

NeoFlood Ltd

Mrs T Hunter-Shaw

Proposed Residential Development

Land off Crease Drove, Crowland

Drainage Strategy and Flood Risk Statement

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1 Executive Summary

This Drainage Strategy and Flood Risk Statement has been prepared to accompany the planning submission for the proposed residential development of land located off Crease Drove, Crowland.

The site has been assessed using the guidance noted in the Planning Practice Guidance: Flood Risk and Coastal Change documentation available on the Gov.uk website¹.

The report concludes that the site is located within **Flood Zone 3, however it is sequentially tested and should therefore be considered for residential development** and that the proposed development type is appropriate for this location.

The assessment identifies the management of surface water generated by the development itself as the only residual flood risk in this area.

Therefore the site should be developed with a suitable surface water management strategy to collect, convey and control runoff from the new impermeable areas of the site. The drainage masterplan illustrates a drainage system designed to discharge to the adjacent Internal Drainage Board system without attenuation.

This strategy will not only control runoff from the development site but also reduce flood risk downstream by providing a significant reduction in the peak runoff from the site.

Reference is made in this report to the following separately issued sources of information

1. Noise Assessment Report – Ref 2707.11/1 – Blue Tree Acoustics
2. Transport Assessment Report – Ref ADC120 – ADC Infrastructure Limited

¹ <http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/>

2 Introduction

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process, to reduce future damage to property and loss of life. National Planning Policy Framework and associated Technical Guidance (NPPF-TG) identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications.

The purpose of this report is to assist our client and the Local Planning Authority to make an informed decision on the flood risks associated with the sites redevelopment.

Local Planning Authorities have the powers to control development in accordance with the guidelines contained in NPPF-TG, and are expected to apply a risk-based approach to development with the Sequential Test. This sets out a sequential characterisation of flood risk in terms of annual probability of river, tidal and coastal flooding.

In accordance with the sequential test sites are to be classed as follows:

Flood Zone	Appropriate Uses
Flood Zone 1 - Low Probability – This zone comprises land having less than 1 in 1000 annual probability of river or sea flooding (<0.1%)	All uses of land are appropriate in this zone
Flood Zone 2 - Medium Probability – This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this Zone Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test is passed
Flood Zone 3a - High Probability – This zone comprises 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 year	The water-compatible and less vulnerable uses of land in Table D.2 area appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this should be designed and constructed to remain operational and safe for users in time of flood.

Flood Zone 3b - Functional

Floodplain

– This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (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 LPA and the Environment Agency, including water conveyance routes)

Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. 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; and
- Not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

This report is a **Drainage Strategy and Flood Risk Statement** for the **Proposed Residential Development of Land off Crease Drove, Crowland**.

The site is to be assessed with respect to the requirements of National Planning Policy Framework (NPPF) and the associated Technical Guide (NPPF-TG) to determine the suitability of the proposed type of development for this site.

As well as fluvial flood risk the report will also assess the risk posed locally by the development itself and the runoff it may potentially generate.

This element will include a general overview of the suitability of SuDS type systems.

Finally, if required, mitigation measures and recommendations will be made that will enable the site to be suitably developed while actively seeking to reduce flood risk locally.

The following guidelines and references have been used in the preparation of this report:

- a) Planning Practice Guidance – Flood Risk and Coastal Change²
- b) DEFRA / EA – Flood Risk Assessments : Local Planning Authorities³

The report is also based on additional information received from the Environment Agency (EA), and Anglian Water (AW).

This report has been produced on behalf and for the sole use of **Mrs T Hunter-Shaw** for the purposes of the application described herein with the permission of the author. If any unauthorised Third Party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

The findings and opinions conveyed within this report are based on information obtained from a variety of sources, as detailed, which the Author believes are reliable. Nevertheless, the Author

² <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>

³ <https://www.gov.uk/flood-risk-assessment-local-planning-authorities>

cannot and does not guarantee the authenticity or reliability of the information it has relied upon from these sources.

The report will follow accepted procedure in providing the services but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, the Author takes no liability for and gives no warranty against actual flooding of any property (client's or third party) or the consequences of flooding in relation to the performance of the services. Similarly, our preparation of this report does not guarantee that a Planning Consent will be granted.

3 Existing Site

3.1 Site Location

The site is located off land located to the south of the Settlement of Crowland approximately 0.7km from the settlement centre which in turn is approximately 11.0km north east of Peterborough.

The site comprises undeveloped land between Crease Drove and residential development on Penwald Close and is approximately centred on National Grid Reference 523775 E 309632 N. A site location plan illustrating the same is included in Appendix A for reference with the site bound in red.

3.2 Site Description

The proposed development site encloses an area of approximately 1.69ha and is rectangular in shape having approximate major and minor dimensions of 195 x 86m.

It is accessed from Crease Drove, which forms the western boundary, a former industrial development is located to the north, residential development to the east and open, agricultural land to the south.

The site is essentially flat with a slight fall from Crease Drove in the west to the existing drainage ditch to the east. This fall is less than 700mm over 195m.

A topographical survey is included in Appendix B.

The development site is undeveloped and currently in agricultural use.

3.3 Existing Site Drainage

The site is currently undeveloped and has no evidence of existing positive drainage systems within the site boundaries. The site is therefore assumed to drain via natural systems (infiltration and overland flow).

3.4 Existing Watercourses

The River Welland dominates the fluvial scenario in this area and is located 1.22km north west of the site.

3.5 Existing Land Drains / Ditches

Given the flat topography of the Crowland area, the settlement of Crowland is drained via a network of linked drainage features which outfall to the local internal drainage board (IDB) system. These are part of the North Level IDB.

3.6 Adopted Drainage

Sewer records received from Yorkshire Water (AW) are included in Appendix C.

These shows that there is limited foul drainage adjacent to the site but that there are gravity drainage systems to the north west at the junction of Crease Drove and Alderlands Close.

The area is generally served by pumped drainage systems due to the flat topography of the whole area.

3.7 Highway Drainage

Crease Drove is drained via an over-the-edge system, with no apparent kerbs or gullies in the vicinity of the development site.

Outfall from the system is to the network of drainage ditches adjacent to the carriageway.

