STUDIO 11
architecture

PROPOSED RESIDENTIAL DEVELOPMENT, LITTLEWORTH DROVE, DEEPING St NICHOLAS

DRAINAGE STRATEGY 615

STUDIO 11
KING'S LYNN INNOVATION CENTRE, INNOVATION DRIVE, KINGS LYNN, PE30 5BY

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Introduction

This drainage strategy report has been produced to accompany a planning application to South Holland District Council (SHDC) for a residential development on land off Littleworth Drove, Deeping St Nicolas. This document should be read in conjunction with the Concept Drainage Strategy drawing – 615-S11-00-SI-SK-C-9000, and also the Flood Risk Assessment (FRA) undertaken by S M Hemmings.

Site Description

The proposed site covers an area of approximately 1.40 hectares, and is a greenfield site. The proposal is to erect 24 dwellings on the site. The indicative site layout and location is shown in the figure below.



Figure 1 - Proposed Site Layout

Drainage

For developments of 10 or more dwellings there is a requirement to apply sustainable drainage principles (SuDS) to the disposal of surface water from the site. Generally, the aim should be to discharge surface water as high up the following hierarchy of drainage options as reasonably practicable:

1. Into the ground (infiltration);
2. To a surface water body;
3. To a surface water sewer or highway drain;
4. To a combined sewer.

Infiltration

At this stage of the project a phase 2 ground investigation report has not been undertaken, and therefore a desktop study is being undertaken to understand the prospect of infiltration.

BGS mapping shows that the bedrock of the area is 'Oxford Clay Formation - Mudstone', This natural indicates that infiltration into the bedrock is unlikely to be feasible.



Figure 2 - Bedrock

The superficial deposits, as shown in the figure below, is shown as 'Tidal Flat Deposits – Clay and Silt'. The prospect of infiltration in this type of soil is also likely to be very limited, and is highly unlikely to be viable.

