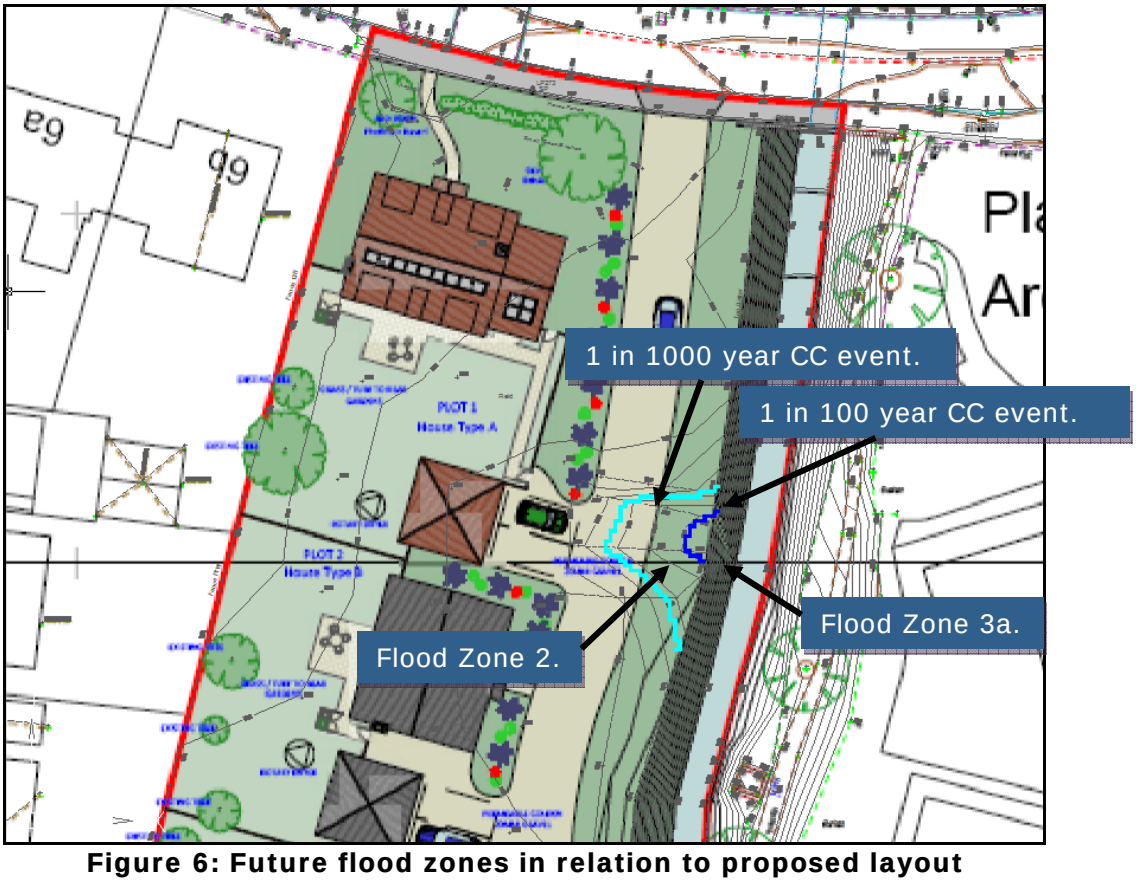

Figure 6: Future flood zones in relation to proposed layout

4.2 Flood Warning and Emergency Planning

4.2.1 The site is not located within Environment Agency Flood Alert or Flood Warning area.

4.2.2 It is understood that in the event of flooding, evacuation is managed by a multi-agency team in conjunction with the Police. The multi-agency team provides suitable premises for shelter, first aid, refreshments and possible transportation with consideration given to the elderly and vulnerable groups. It is essential that occupants produce robust Emergency Flood Plans to avoid putting themselves or emergency services at risk and that they do not rely solely on emergency services during the event.

5. FLUVIAL FLOOD RISK

5.1 The flood modelling report carried out by Evans Rivers and Coastal Ltd (ref: 1714/RE/10-16/01 Rev A) indicates that floodwater does not reach a level high enough to inundate the part of the site intended for the dwellings, garages and driveways during the present day and future 1 in 20 year event, present day and future 1 in 100 year event (including the Upper End climate change scenario) and present day and future 1 in 1000 year event (Figures 7-9).

5.2 The proposed finished floor level of the dwellings of 3.75m AOD is 0.868m higher than the worst-case climate change 1 in 1000 year flood level of 2.882m AOD. When considering the climate change (35% Higher Central) 1 in 100 year flood level of 2.390m AOD and climate change (65% Upper End) 1 in 100 year flood level of 2.581m AOD, the proposed finished floor level will be set 1.360m and 1.169m higher respectively thus providing safe (dry) refuge during all modelled events.

5.3 The results indicate that the flood extent is limited to the localised lower area associated with the former footbridge. Part of the proposed accessed road is shown to be affected during the climate change 1 in 1000 year event.

5.4 Based on a minimum ground level of 2.60m AOD across the access road (and based on flood level result at cross section 63 of 2.876m AOD), the maximum flood depth across this part of the proposed access road would be 0.276m during the climate change 1 in 1000 year event.

Figure 7: 1 in 1000 year flood extent in relation to proposed layout

Figure 8: Climate change 1 in 1000 year extent and climate change 1 in 100 year (Higher Central) 1 in 100 year extent in relation to proposed layout

Figure 9: Extent of Upper End climate change 1 in 100 year event in relation to proposed layout

5.5 A sensitivity analysis was carried out as part of the modelling assessment and indicated that in the event that the downstream bridge became partially blocked during the climate change (Higher Central) 1 in 100 year event, the floodwater would rise and the flood extent would increase across the site by 1m when compared to the baseline climate change 1 in 1000 year event.