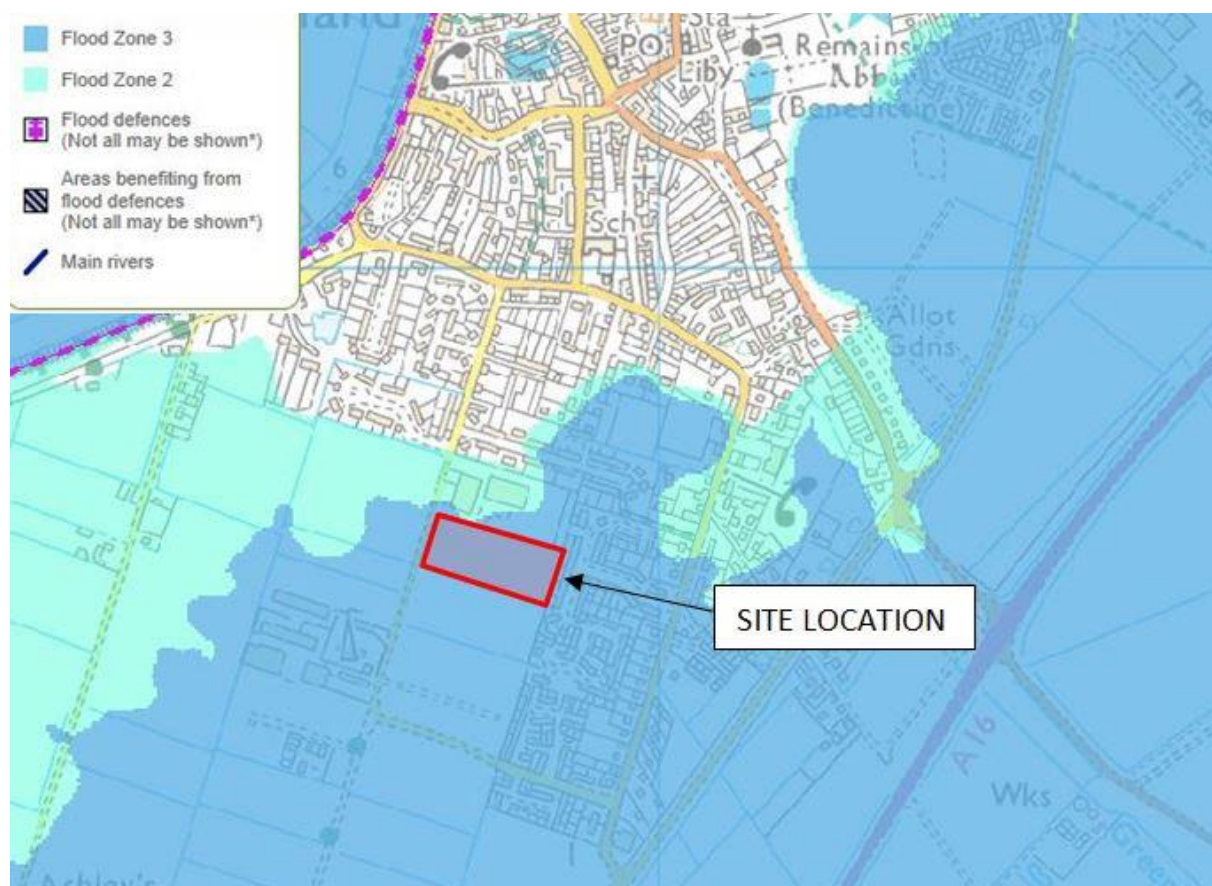
4 Sources and Extent of Existing Flooding

4.1 Natural Sources

4.1.1 Watercourses

Environment Agency (EA) flood zone maps indicate that the site is located on the periphery of Flood Zone 3. It is noted that this does not account for all the flood defences in this area.