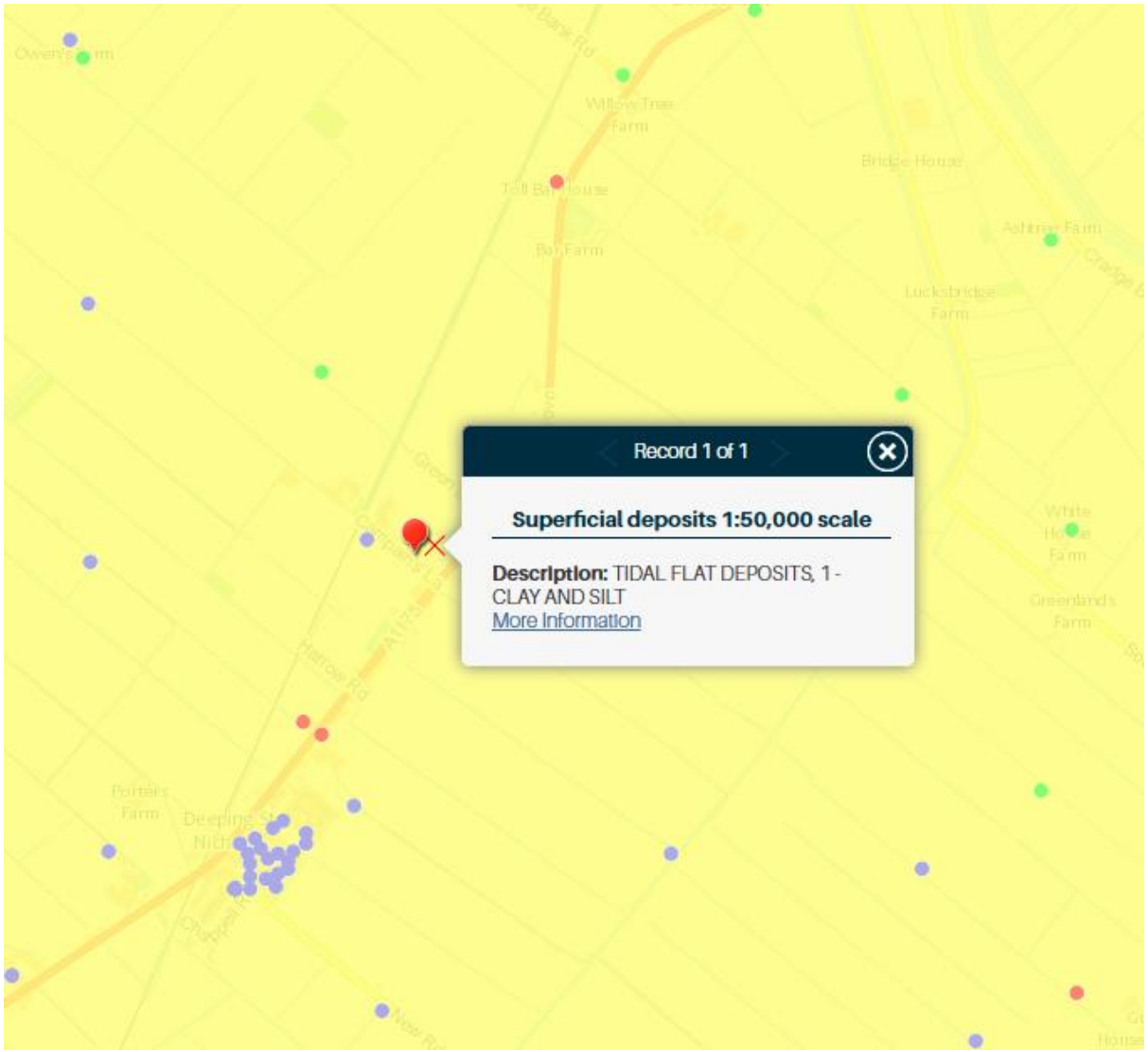


Figure 3 - Superficial Deposits

There is a publicly available borehole in proximity to the site. This confirms the superficial observations as above.

With the above factors considered, although infiltration will be tested during a phase 2 ground investigation, given local knowledge of the site and the findings of the desktop study, it is highly unlikely that infiltration will be viable for the scheme, and an alternative disposal method is being sought.

Watercourses

There is an existing riparian ditch which runs to the east of the site. The site typically falls towards this location, and this ditch would serve as drainage for the site.

The site falls within the catchment of 'Welland and Deepings IDB', as shown in the figure below. The riparian ditch, flows into the IDB drain to the north – approximately 200m away.