5.6 The results indicate that there would not be an increased risk to the dwellings and garages (Figure 10) as a result of a potential blockage, as the flood level would be a maximum of 2.980m AOD and therefore 0.770m lower than the proposed finished floor levels.

5.7 There would be no additional overtopping points onto the site during the blockage scenario. However, the part of the proposed access road would be flooded to a maximum depth of 0.378m during the climate change (Higher Central) 1 in 100 year event.

Figure 10: Blockage scenario flood extent in relation to climate change 1 in 1000 year flood extent

6. FLOOD RISK MITIGATION AND EVACUATION

6.1 Reducing Exposure to the Hazard

6.1.1 In order to assess and reduce the exposure to the hazard and the vulnerability to the hazard after the site has been developed, the guidance outlined in the DCLG/DEFRA/EA document entitled *Flood Risk Assessment Guidance for New Development Phase 2*; *Flood Risks to People, Phase 2*; *Improving the Flood Performance of New Buildings* has been consulted.

6.1.2 Paragraph 060 (ID 7-060-20140306) of the NPPF Planning Practice Guidance states that the first preference is to avoid flood risk by raising floor levels above the design (Higher Central) climate change 1 in 100 year flood level.

6.1.3 As discussed in Chapter 5, the proposed dwellings and garages will be located well above the design climate change (Higher Central) 1 in 100 year flood level, as well as the extreme climate change 1 in 1000 year level, present day 1 in 1000 year level and climate change (Upper End) 1 in 100 year level. These areas would also not be affected in the event that there is a partial blockage of the downstream bridge opening.

6.1.4 Therefore, safe (dry) refuge will be available at all times and the proposals comply with the NPPG. There will also be no displacement of floodwater during the flood event resulting in no offsite impact.

6.2 Reducing Vulnerability to the Hazard

6.2.1 Although people will remain safe across the proposed dwellings during all modelled flood events, people at the site are unlikely to have detailed knowledge of the dynamics of the flood event and the storminess of the event could result in people panicking or becoming anxious, particularly if they observe flooding across part of the proposed access road identified in Chapter 5.

6.2.2 Despite the site not being located within a Flood Warning area, it is understood that the police and other emergency services will assist in the evacuation to rest centres operated by the Council. It is not mandatory for occupants to use these centres and personal evacuation arrangements can be just as effective. The Fire Service will assist in any rescuing of people from the flooded area once this has occurred. People at the site will need to make a judgment themselves with regards to the flood hazard if evacuation is attempted and not solely rely on the emergency services.

6.2.3 The occupants should develop a *Family Flood Plan*. Further guidance is offered in the Environment Agency's guidance document entitled *What to do before, during and after a flood*. The *Family Flood Plan* should consider, for example, information about vital medication needed and a *Flood Kit*.

6.2.4 A *Flood Kit* is a useful precautionary measure especially if evacuation from the site is prolonged. The kit should be stored in an accessible location to ensure that it is not affected by floodwater. The contents should also be checked every 6 months and items replaced if necessary.

6.2.5 It may be sensible to compile two *Flood Kit's* to suit each eventuality. For example, a smaller kit could be compiled which would allow the occupants to carry it during evacuation. A larger kit could also be compiled which included additional food and beverage items in case of ongoing safe refuge within the property. Both kits should contain the necessary items as suggested overleaf.

1. Important documents
2. Torch and batteries
3. Mobile phone (fully charged)
4. First-aid kit
5. Wind-up radio
6. Important telephone numbers
7. Bottled water
8. Non-perishable food provisions
9. Rubber Gloves and wellington boots
10. Medication or information relating to medication and its location
11. Blankets, warm clothes
12. Essential toiletries
13. Camera to record any damage
14. Emergency cash

6.2.6 It is not recommended that people remain within the buildings after the order for evacuation has been issued by the emergency services, unless the occupant is vulnerable (i.e. infirm) and the emergency services should be notified. If safe refuge is preferred, then the occupants should turn off the gas and electricity and non-return valves will ensure that there is no back flow of foul water (occupants should, however, refrain from flushing toilets or emptying sinks).

Floodwater is dangerous:

- Six inches of fast flowing water can knock you over.
- Two feet of water will float your car.
- Flooding can cause manhole covers to come off, leaving hidden dangers.
- Don't walk or drive through flood water.
- Don't let children play in flood water.
- Don't walk on sea defences or riverbanks.
- When water levels are high be aware that bridges may be dangerous to walk or drive over.
- Look out for other hazards such as fallen power lines and trees.
- Wash your hands thoroughly if you touch floodwater as it may be contaminated.

6.3 Vulnerable Groups

6.3.1 The occupants at the site may include vulnerable groups such as elderly people, children with sensory or physical disabilities, minority ethnic groups, or the infirm. Priority will need to be given to these people during the flood event.

6.3.2 Research suggests that older people may have life experiences which inhibit appropriate action on receipt of a flood warning and warnings may not be heeded due to this strong sense of independence.

6.3.3 Minority ethnic groups may not be aware of warnings because these warnings are not conveyed on radio channels customarily heard by them. Also a poor command of English (verbally and written) may also inhibit their response to any flood warning and advice issued by the emergency services.

6.3.4 The infirm or disabled may also be vulnerable to flood risk. This may be in the form of anxiety or other ailments which are aggravated by flooding. Evacuation may also be a more extensive exercise for these groups than for other people at the site.

6.3.5 People with no prior experience of flooding tend to have a lack of awareness, preparedness and knowledge of flooding. These people often disbelieve that the flood water would reach their location and are not aware of how resilient their building is.

6.3.6 The research document entitled *Public Response to Flood Warning* published by the EA/DEFRA in 2007 suggests that warning messages issued face-to-face have been found to increase public response to hazard. Conversely, fear of looting can decrease the probability of response and therefore the necessary security measures will need to be implemented once evacuation has been ordered.