Figure 1 - Environment Agency On-line Indicative Flood Map June 2016

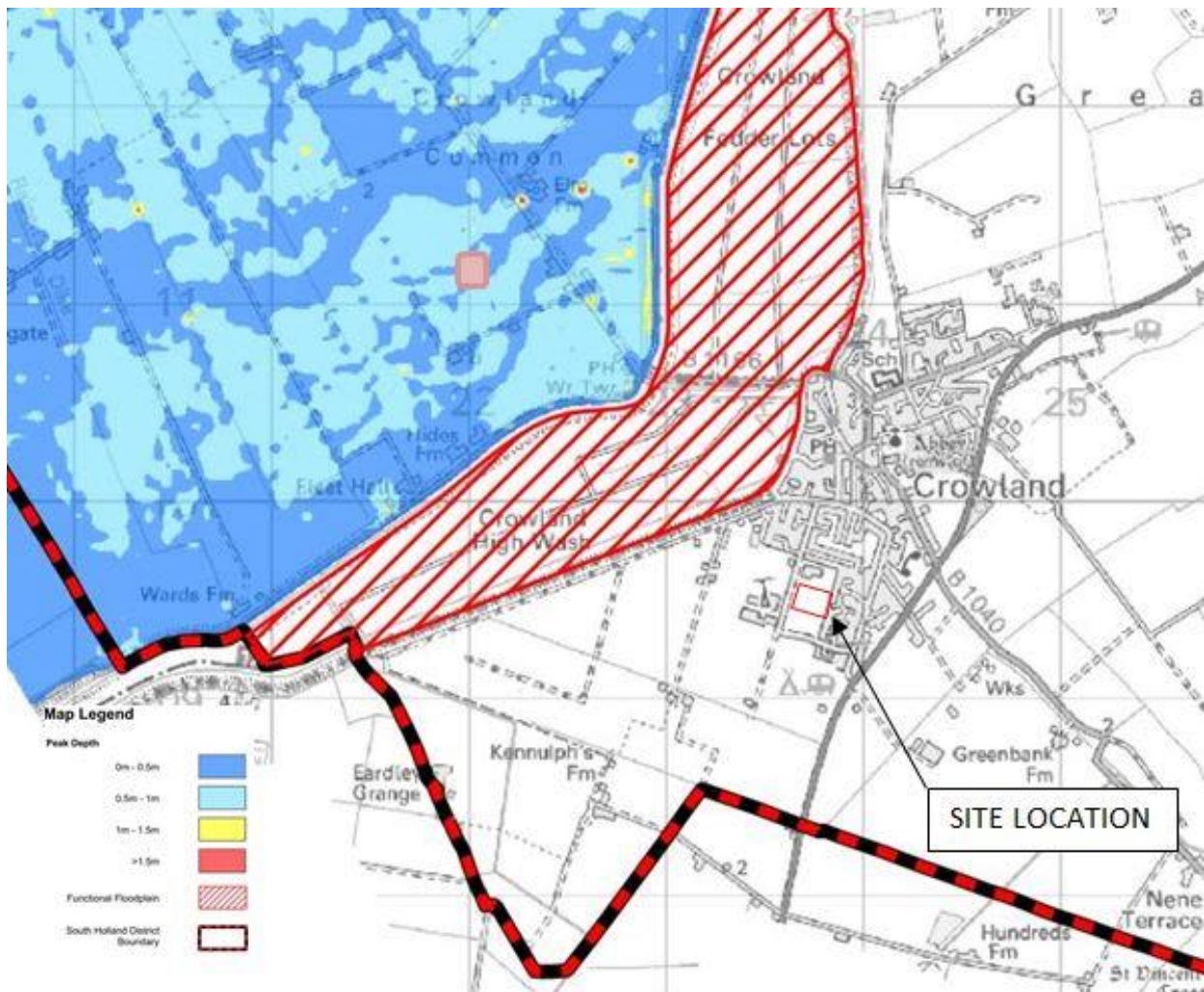


Source - 1 - [© Environment Agency copyright and database rights 2015. © Ordnance Survey Crown copyright. All rights reserved. Environment Agency, 100026380.](#)

In addition to this South Holland District Council (SHDC) have produced a Strategic Flood Risk assessment (SFRA) which has separately modelled the local flood risk from the River Welland.

An extract from the SFRA showing the estimated 1% Fluvial and .5% tidal event for the year 2115 is included below.

Figure 2 – SHDC SFRA dated 2010 – Extract from 1%fluvial/0.5% Tidal 2115 Map



Source - 2 - <http://www.sholland.gov.uk/article/4193/Strategic-Flood-Risk-Assessment-2010>

This map shows that Crowland is protected by flood defences and is not in Flood Zone 3. The washlands of Crowland and Cowbit in conjunction with the raised Corporation Bank to the north west protect the development site from the natural flood plain of the River Welland.

4.1.2 Land Drainage

The level of water in the land drainage system is managed by the IDB, it is effectively kept to a level such that the land in the area will drain enabling it to be utilised.

Local levels are controlled by a pumping stations at Peakirk and Newborough, which drains an area of 36 hectares and 3320 hectares respectively, to the south west of the development site and Postland draining some 2567 ha to the north and east of Crowland

There is a residual risk associated with the failure of the pumped system, however, the extent of the drainage system will provide a significant inherent attenuation capacity which would, during and emergency pump failure, provide the IDB sufficient time to rectify the issue and reinstate pumping within the system and return levels to normal.

4.1.3 Pluvial Flooding

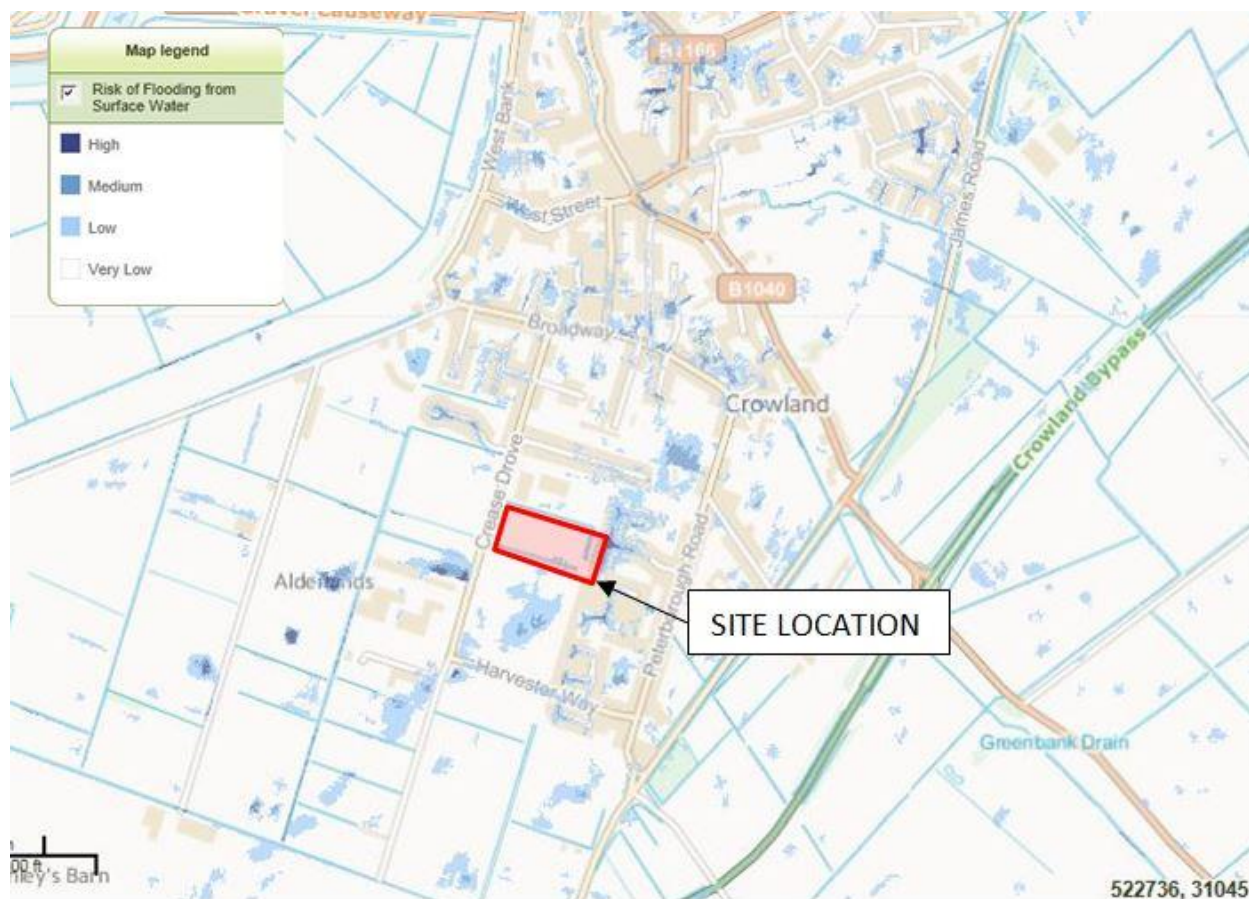
The EA provide indicative flood mapping for pluvial events, these assessments are based on failure of local drainage systems and are used to estimate where pluvial runoff that cannot enter an existing drainage system may flow towards.