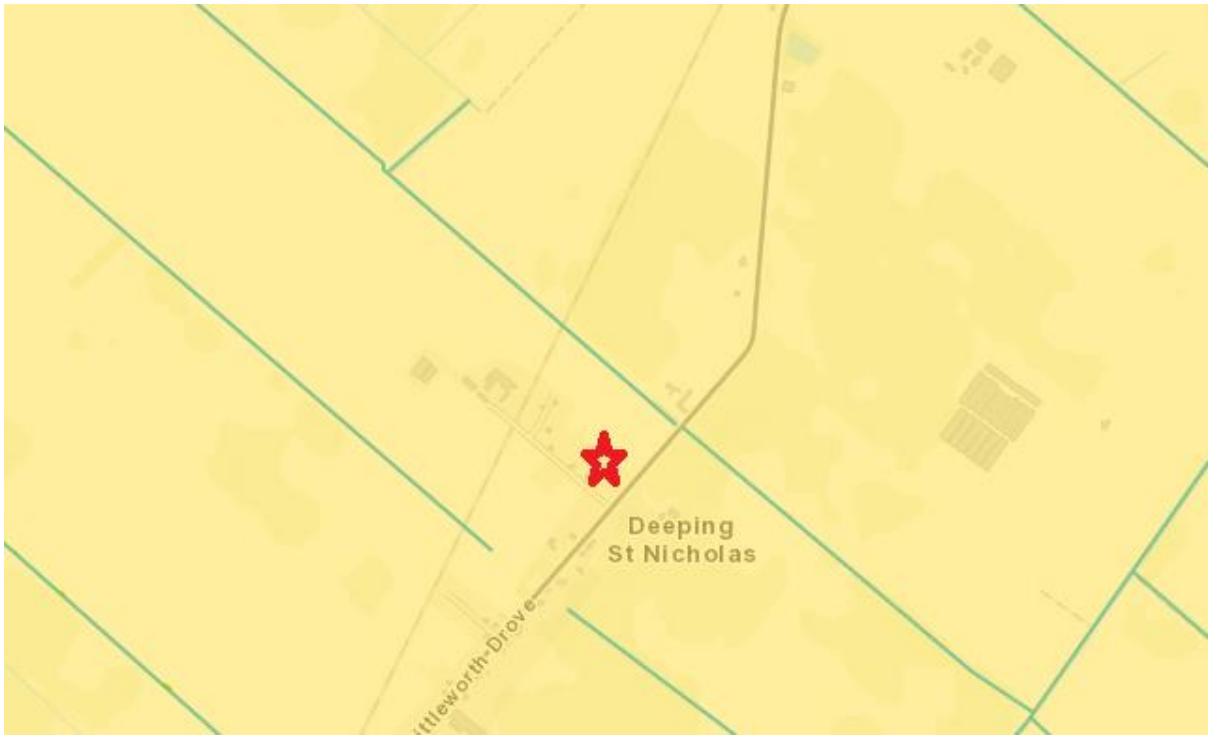


Figure 4 - IDB Map

The site will require byelaw consent for the surface water discharge and ordinary watercourse consent, both from the IDB. This will be applied for upon detailed design.

Run-off Rates

In line with current guidelines, the developed site shall not exceed the pre-development greenfield run-off rate for the Q_{BAR} event - post development. The greenfield run-off for the site has been calculated in accordance with HR Wallingford's 'Greenfield runoff rate estimation', and their guidance has been followed when entering the data. The proposed run-off from the site will therefore be restricted to a maximum of 1.2l/s. An extract of the existing greenfield runoff is shown below.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	1.15	1.15
1 in 1 year (l/s):	1	1
1 in 30 years (l/s):	2.81	2.81
1 in 100 year (l/s):	4.08	4.08
1 in 200 years (l/s):	4.83	4.83

Figure 5 - Greenfield Runoff Rates

As the actual greenfield run-off from the site and the IDB rates for contribution differs, there will be the need to apply to the IDB for a consent to discharge surface water and pay for a development contribution.

Proposed Surface Water Drainage Design

The proposed drainage layout is shown on S11 drawing 615-S11-00-SI-SK-C-9000, which has been provided as part of the overall planning submission.

All drainage models has been simulated for the 1 in 1, 30, 100 and 100 + 40% climate change events using FSR data, with a Cv value set to 1.

A full copy of the preliminary drainage calculations can be found in appendix A of this document, and a graphical representation of the model is shown in the figure below. Please note, that some of the drainage model has been simplified for this stage of the design. The final model will be fully represented and fine-tuned.