6.3.7 Vulnerable groups should be identified by the seller and information passed to the Council's emergency planning department if considered relevant.

6.4 Safe Access/Egress

6.4.1 Safe (dry) refuge is available during all flood events across the proposed dwellings.

6.4.2 Figures 7, 8 and 9 and information in Chapter 5 indicate that the maximum flood depth across the affected part of the proposed access road would be 0.276m during the climate change 1 in 1000 year event.

6.4.3 Therefore, the flood hazard to people across this area, according to the hazard equation outlined in paragraph 13.7.2 of *FD2320/TR2,* would be *Dangerous for Some* during the climate change 1 in 1000 year event.

6.4.4 When considering a partial blockage of the downstream bridge opening during the climate change (Higher Central) 1 in 100 year event, the flood depth would be 0.378m and the hazard would be *Dangerous for Most*.

6.4.5 Research provided in paragraph 6.13 of the superseded 2009 DCLG document entitled *PPS 25 Development and Flood Risk Practice Guide* states that vehicles can become unstable in depths of more than 300mm. The DEFRA/EA document FD2321/TR1 and FD2321/TR2 suggests that heavier vehicles such as fire engines become unstable in 0.9m of still water and this value reduces as the velocity increases.

6.4.6 Therefore, as the flood depth would be lower than the critical threshold during the climate change 1 in 1000 year event, there would not be a risk to vehicles or emergency services leaving or accessing the site.

6.4.7 When considering a partial blockage of the downstream bridge opening during the climate change (Higher Central) 1 in 100 year event, only vehicles would have difficulty accessing leaving the site. Emergency services are likely to be able to access the site safely.

6.4.8 It may be feasible to locally raise ground levels across the affected part of the proposed access road, in order to reduce the flood depth and hazard to safe limits during the climate change 1 in 1000 year event. As the access road does not flood during other flood events, flood compensation would not be required in this instance.

6.4.9 A flood response plan will be compiled to ensure that the occupants are aware of the flood risk and procedures to take before, during and after a flood.

6.5 Insurance

6.5.1 The Association of British Insurers (ABI) published a guidance document in 2012 entitled *Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England*.

6.5.2 The ABI guidance sets out the requirements of the insurance industry when considering flood risk and insurability of the property. The guidance suggests that properties should be protected for flood events up to the 1 in 100 year event in order to access insurance at a competitive price.

6.5.3 The guidance also states that insurers would of course prefer to cover properties which are not at risk of flooding, however, for those properties which are at risk of flooding insurers would prefer that the properties are raised above the flood level, over resistance measures which prevent floodwater from entering the building, or resilience measures which allows floodwater to enter the building.

6.5.4 The proposals will be set above the fluvial climate change 1 in 100 year flood level and climate change 1 in 1000 year flood level. Therefore, the ABI's requirement of protection during a 1 in 100 year event will be exceeded and there will be a good chance of the property being insured at a competitive rate.

7. OTHER SOURCES OF FLOODING

7.1 Groundwater Flooding

7.1.1 In order to assess the potential for groundwater flooding during higher return period rainfall events, the Jacobs/DEFRA report entitled *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study*, published in May 2004, was consulted, together with the guidance offered within the document entitled *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*, commissioned by DEFRA and carried out by Jacobs in 2006.

7.1.2 According to Cobby et al (2009), groundwater flooding can be defined as flooding caused by the emergence of water originating from subsurface permeable strata. The greatest risks of groundwater flooding are considered to be from either:

- a rise of groundwater in unconfined permeable strata, such as Chalk, after prolonged periods of extreme rainfall;
- a rise of groundwater in unconsolidated, permeable superficial deposits, which are in hydraulic continuity with local river water levels and where the hydraulic gradient of the water table is low.

7.1.3 As described above, it is widely accepted that groundwater flooding generally occurs from both permeable strata (e.g. Chalk) and superficial deposits (e.g. sands and gravels). In particular, unconfined water-bearing deposits (i.e. those with permeable soils above them) are susceptible to a rise in groundwater during prolonged, extreme rainfall and during periods of high recharge throughout autumn and winter. Antecedent conditions, such as, above average groundwater levels prior to the rainfall event, are also a contributing factor to a variation in the water table.

7.1.4 Permeable superficial deposits can also hold quantities of groundwater, although these tend to be insignificant compared to the stored quantities within consolidated aquifers. Unconsolidated deposits such as sand and gravels are sufficiently permeable to store water; however such deposits which yield a low quantity of water are commonly termed a non-aquifer.

7.1.5 Deposits comprising a mixture of permeable and impermeable soils can lead to a presence of perched water. Perched water tables are located above less permeable deposits such as clay and are located within water-bearing soils such as sand and gravel. If perched water is unconfined then the potential for recharge and groundwater flooding can be high. If the perched water is confined by less permeable clay deposits, then the clay deposits will have a buffering effect on percolating surface water and thus the recharge potential and rise in the water table is low.

Soil and Geology at the Site

7.1.6 It can be seen from the various soil and hydrogeological data, listed in Section 2, that the soils beneath the site comprise peaty clay with some sand and gravel. The Local Borehole Data extracted from the British Geological Survey, *Online Geology of Britain Viewer,* indicates that the water table is present at approximately 3.80m bgl.

Groundwater Flooding Potential at the Site

7.1.7 There have been no recorded groundwater flood events across the area between 2000 and 2003, as indicated by the Jacobs study. The BGS *Groundwater Flooding Susceptibility Map* shows that there is "Potential for Groundwater Flooding of Property Situated Below Ground Level".