The maps are not detailed hydraulic assessments but they do identify lower areas of topography where overland flow may accumulate.

Therefore, while these do not provide a flood risk assessment in themselves they are a useful tool in highlighting locations for further investigation.

Extracts from this mapping are included below for reference.

Figure 3 - Extract from EA Surface Water Flood Mapping



Source – [EA on-line flood mapping](#)

The mapping identifies the boundary ditches to the site and also the overland flow routes from the residential development to the east of the site, which also discharge to the IDB system.

The flat topography of the area results in little overland flow with mainly areas of ponding on slightly lower lying areas.

4.1.4 Overland flow

In the context of the local topography, the development site lies slightly higher than the adjacent land and the existing natural flow paths noted in 4.1.3 indicate the same.

As noted previously, the flat nature of the topography will curtail the development of any significant overland flows.

4.1.5 Groundwater

The local ground water level is linked to the retained water level in the IDB ditch system. The pumped system will drain both direct surface water inputs and also rainfall that percolates through the upper ground layers which becomes groundwater.

Ground water is therefore maintained by the IDB also and so this flood risk would be analogous to the land drainage risk.

4.1.6 Climate Change

The Environment Agency requires via the NPPF-TG document, that there should be no increase in the rate of surface water emanating from a newly developed site above that of any previous development. Furthermore, it is the joint aim of the Environment Agency and Local Planning Authorities, to actively encourage a reduction in the discharge of storm water as a condition of Approval for new developments. In addition, all drainage systems should be sized to accommodate for the runoff arising from a 1 in 100 year rainfall event, and should include a further allowance to account for the future effects of climate change. Table 1 below, shows the anticipated increases in rainfall intensities and river flows with time.

Table 1 – Extract from Table 1 Peak river flow allowance by river basin district taken from Flood Risk Assessments : Climate Change Allowances (www.gov.uk)

River District	Basin	Allowance category	Total potential change anticipated (2015 to 2039)	Total potential change anticipated (2040 to 2069)	Total potential change anticipated (2070 to 2115)
Anglian		Upper End	20%	30%	50%
		Higher Central	15%	20%	30%
		Central	10%	15%	20%

Source - 3- <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Assuming a minimum design life of 100 years for residential development, the Higher End assessment for this epoch indicates that an increase in river flows of 30% would be appropriate for this site.

Table 2 – Extract from Table 2 peak rainfall intensity allowance in small and urban catchments taken from Flood Risk Assessments : Climate Change Allowances (www.gov.uk)

Applies across all of England	Total potential change anticipated (2015 to 2039)	Total potential change anticipated (2040 to 2069)	Total potential change anticipated (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

Source - 4- <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Again, with a design life of 100 years, rainfall assessments for this site should be made using a 20% increase in rainfall intensities.

4.2 Artificial Sources

4.2.1 Adopted Drainage

The sewer records (Appendix C) show that there are no adopted assets that will directly affect the development site. Surface water systems are located on the opposite side of the drainage ditch network and so will not impact on the site in the event of a failure.

4.2.2 Highway Drainage

The highway drainage system is in effect the same as the IDB drainage system as it discharges directly to the ditches throughout this area. This will reduce the risk of a localised flood incident on the carriageway.

4.2.3 Development Proposals

The development of the site will generate storm water runoff from the new impermeable areas such as roads, driveways and roofs.

An indicative development scheme is included in Appendix D for reference.

The shape of the site is such that not all of it may be developed for residential use. The proposed development yields 2390m² of roof area, 1750m² of private driveway and 2280m² of road. This equates to a total developed impermeable area of 6940m².

The anticipated peak runoff rate from this site would be in the region of 96l/s for a 50mm/hr event if left unrestricted.

This runoff will itself pose a flood risk to both the development site and the areas downstream of this point. The new impermeable area arising from the development will alter the existing runoff

profile of the site with a commensurate increase in runoff potential. As such, the management of surface water will be extremely important so as not to pose a significant flood risk and is dealt with in more detail in Section 8.

5 Flood Risk Assessment

5.1 Natural Sources

5.1.1 Fluvial Flooding

The site is shown to be located in Flood Zone 3 on the EA's natural flood plain maps but within Flood Zone 1 courtesy of the local flood defence systems as illustrated on the SHDC SFRA maps.

With a commitment to maintain the defences, the site can be considered to be protected from fluvial flood risk.

5.1.2 Land Drainage

Water levels in the local drainage system will be maintained by the IDB and as such will not be a flood risk under normal operational circumstances.

In the event of a pump failure, the inherent attenuation capacity in the system and the interlinked nature of the pumped system locally would reduce the residual risk to a low and manageable level for the lifetime of the development.

5.1.3 Overland Flow

The flat nature of the overall area curtails the potential for the generation of significant overland flows. The network of drainage ditches will intercept all overland flows.

5.1.4 Groundwater

Groundwater will be shallow in this area but the level will be controlled as part of the IDB land drainage system. Therefore, it is considered to be a low and manageable residual risk to the site.

5.1.5 Climate Change

The development drainage system should be designed considering a 20% increase in rainfall.

5.2 Artificial Sources

5.2.1 Adopted Drainage

The absence of local existing assets indicates that there is no residual flood risk from this source.

5.2.2 Highway Drainage

Similarly to the groundwater source, due to the nature of the system the highway drainage, discharging directly to the land drainage system can be considered to be a linked flood risk and therefore low and acceptable for the life time of the development.

5.2.3 Development Proposals

The proposed development will consist of approximately 41 units comprising a mix of detached and semi-detached plots.

This configuration will yield a total impermeable area of 6940m².

The proposed layout is show in Appendix D for reference.

Recommendations for mitigation of the development are discussed in Section 8.