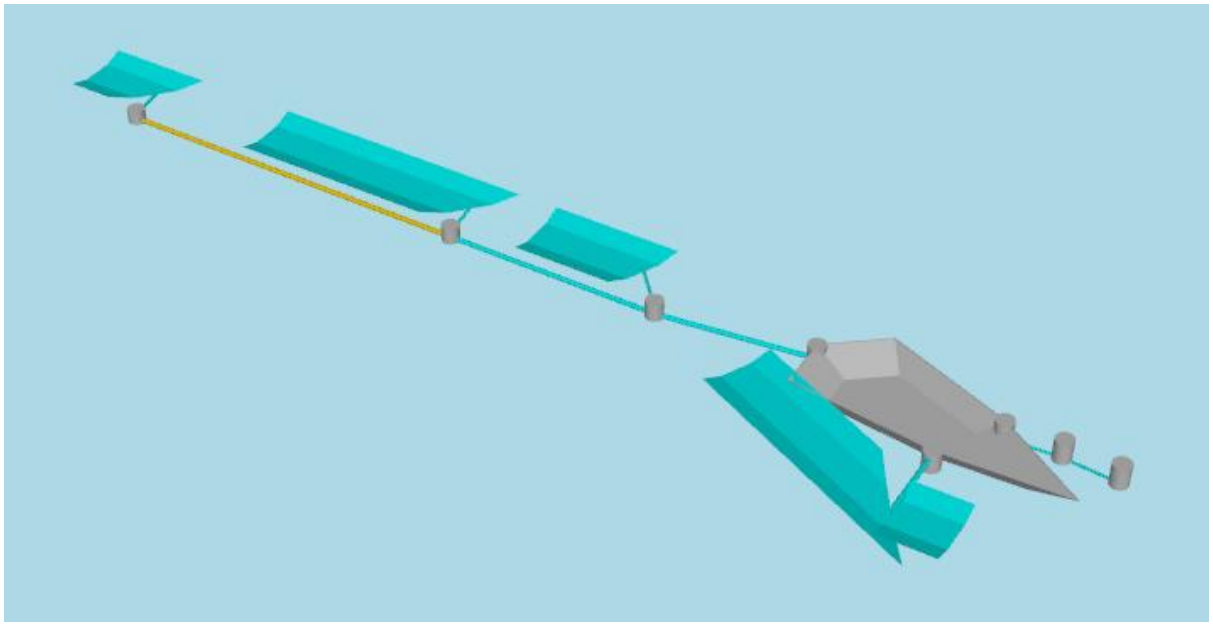


Figure 6 – Drainage Model

As outlined previously, it is assumed that infiltration is not feasible for this site, therefore the SuDS strategy for the surface water highway drainage will be achieved using the provision of surface water conveyance, cleansing and attenuation. The site layout has generally been designed to utilise a swale to collect highway and domestic water before flowing into the basin, or simply to discharge into the basin. In order to be able to connect into the swale, the drainage needs to be kept shallow and to do this, porous paving will be used. The plots to the south of the road will naturally be deeper and therefore the house/parking drainage will be more traditional, before discharging into the basin.

It is proposed the carriageway will generally be laid to a single crossfall, which will discharge into a filter strip before discharging into the swale. The swale will likely contain both road and domestic water, and therefore will be put forward for adoption to Anglian Water. To meet CIRIA C753's mitigation indices, the swale will undergo pre-treatment via a 'filter strip' – this is also a detail requirement of LCC. It will be proposed that the swale and filter drain is adopted by AW. It is worth noting that the basin alone will achieve full mitigation for the water quality.

Dependant on final levels, it is likely that gullies may be required to the highway at local areas. This will still pass through the basin so water quality is being achieved.

Once a full phase 2 ground investigation has been undertaken, more will be known regarding the water table for the site. If the site has a high-water table, or at least if this is within or close to the base of the filter drain, it will be proposed that below the swale will be lined with an impermeable membrane to stop below ground lateral flow of the ground water – in essence acting as a land drain. Additionally, if the swale is within 5m of a foundation should also be lined. Similarly, the same rules would apply with the attenuation basin. Soaked CBR's will also need to be considered for the adoptable carriageway, but this will be fully established at detailed design.

Given the use of the filter strip, swale and attenuation basin, it is proposed that sufficient suds features are being used, and as a result the drainage from the dwellings are to discharge into traditional pipework before entering the SUDs features as mentioned above. For the purpose of the preliminary drainage strategy, only the key, typically adoptable drainage features are being shown.

The final discharge into the drain – subject to byelaw consent (as the catchment is into the Welland and Deeping IDB), will be via. a new insitu headwall. At present it is proposed that the discharge rate will be 1.2l/s, which falls inline with the greenfield runoff from the site. This results in a small orifice size on the flow control, and therefore a higher rate will be discussed with the IDB, LLFA and AW in order to provide a safe and manageable device – once which is less prone to blockage. For the sake of the drainage strategy, the flow rate of 1.2l/s is being used.