7.1.8 It is considered that a precautionary approach is adopted when considering groundwater flood risk to foundations. A *Water Exclusion Strategy* as outlined further in the DEFRA/EA document *Improving the Flood Performance of New Buildings* is recommended, which aims to prevent groundwater from affecting the foundations below ground. For example, 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.

7.2 Surface Water Flooding and Sewer Flooding

7.2.1 Surface water and sewer flooding across urban areas is often a result of high intensity storm events which exceed the capacity of the sewer thus causing it to surcharge and flood. Poorly maintained sewer networks and blockages can also exacerbate the potential for sewer flooding. Surface water flooding can also occur as a result of overland flow across poorly drained rural areas.

7.2.2 The Agency's Surface Water Flooding Map (Figure 11) indicates that there is mainly a low surface water flooding risk (i.e. chance of flooding between 1 in 1000 years and 1 in 100 years).

7.2.3 The data associated with the EA map indicates that the depth of water would generally be less than 0.3m, however, some parts of the site would be affected to a depth of between 0.3m and 0.9m (Figure 12).

7.2.4 The map generally shows lower areas of ground where water may pond during storm events and identify areas which receive subsequent runoff from surrounding land during heavy rainfall events (i.e. these parts of the site are acting as small basins).

7.2.5 By comparing Figures 11 and 12 to the LIDAR data it can be seen that the areas of the site affected by higher depths of surface water flooding correlate well with localised low areas/depressions up to 0.3m deep. The LIDAR data suggests that adjacent areas of the site which experience lower depths of surface water flooding are set at least 3.50m AOD.

7.2.6 It is likely that as part of the proposed development these localised depressions will be in-filled in order to achieve a finished floor level of 3.75m AOD, and hence will cease to become focused areas of surface water ponding. The finished floor levels will therefore be set above the aforementioned adjacent areas which experience a lower depth of surface water flooding (i.e. 3.50m AOD). Therefore, all proposed dwelling would subsequently be at risk during low risk events and to a depth of below 0.3m.

7.2.7 Having finished floor levels set 0.15m higher than existing ground levels will ensure that the surface water flood risk is avoided during low risk events.

7.2.8 Despite the flood depth being below 0.3m and velocity being greater than 0.25 m/s along the proposed access road and external areas (and along Beccles Road adjacent to the site entrance), the hazard to people and vehicles would be *Very low.* Therefore, safe access/egress can be achieved at all times.

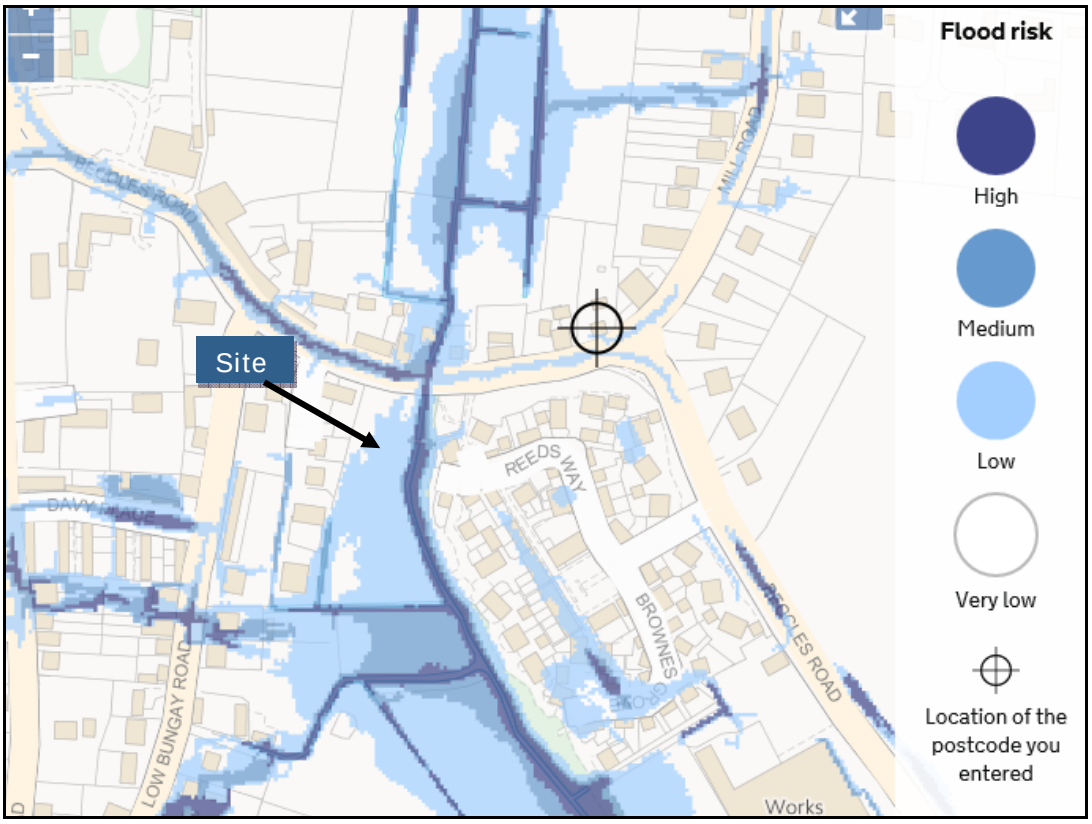

Figure 11: Environment Agency Surface Water Flooding Map and site extent (Source: Environment Agency, 2016)