6 Sequential Test

6.1 Scope and Application

With reference to the NPPF-TG document, as the site is classified as Flood Zone 3 on the EA's flood mapping it is necessary for the site to pass both the Sequential and Exception Test in order to determine the suitability of development in this location.

The NPPF-TG, in paragraphs 100, 101 and 102 sets out the principle of the Sequential Test, initially to avoid inappropriate development in flood risk areas (para 100) to steer development away from areas of flood risk by sequentially assessing sites as part of the Strategic Flood Risk Assessment (para 101) and finally, where not enough suitable sites in areas of lower flood risk are identified other sites, consistent with wider sustainability objective, can be considered provided that they then subsequently pass the Exception Test.

For the Crowland settlement the following documents have been produced to assist in determining the sequential assessment of development sites.

1. South Holland District Council 5-year Housing Land Supply Assessment (as at 31st March 2016)⁴.
2. South East Lincolnshire – Strategic Housing Land Availability Assessment – Crowland (Jan 2016)⁵.

6.2 Planning Context

Projected housing requirement will be driven in the future by the emerging Local Plan for South East Lincolnshire. This is currently out for public consultation.

Within this document, proposals for development of the whole area can be extracted and used to determine criteria such as local settlement hierarchy and anticipated 5-year housing need both across the county area and per settlement.

It is noted in the Local Plan⁶ that Crowland is defined as a Main Service centre, these are a sub-classification to the Sub-regional centres of Boston and Spalding. Main service Centres are larger settlements with good quality links to the sub-regional centres and good settlement services.

It is these areas that will provide the bulk of the housing development outside Boston and Spalding.

Policy 12 Local plan determines that the Crowland would require 380 new dwellings to meet the aspirations of the Local Plan.

⁴ <http://www.southeastlincslocalplan.org/wp-content/uploads/2016/04/South-Holland-District-Council-5-year-Housing-Land-Supply-Assessment-31st-March-2016.pdf>

⁵ <http://www.southeastlincslocalplan.org/wp-content/uploads/2016/01/merged-Crowland.pdf>

⁶ <http://www.southeastlincslocalplan.org/wp-content/uploads/2016/01/Local-Plan-January-2016-text.pdf>

It is noted in paragraph 47 of the NPPF⁷ that there is a need to 'To boost significantly the supply of housing.' And that to achieve this Local Planning Authorities should include a 5% buffer on housing requirements and where there has been a record of persistent under delivery this should be increased to 20%.

Further to this, in the SHDC 5-year Housing Land Supply Assessment, Table 1 indicates the previous rate of under provision and calculates this to be a shortfall of 919 from a target of 2,150, or 42% between 2011 and 2016.

As such the 20% buffer would be appropriate in this case.

Therefore the housing target for Crowland should be 380 rising to 456.

6.3 Crowland SHLAA

The SHLAA prepared for Crowland identifies 34 potential sites in the settlement that may be put forward for residential use. The sites are then classified and assessed on several criteria including availability, achievability and delivery numbers, flood zone and hazard rating. Using these criteria the developed is assessed to see if it is suitable for residential development.

Based on this assessment the SHLAA identifies 19 sites that are deemed to be developable.

This proposal site is noted to as Cro12 and the initial SHLAA assessment determines that the site is not suitable for development citing proximity to local employment use (Crowland Cranes) and the sub-standard condition of Crease Drove.

Two separately issued reports have been produced to review each of these elements, the noise assessment report notes that the adjacent commercial/warehousing site is no longer in use and that a residential planning application has been made for the site and that Crowland Cranes does not have any impact with regard to noise on the development site. It concludes that noise levels on the site are suitable for residential development.

The transport assessment concludes that improvements proposed for Crease Drove and the new site access junction would enable safe and sustainable vehicle access along Crease Drove and that the local junctions have more than sufficient capacity to accommodate this development.

Given that these two reports demonstrate that the two criteria used to classify the Cro12 as unsuitable are no longer valid, this indicates, using the SHLAA's methodology, that the site would move in to the suitable and developable category similarly to Cro10 and Cro17.

6.4 Site Suitability

The SHLAA acknowledges that the development site is located on the periphery of the existing settlement boundary and that it therefore relates well to the existing town. The SHLAA notes, and is confirmed by the traffic assessment, that the site has good access by foot, bicycle and public transport and can be considered as a sustainable development.

⁷ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

Its location allows good access to the existing services and facilities located in Crowland and that it has no adverse impacts on natural, built or historic assets.

As the site is currently available for development (i.e. requires no demolition or remediation and infrastructure costs are likely to be low) it would move to the top of the hierarchy for deliverable sites in the SHLAA assessment.

Given the immediate need for housing in Crowland and the general under delivery of sites across South Holland it is considered that this site would be a prime location for immediate development and therefore delivery of much needed housing and as such passes the Sequential Test.

7 Exception Test

7.1 Introduction

With regard to NPPF, upon demonstrating the site is Sequentially preferable, it is necessary to then demonstrate that the site can be safely developed and occupied.

The Exception Test forms two parts; the development of the site must provide wider sustainability benefits to the community that outweigh the flood risk and a site specific flood risk assessment must show that the site is safe for the lifetime for the proposed development without impact on others.

These points are addressed below.

7.2 Wider Sustainability Benefits

It has been established as part of the Sequential Test that Crowland requires new housing to satisfy the local market and that there has been persistent under supply of housing across the South Holland area for several years.

As such the development of this site will fulfil a fundamental local and District-wide housing need.

Furthermore, the transport assessment notes that the site is in a sustainable location for access to local public transport linking the site to the main centres of Boston and Spalding. This would enable people living in Crowland to access jobs and services in both locations.

Additionally, the development will comprise buildings built to the latest Building Regulations which in respect of heating and energy use are significantly better than older housing.

Finally, the provision of 41 new houses and the potential for around 100 new residents, would help to bring in additional money to the local economy and more efficiently utilise local services and facilities.

7.3 Safe Operation

The SHSFRA classifies the site as being outside of a flood zone, therefore on this assessment the development is already safe for residential development.

In addition, it is noted that there is a significant volume of latent attenuation in the network of IDB ditches and that this system is backed up by several locally high capacity pumping stations, this combined flood management capacity would help to protect the development site even during extreme events.