In the event that the discharge rate is increased above greenfield rates, the IDB will need to be consulted to comment on the impact of an increase to run-off rates. As the discharge will still be low, and the location is fairly remote, with significantly sized drains, it is not expect that this will be an issue.

The attenuation basin has been designed to store all storms, up to and including the 1 in 100 year + 40% climate change storm events. All storms up to and including the 1 in 100 year + 40% climate change event will be stored below ground. This design ethos is in accordance with DEFRA guidance and LCC's requirements.

Given the elevation of the ditch and natural falls, it is not expected that surcharging could cause some issues. Once planning has been achieved and detailed design is commenced, the IDB will be consulted over water levels, so that it can be fully considered in the design. Impacts of surcharging are likely to be limited owing to the raised FFL's/land levels.

Surface Water Drainage Summary

In summary, the surface water drainage will be to the following.

- Domestic roofwater will discharge into a piped system before discharging into the swale and attenuation basin, or alternatively just the attenuation basin.
- The plots to the north east of the swale will discharge into porous paving before entering the swale – this is to keep the drainage as shallow as possible.
- Domestic drives will discharge into a piped system before discharging into the swale and attenuation basin, or alternatively just the attenuation basin, other than the plots north of the swale which will utilise porous paving.
- The highways will drain into filter strip and swale to the side of the roads before discharging into the attenuation basin.
- There is a very small section of highways which cannot drain via. swales, and will need to have gullies to discharge this element. This will still eventually pass through the basin so achieves a compliant SUDS scheme.
- The basin will discharge into the ordinary watercourse to the east of the site which eventually flows into a riparian drain, before discharging into an IDB drain to the north. Noting the riparian drain between the site and IDB outfall is wholly within the ownership of the landowner.

Urban Creep

In this instance, as the site is residential, an Urban Creep of 10% additional impermeable area has been included into the calculations. At present this has been included as a global factor, but at detailed design will be limited to private curtilages (as per CIRIA 753).

Culvert

The site entrance will need a culvert to generate the access. The upstream incoming pipe is 300 dia., so it is proposed that any new pipe will be in excess of this. For robustness, a pipe size of 450mm dial will be considered. There will be some loss of volume, but given the relatively small catchment of this area as a whole it is considered that this will not cause any issues. The culvert works will be subject to byelaw consent from the IDB.

Flood Routing

The scheme has been designed so that no above ground flooding is created in the 1 in 100 year + 40% climate change + 10% urban creep storm, and therefore a plan is not required to represent the volumes, depths, velocities or extents of flooding. The design compliments the natural ground levels, and any flood water will either be cut off by the swale, free board in the attenuation basin, or rear gardens. Indicative exceedance flow routes have been provided on the strategy drawing.

Water Quality

The methods of surface water disposal mentioned above have included provisions for water quality. In accordance with CIRIA C753, the pollution hazard features for the drainage areas are;

Residential roofs	- Very low
Individual property driveways	- Low
Private access	- Low
Adoptable cul-de-sac	- Low

To remove the pollution risks, CIRA have developed 'Pollution hazard indices' and the 'mitigation indices' that the SuDS components provide, further details of these are found in the tables below.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each containment type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ pollution hazard index
(for each contaminant type) (for each contaminant type)

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required where:

$$\textit{Total SuDS mitigation index} = \textit{mitigation index}_1 + 0.5\ (\textit{mitigation index}_2)$$

Where:

$$\textit{Mitigation index}_n = \textit{mitigation index for component } n$$

Provided the total SuDS mitigation index exceeds the pollution hazard indices, then sufficient water quality will be provided.

For the calculations below the hazards are represented by;
Total suspended solids = Red
Metals = Blue
Hydrocarbons = Green

Roofs (worst case, passing through porous paving only improves)

0.2 0.2 0.05 = Attenuation Basin 0.5 0.5 0.6

The mitigation provided by the SUDs features exceeds all the pollution indices, therefore sufficient treatment has been provided.