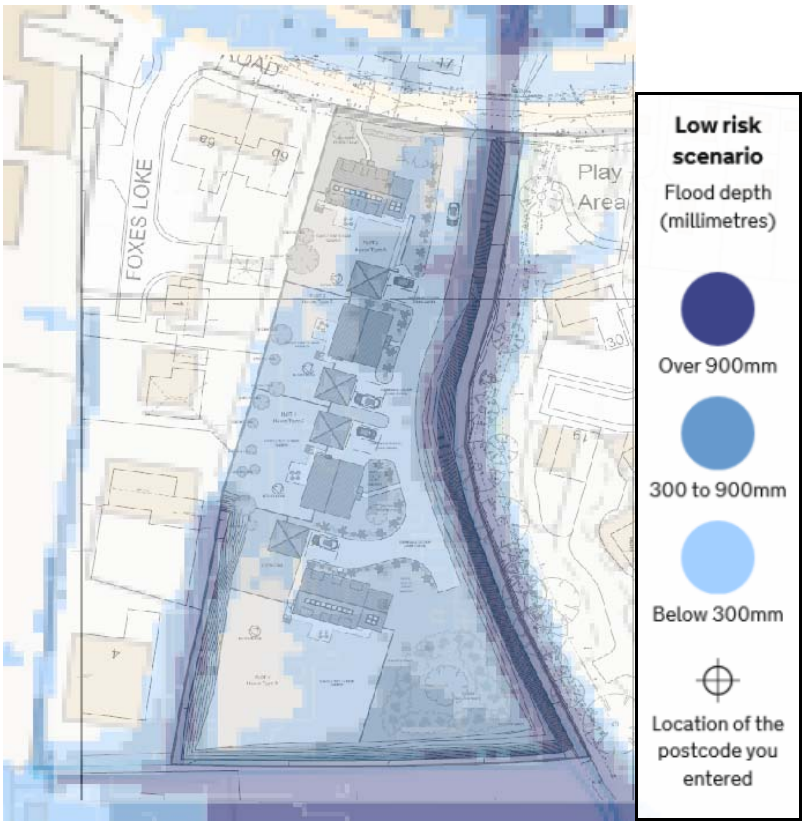

Figure 12: Environment Agency Surface Water Flooding Map and site proposals during low risk events

7.3 Reservoirs, Canals And Other Artificial Sources

7.3.1 The failure of man-made infrastructure such as flood defences and other structures can result in unexpected flooding. Flooding from artificial sources such as reservoirs, canals and lakes can also occur suddenly and without warning, leading to high depths and velocities of flood water which pose a safety risk to people and property.

7.3.2 The Environment Agency's "Risk of flooding from reservoirs" map suggests that the site is not at risk from such features.

8. CONCLUSIONS

8.1 A review of the relevant guidance documents and various types of data collected at the site has enabled a full assessment of the flood risks to be quantified.

8.2 Flood modelling has determined that the proposed dwellings and garages will be located within the present day and future Flood Zone 1 and when considering the climate change 1 in 100 year event (both Higher Central and Upper End).

8.3 A small part of the proposed access road will be affected during the climate change 1 in 1000 year event.

8.4 When considering a partial blockage of the bridge there is out of bank flooding during the climate change (Higher Central) 1 in 100 year event and the proposed access road would become flooded to a slightly larger extent than during the climate change 1 in 1000 year event (with no blockage). The proposed dwellings and garages are not at risk under blockage conditions.

8.5 Proposed finished floor levels should be set at 3.75m AOD (i.e. 150mm higher than existing ground levels) as this will provide additional freeboard above the fluvial flood level and will mitigate against surface water flood events. Safe (dry) refuge during all modelled events can be achieved at all times.

8.6 Safe access/egress can be guaranteed during the present day 1 in 1000 year event, climate change (Higher Central) 1 in 100 year event and climate change (Upper End) 1 in 100 year event.

8.7 However, the hazard along the affected part of the proposed access road would be *Dangerous for Some* during the climate change 1 in 1000 year event and *Dangerous for Most* when considering a partial blockage of the downstream bridge opening during the climate change (Higher Central) 1 in 100 year event.

8.8 Despite the low fluvial flood risk, an evacuation strategy has been developed within this assessment. It is proposed that the occupants prepare a *Family Flood Plan*. It is recommended that the occupants also take advice from the emergency services but do not rely on them with regards to evacuation.

8.9 This assessment has investigated the possibility of groundwater flooding and flooding from other sources at the site. It is considered that there will be a low risk of groundwater flooding across the site.

8.10 There will be a low surface water flood risk across the site and the dwellings and garages will be set 150mm higher than existing ground levels which will reduce the flood risk to acceptable levels. Safe access/egress can be achieved during the peak of the surface water flood events.