However, as part of the development of the site it will be necessary to provide a positive site drainage system and due to the flat nature of the site this will require slight elevation of the proposed development units. This drainage system will be designed to accommodate flows from events up to and including the 1 in 100 plus climate change event.

Along with general detailing providing unit finished floor levels above the adjacent carriageway channel line this will provide even more inherent protected of property.

7.4 Summary

Given the above evidence, it is considered that the site can be shown to provide both wider sustainability benefits and will be safe in operation for the lifetime of it use. As such the Exception Test is passed.

8 Run-off Assessment

8.1 Control of Surface Water Run-Off

Part H of the Building Regulations 2010 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

- a) an adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable,
- b) a watercourse, or, where that is not reasonably practicable,
- c) a sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

8.1.1 Infiltration Based Systems

According to the 1:50,000 scale British Geological Survey the site sits on an interface between sandy gravelly and peat superficial deposits with the whole area underlain by Oxford Clay.

The presence of the IDB drainage system and the relatively high water level in the system would tend to indicate the need for positive drainage as opposed to infiltration.

As such infiltration has not been pursued as the primary means of discharging surface water from the site.

8.1.2 Watercourse

As noted previously, the site is bound on three of its four sides by a ditch drainage system.

It is therefore proposed that the site will discharge to this on the site boundary.

8.1.3 Adopted Drainage

There are no available surface water assets in the vicinity of the site. It is noted where these do exist to the east of the site these systems discharge to the ditch drainage system.

8.2 Allowable Site Discharge

Discharges to watercourses are normally restricted to equivalent greenfield rates, however, in this location as the watercourse level is determined by the IDB pumping system, similar sites have been granted permission to discharge runoff at an unrestricted rate subject to the payment of a commuted sum to the IDB to manage the water downstream.

It is considered that this arrangement may be negotiated for this site post-planning.

8.3 Drainage Strategy

The removal of an end flow restriction will also negate the need for any specific site attenuation. However, given that the site will need to maintain a positive outfall to the ditch system (i.e. be above the operating water levels in the ditch) this can be achieved either by elevating the site to mobilise sufficient falls on a traditional piped system or use a shallow depth and gradient system to reduce the amount of land raising required.

It is also noted that as the carriageway of the road is likely to generate more polluted runoff that pollution prevention measures should be included in any proposed system.

There are a variety of means that these criteria may be achieved, one system that incorporates several of these is permeable paving and permeable sub-base systems.

These systems can operate with virtually no gradient and depending on the selected loading criteria can be in the region of 500mm deep overall. CIRIA SuDS Manual 753 notes that permeable paving and sub-bases significantly reduce the concentrations of heavy metals, oils, sediment and some nutrients when compared to impervious paving systems.

A suitably designed system will be able to provide, collection, conveyance and water quality improvements while also reducing the amount of land raising on the site.

Given the multitude of advantages to this system it is recommended that this is explored as the primary means of surface water management on the site. As part of the site will include an adopted carriageway it will be necessary to discuss the use of this type of system and its adoptability with the Local Highway Authority.

8.4 Flood Routing

The performance of the system during extreme events (>1 in 100 years) should also be considered at this stage. The routing of potential surface water run-off, should the capacity of the proposed system be exceeded, needs to be built into the layout of the site such that the residual risk of flooding from this element can be easily mitigated.

By identifying the most vulnerable manholes in the system, flooding routes on to landscaped areas may be incorporated relatively easily and economically at the planning stage.

For this site the natural failure route from the development site would be to the lower lying land to the north of the site identified on the EA's pluvial map. This is away from the residential development area.

8.5 Foul Drainage

The asset records indicate that a gravity connection from the development site is not viable and that a pumped system will be required.

A connection point for the foul drainage is to be confirmed with Anglian Water but it is likely to be to the existing sewer noted at the junction of Alderlands Close and Crease Drove.

The route is indicated on the drainage masterplan included in Appendix E.

9 Flood Risk Mitigation

9.1 Site Levels

Whilst there is no requirement for the increasing of site levels to prevent flooding, as a standard design measure the residential plots with a boundary to proposed carriageway should be located 200mm higher than the adjacent channel level. This would provide additional protection for more extreme rainfall events than considered in this assessment.

9.2 Access and Egress

Safe access and egress will be maintained via the site development roads Crease Drove to the west.

9.3 Site Drainage

Infiltration is not considered as being viable on this stage. A positive outfall to the drainage ditch to the east of the site is recommended and this is to be confirmed with the IDB. It is likely that a commuted sum will be required but that a free discharge is achievable.

It is recommended that the use of a permeable paving and permeable sub-base option is considered for the estate roads and private driveways as the principle means of collecting and conveying road and roof runoff from the site.

This option would have significant water quality and peak discharge reduction benefits not achievable with a piped system. An illustrative drainage scheme based on the above is shown on the drawing included in Appendix E.

Foul drainage should utilise a pumped system to the adopted foul sewer at the junction of Alderlands Road and Crease Drove.

9.4 Flood Resistance and Resilience

Irrespective of the design standards applied within this document or the currently defended scenario in this area there remains to chance that a storm even occurs that exceeds these criteria.

It is therefore considered prudent to incorporate measure within the development of the site and individual properties that will provide inherent flood resilience and resistance and assist in minimising disruption should an ultra-extreme event occur.

These measures are relatively cost effective and if incorporated at the inception of a project can be cost neutral. These would include raising utility inlet points, fixing electrical circuits from first floor down, locating boilers at a high level and sloping landscaping away from properties.

More information can be found in the DEFRA publication 'Improving the Flood Resistance of New Buildings'⁸.

⁸ <https://www.gov.uk/government/publications/flood-resilient-construction-of-new-buildings>

10 Conclusions

Following this assessment and with reference to the EA flood maps the site is noted to be within the natural flood plain of the River Welland and is in Flood Zone 3, however, it is noted that the SFRA categorizes the site being outside this designation when the impact of the local washlands and flood defences is considered.

Notwithstanding the above, it is demonstrated via the Sequential and Exception Tests that development of the site is required to meet local housing need and that it can be constructed in such a way that it will have wider sustainability benefits and be safe to occupy.

The report confirms that the site is not at risk of flooding from other sources and may be developed for residential use on this site.