Individual property driveways (worst case, passing through porous paving only improves)

0.5 0.4 0.4 = Attenuation Basin 0.5 0.5 0.6

The mitigation provided by the SUDs features exceeds all the pollution indices, therefore sufficient treatment has been provided.

Adopted Cul-de-sacs

0.5 0.4 0.4 = Filter strip 0.4 0.4 0.5 + ½ Swale 0.25 0.3 0.3 + ½ Attenuation Basin 0.25 0.25 0.3 (Total 0.9 0.95 1.1)

The mitigation provided by the SUDs features exceeds all the pollution indices, therefore sufficient treatment has been provided.

Adopted Cul-de-sacs (Gullies only)

0.5 0.4 0.4 = Attenuation Basin 0.5 0.5 0.6

The mitigation provided by the SUDs features exceeds all the pollution indices, therefore sufficient treatment has been provided.

All the methods above provide enough water quality in accordance with CIRIA's C753 document. Further evidence will need to be provided at detailed design stage.

Finished Floor Levels

The FRA has recommended that the floor levels are set a minimum of 2.25m AOD. Proposed levels will be reworked to ensure part M compliance can be achieved. Additionally, it is likely that the FFL's will be raised beyond this to support the drainage strategy.

Foul Water

We have undertaken a wide search for the nearest AW foul asset, the extract below shows the an extract of the site, with the full map being provided in appendix B.



Figure 7 - AW Asset Map

There are no recorded assets within the vicinity of the site, with the closest main drain being confirmed to be approximately 850m away (south west) by Anglian Water. As a result of this, it is deemed given the scale of the development, that this connection is not viable, and we are looking at alternative methods of connection. Given the relatively remote location, it is assumed that the majority of the surrounding properties are 'off main drain solutions).

Further to this, the EA's own criteria is that if the development is within 30m for each plot to the nearest sewer then it should be considered. This would give a connection distance of 720m, which exceeds this distance and therefore it should be considered unrealistic to be able to connect this far. If the connection was to be sought the only viable access would be to Littleworth drove which is a main road and would be exceedingly expensive to install, not to mention the disruption. This stretch of road does not have verges available so the excavation will to the road.

The proposals is for the foul to discharge to a waste water treatment plant, where the treated water will then discharge towards the Riparian drain to the front.

Given the overall size of the development, and as it is expected that the drain will run dry, an environmental permit will be required by from the EA. This cant be undertaken at this point of the project, and if planning is granted, it is critical that the EA is consulted early on in the process as the requirements may be stringent, or they may even ultimately reject the proposals.

In the event that the EA reject this, then the development will need to be served by foul storage tanks. The site has multiple locations for such an item and it is deemed this will not significantly impact the design and more importantly the layout.

The connection into the drain will be subject to byelaw consent with the IDB.

Conclusion

- The above drainage strategy demonstrates that the site can be drained appropriately including the use of a Sustainable Drainage System.
- The run-off rate from the developed site will be no higher than 1.2l/s for all storm events, although it is proposed to increase this rate, to make the flow control device more maintainable.
- Discharge from the site will ultimately be to a Welland and Deepings maintained drain via. an ordinary watercourse (possible riparian drain).
- A full maintenance strategy will be developed at the detailed design stage.
- A drainage sketch can be found on Studio 11's Concept Drainage Strategy drawing: 615-S11-00-SI-SK-C-9000.
- As the run-off from the site is being restricted to greenfield run-off the risk of flooding as a result of the site's development will not increase. Even if this is increased, it is expected that the IDB has some spare capacity, and as the area is relatively undeveloped, it is not expect to cause significant issues.
- No flooding is currently anticipated for the 1 in 100 year + 40% climate change event.
- Finished floor levels will be set at a minimum of 2.25m AOD above in accordance with the FRA.
- The foul drainage solution will be reliant on 'off-mains' drainage, subject to an EA permit.

Appendices

Appendix A - Calculations