9. BIBLIOGRAPHY

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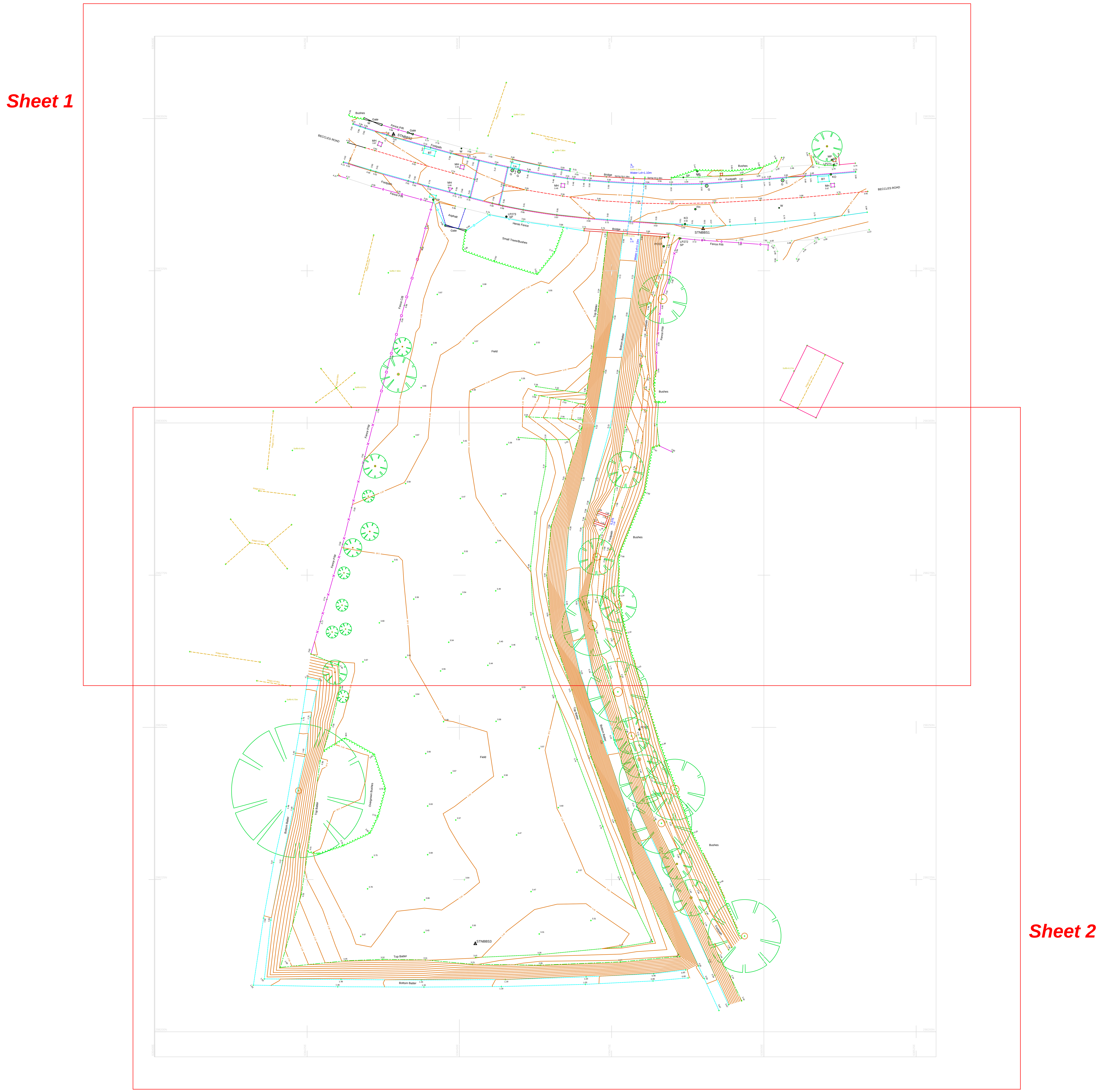
DRAWINGS



DRAWING NUMBER:

2219-384-S01

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	PO	Post	YL	Yellow Line
DR	Door	RE	Rodding Eye		
EEB	Electric MH Cover	RL	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
ER	Earth Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

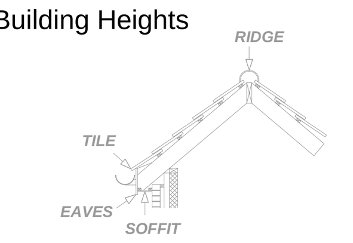
Services

Foul Sewers — 0.225Ø FW MH
Storm Sewers — 0.375Ø SW MH
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey,
Deciduous
Coniferous

Building Heights



SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS.
ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OSTN02)

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.

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ANY ERRORS SHOULD BE NOTIFIED TO BB SURVEYS LTD.

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STATION TABLE

Station Name	Easting	Northing	Height (m)
STNBBS1	636490.020	298331.909	3.651
STNBBS2	636439.174	298347.418	3.854
STNBBS3	636452.609	298214.459	3.791

Note: This survey has been carried out for flood risk analysis and should not be used for any other purpose.

DATE:	REV:	REVISIONS
24.10.16	-	Survey Issued

BBS
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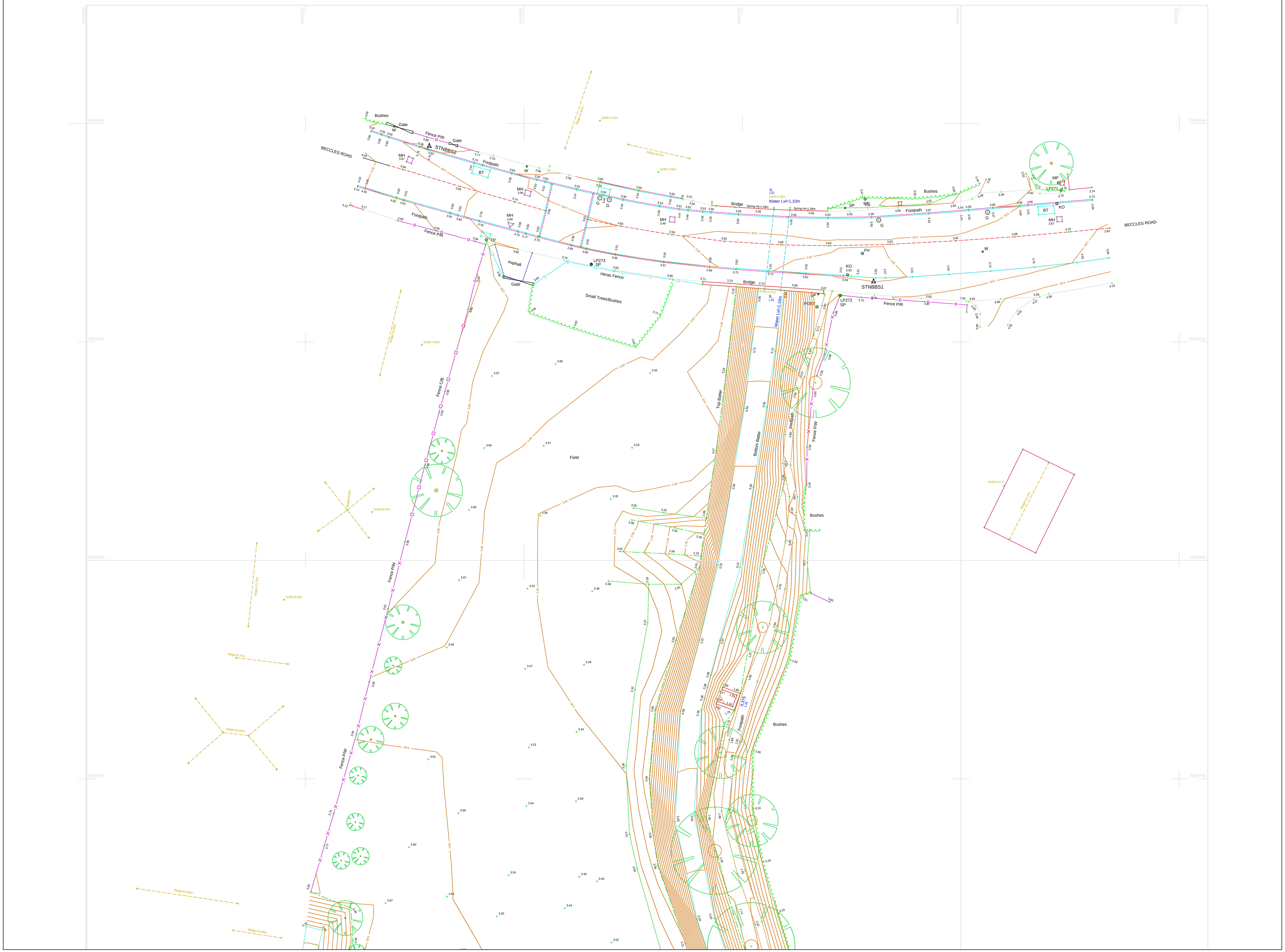
CLIENT:
Rupert Evans
Reg Holmes