The development itself will yield an increase in the impermeable footprint and will therefore require suitable on-site mitigation to protect both the development site and downstream assets.

It is considered that given the likely underlying ground conditions that infiltration will not be viable for this site and that a positive outfall to the adjacent minor watercourse should be considered instead.

Subject to approval for the IDB it is recommended that a drainage system is installed with a free discharge to the adjacent IDB drainage system.

The use of permeable paving and sub-base systems should be considered on this site. These types of system will offer significant potential for the improvement of the quality of the run-off from the development in line with the requirements of CIRIA C753 – SuDS Manual.

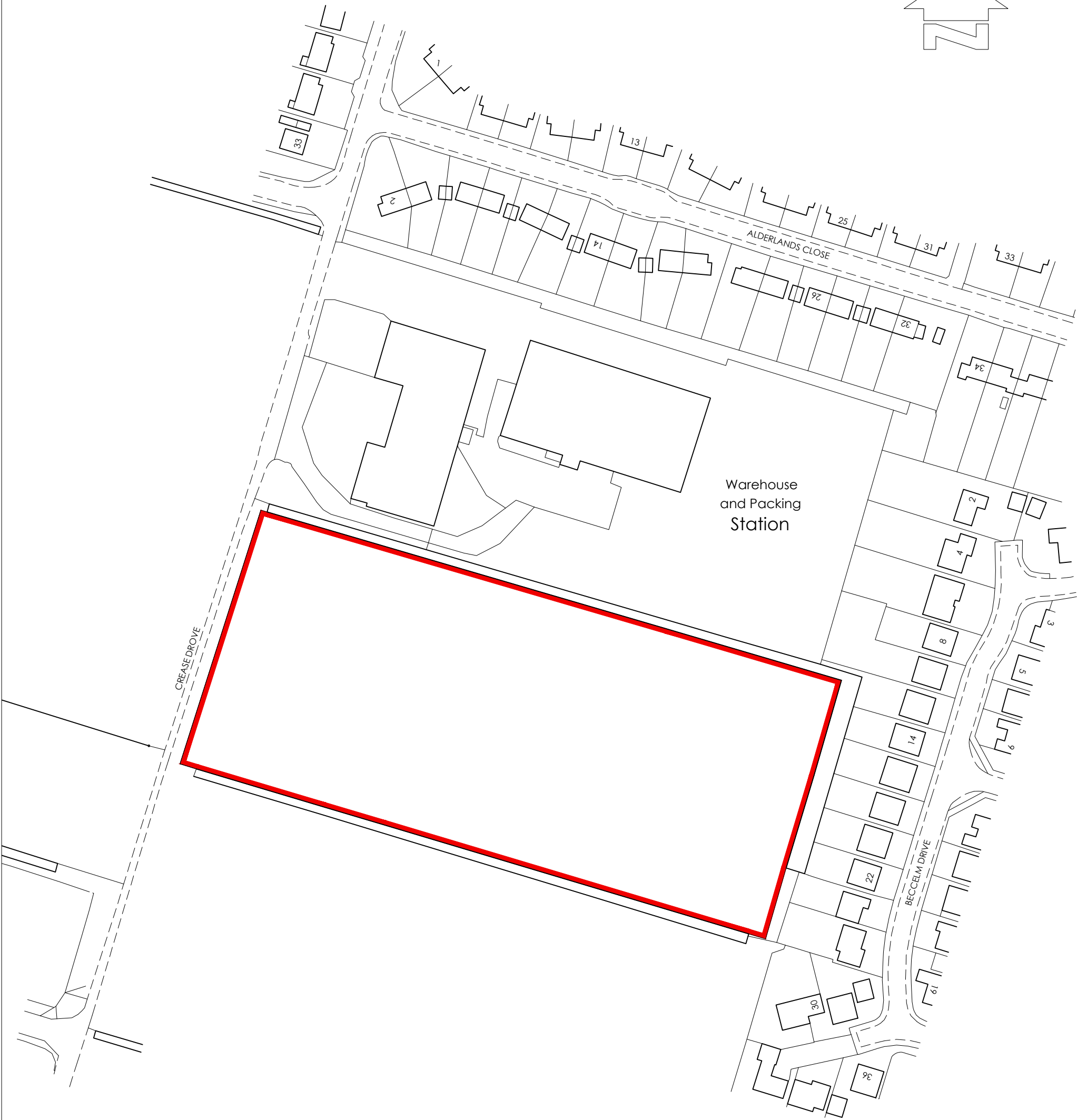
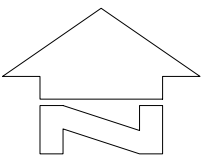
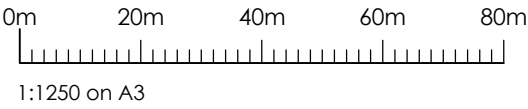
The use of the system under the adopted site road should be discussed with the LLFA and local Highway authority.

A gravity foul connection is not possible from this site and so an adoptable foul pumping station will need to be included on the site with a pumped outfall to the adopted asset on Alderlands Close.

The proposed flood mitigation measures for this site are shown on the drainage masterplan included in Appendix E.

Appendix A – Site Location Plan

- MPJ Design Drawing reference 15/188-01



Client	Mrs T Hunter-Shaw
Job	proposed residential development off Crease Drove, CROWLAND
Title	Location Plan

Scale	1:1250	Dwg No	15/179-01
Date	July 2015		

MPJ DESIGN ASSOCIATES Ltd
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CHESTERFIELD. S43 4EP

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Appendix B – Site Topographical Survey Data

Appendix C – Anglian Water Asset Records



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Date: 30/06/16

Scale: 1:1250

Map Centre: 523797,309581

Data updated: 01/02/16

Our Ref: 190586 - 1

Wastewater Plan A2

This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2016 Ordnance Survey 100022432. This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