PROJECT:
Beccles Road
Loddon

TITLE:
Existing Ground Level Survey
Overview

SCALE:	DRAWN:	SHEET SIZE:	DATE:
NTS	N.P.	A1	24.10.16

DRAWING NUMBER:
2219-384-S01



DRAWING NUMBER:

2219-384-S02

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	PO	Post	YL	Yellow Line
DR	Door	RE	Rodding Eye		
EEB	Electric MH Cover	RL	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
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ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

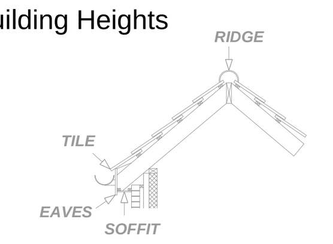
Foul Sewers — 0.225Ø FW MH
Storm Sewers — 0.375Ø SW MH
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey,

Deciduous
Coniferous

Building Heights



SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS.
ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OSTN02)

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24.10.16	-	Survey Issued

BBS
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m: 07786 388175
e: barry@bbsurveys.co.uk

CLIENT:
Rupert Evans
Reg Holmes

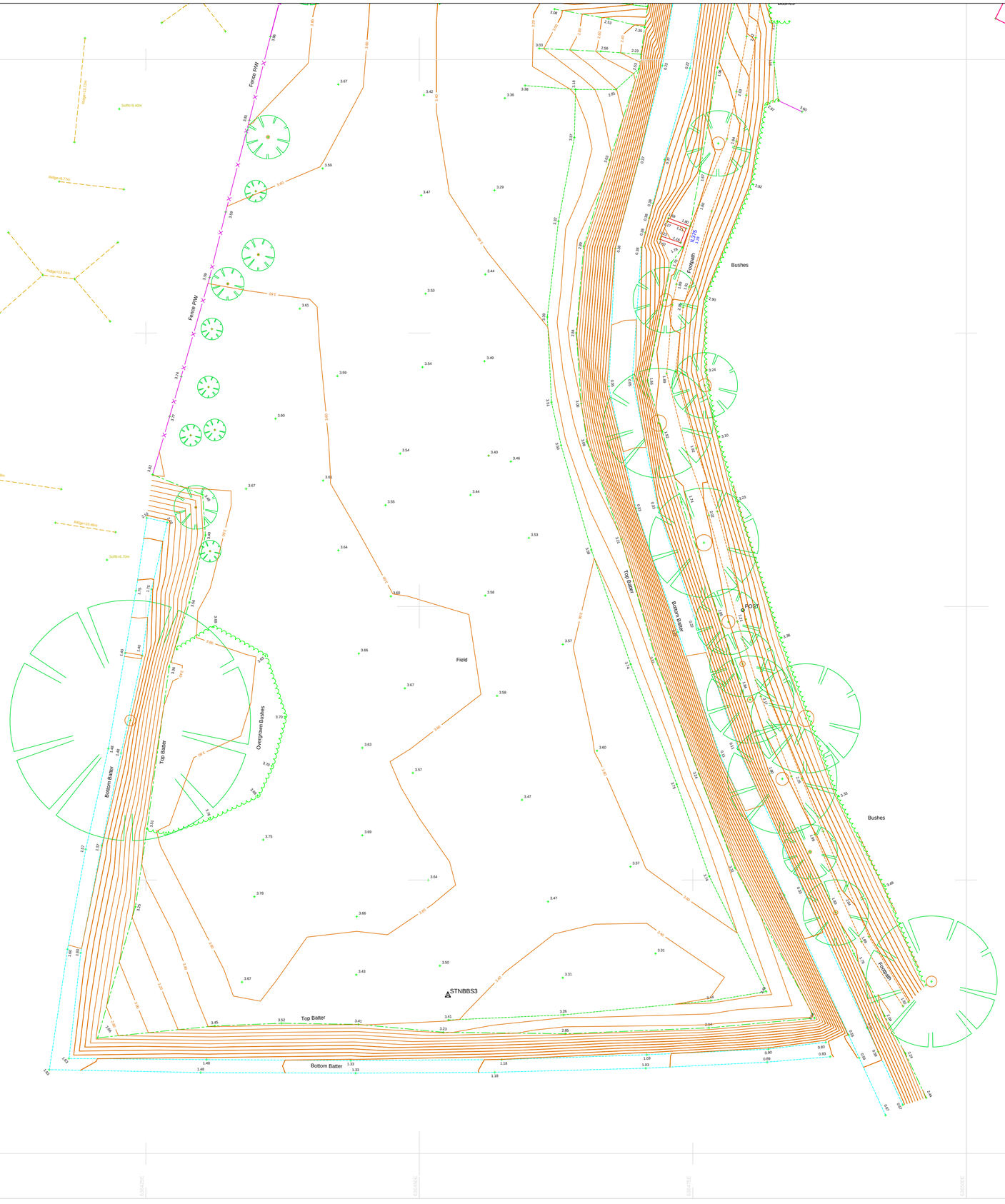
PROJECT:
Beccles Road
Loddon

TITLE:
Existing Ground Level Survey
Sheet 1

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	24.10.16

DRAWING NUMBER:

2219-384-S02



DRAWING NUMBER:

2219-384-S03

NOTES:

AV	*Air Valve*	*EH*	*Fire Hydrant*	*SP*	*Sign Post*
BB	*Bottom Bank*	*FP*	*Footpath*	*STAY*	*Stay*
BH	*Bore Hole*	*G*	*Gully Grate*	*SV*	*Sluice Valve*
BL	*Lit Bollard*	*GV*	*Gas Valve*	*TAC*	*Tactile Paving*
BOL	*Bollard*	*HEDGE*	*Hedge*	*TB*	*Top Bank*
BIN	*Bin*	*IC*	*Inspection Cover*	*TBOX*	*Telephone Box*
BS	*Bus Stop*	*IL*	*Invert Level*	*TL*	*Traffic Light*
BUSH	*Bush*	*KO*	*Kerb Outlet*	*TOK*	*Top Of Kerb*
BOX	*Box (Utilities)*	*LP*	*Lamp Post*	*TP*	*Telegraph Pole*
CAB	*Cabinet*	*MH*	*Manhole*	*TRK*	*Track*
CHNL	*Channel*	*MP*	*Marker Post*	*TS*	*Traffic Sign MH*
CL	*Centreline*	*NB*	*Name Board*	*VENT*	*Vent*
CONC	*Concrete*	*PW*	*Partition Wall*	*W*	*Water Cover*
COL	*Column*	*PB*	*Post Box*	*WL*	*White Line*
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FCB	*Close Boarded*
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FHD	*Hoarding*
FNR	*Heras Fence*
FPL	*Palisade*
FPR	*Post & Rail*
FPW	*Post & Wire*
RAIL	*Railings*

Control Station
Column
X.XX *Floor to Ceiling Height*
X.XX F/C *Floor to False Ceiling Height*

Features

Fences	FCB 1.8h
Walls	Wall 1.2h
Hedges	Hedge 1.2h
Overhead Line	OHL

Average root line shown.
Indicative position of cables.

Services

Foul Sewers	F/S 300
Storm Sewers	S/W 600

Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey.

Deciduous
Coniferous

Building Heights

RIDGE
TILE
EAVES
SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS. ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OSTN02)

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24.10.16	*-*	*Survey Issued*

1 Chestnut Place
Cringleford
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t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

CLIENT:

Rupert Evans
Reg Holmes

PROJECT:

Beccles Road
Loddon

TITLE:

Existing Ground Level Survey
Sheet 2

SCALE:	*DRAWN:*	*SHEET SIZE:*	*DATE:*
1:200	B.B.	A1	24.10.16

DRAWING NUMBER:

2219-384-S03

PROPOSED DEVELOPMENT OF FOUR DETACHED DWELLINGS AT LAND SOUTH OF BECCLES ROAD, LODDON, NORFOLK, NR14 6JQ FOR MR R HOLMES

AERIAL IMAGE OF PROPOSAL

N
W E
S

0 20 40 50 [M]

Aerial Image - Metres @ 1:500 @ A1

BLOCK PLAN

2219-384 ~ Land to the west of Express Plastics, Beccles Road, Loddon - Existing OGL Survey 2D All survey data to Ordnance Survey National Grid (OSTN02)

(Surveyed by BB Surveys 24th October 2016 using Trimble S8 & Trimble R10 GPS with VRS)

STATION TABLE

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0 20 40 50 [M]

Block Plan - Metres @ 1:500 @ A1

ACCOMMODATION SCHEDULE

Plot Number	Plot House Type	Plot Detail	Plot Area	
1	A	4 bedroom house with double garage and 2 parking spaces	Dwelling 195m2	Garage 31m2
2	B	4 bedroom house with double garage and 2 parking spaces	Dwelling 158m2	Garage 31m2
3	C	4 bedroom house with double garage and 2 parking spaces	Dwelling 158m2	Garage 31m2
4	D	5 bedroom house with double garage and 2 parking spaces	Dwelling 210m2	Garage 31m2

K GARNHAM DESIGN
01603 616884 www.kgarnham.co.uk
info@kgarnham.co.uk

Project - Proposed Development Of Four Detached Dwellings At Land South Of Beccles Road, Loddon, Norfolk, NR14 6JQ

Client - Mr R Holmes

Scale - as dwg **Drawing Number -** 1471

Drawn By - James **Sheet Number-** 2

Date - 19.03.2018 **Revision Number -** A

PROPOSED SITE LAYOUT


EVANS
Rivers and Coastal