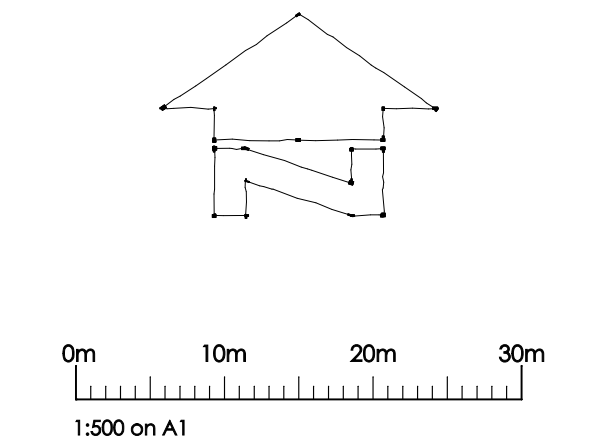
Foul Sewer		Outfall	
Surface Sewer		Inlet	
Combined Sewer		(Colour denotes effluent type)	
Final Effluent		Manhole	
Rising Main		(Colour denotes effluent type)	
Private Sewer		Sewage Treatment Works	
(Colour denotes effluent type)		Pumping Station	
Decommissioned Sewer			
(Colour denotes effluent type)			

a.precious@sky.com
A30 - Crease Drive
Electronic version if possible



Appendix D – Indicative Development layout

NOTES:
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Client
Mrs T Hunter-Shaw

Job
proposed residential development off
Crease Drove
CROWLAND

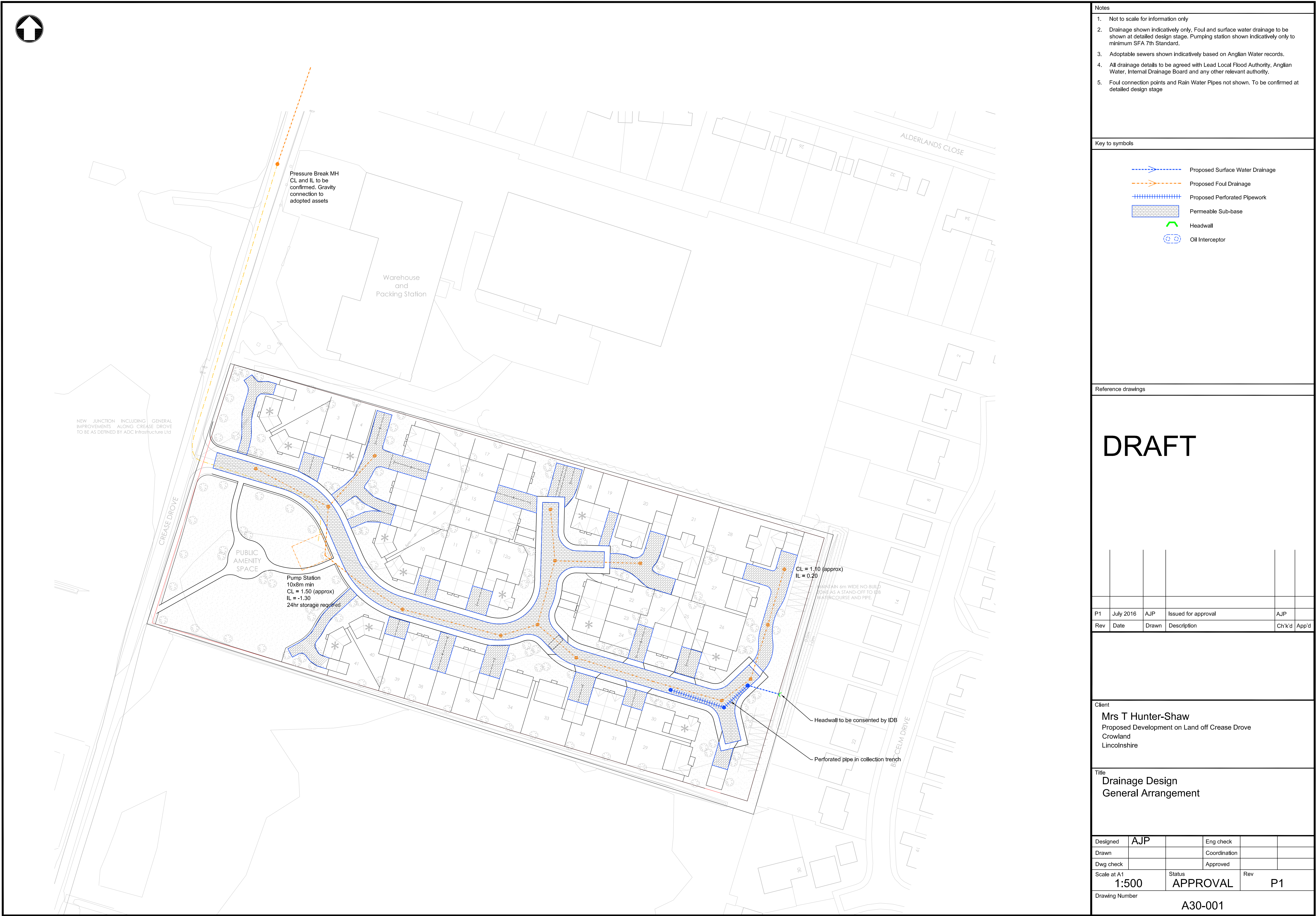
Title
Illustrative Layout Plan

Scale 1:500 Dwg No 16/179-03
Date May 2016

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MPJ
DESIGN

Appendix E – Indicative Drainage Layout



- Notes
1. Not to scale for information only
 2. Drainage shown indicatively only. Foul and surface water drainage to be shown at detailed design stage. Pumping station shown indicatively only to minimum SFA 7th Standard.
 3. Adoptable sewers shown indicatively based on Anglian Water records.
 4. All drainage details to be agreed with Lead Local Flood Authority, Anglian Water, Internal Drainage Board and any other relevant authority.
 5. Foul connection points and Rain Water Pipes not shown. To be confirmed at detailed design stage

Key to symbols

	Proposed Surface Water Drainage
	Proposed Foul Drainage
	Proposed Perforated Pipework
	Permeable Sub-base
	Headwall
	Oil Interceptor

Reference drawings

DRAFT

P1	July 2016	AJP	Issued for approval	AJP	
Rev	Date	Drawn	Description	Ch'k'd	App'd

Client

Mrs T Hunter-Shaw
Proposed Development on Land off Crease Drive
Crowland
Lincolnshire

Title

Drainage Design
General Arrangement

Designed	AJP	Eng check		
Drawn		Coordination		
Dwg check		Approved		
Scale at A1	1:500	Status	APPROVAL	Rev
Drawing Number				P1
A30-001				