1.0 Introduction

1.1 This note has been prepared by MAC Pre-planning Engineering, to provide a formal response to Oxfordshire County Council (OCC) in their capacity as the Lead Local Flood Authority (LLFA); to comments received on the Outline planning application 21/03426/OUT dated 1st December 2021. An excerpt of the LLFA's comments is included as **Appendix A**.

1.2 At the time that the Outline planning application was validated, it was supported by a Flood Risk Assessment (FRA) prepared by MAC Pre-planning Engineering (ref 340-FRA-01-0 dated 23/09/21). A copy of the submitted FRA's cover page and revision record has been included as **Appendix B** for reference.

2.0 Objective

2.1 The main aim of this Technical Note is to provide the additional detail required, to ensure a thorough review of the development's drainage strategy can be carried out. To help guarantee that the level of detail provided within this Technical Note is sufficient, the remaining sub-sections will follow the checklist provided in *'Appendix C: Information Required for Outline Planning Applications'*, which forms part of the OCC publication, *'Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire*'. A full copy of the checklist is included as **Appendix C**.

2.2 Where information alluded to by the title for any of the following headings has already been provided, reference will be made to the relevant part of the submitted MAC Pre-planning Engineering FRA.

3.0 Non-Technical Summary

3.1 The proposed surface water drainage strategy will dispose of future site runoff generated from within the red line application boundary via a direct connection to a roadside ditch, located along the eastern development boundary.

3.2 The conveyance route for surface water runoff will follow permeable paving, an underground piped network, a swale, a detention basin, and a flow control chamber prior to discharging into an existing ditch.

4.0 Description of the type of development

4.1 The Outline planning application is for up to 78 dwellings and associated open space with all matters reserved other than access. The red line application boundary covers approximately 3.73ha of a Greenfield parcel, which will introduce 1.551 ha of hard standing (includes a 10% allowance for urban creep) post-development.

5.0 A Location Plan

5.1 See **Appendix D** for a copy of the Site Location Plan, which shows the extent of the application site submitted for Outline planning consent, as well as adjacent land under the Applicant's control.

6.0 Plans

6.1 A copy of the existing and proposed site layout has been shown on the Topographical Survey and Sketch Layout include as Appendices C and D respectively, within the submitted FRA. An overlay of these plans has been prepared to demonstrate existing overland flow paths (direction and gradient) throughout the extent of the red line application boundary. The overlay also highlights both existing and proposed surface water drainage features.

6.2 See **Appendix E** for a copy of the Existing Overland Flow Path / Proposed Surface Water Attenuation Strategy, for further details.

7.0 Assessment of all Flooding Risks to the Site

7.1 See *'Chapter 2 Site Specific Flood Risk'* of the submitted MAC Pre-planning Engineering FRA report for further details.

8.0 Explanation of how each of these Flood Risks will be Mitigated

8.1 Chapter 2 of the submitted MAC Pre-planning Engineering FRA report, concludes that the proposed development site is located within Flood Zone 1 and is at a low risk of flooding from all other sources. Given the level of flood risk identified for the development site, there is no need to implement mitigation measures.

9.0 Explanation of how the Drainage Discharge Hierarchy has been Followed

9.1 See Section *'3.3 Proposed Method of Discharge'*, of the submitted MAC Pre-planning Engineering FRA report for further details.

10.0 Evidence that the Site has an Agreed Point of Discharge

10.1 The proposed outfall is a ditch / watercourse which is located along the Applicant's ownership boundary. As a result, the Applicant has a Riparian ownership over the ditch / watercourse, to discharge surface water runoff from generated from the development site.

10.2 From the Existing Overland Flow Path plan included as **Appendix E**, it can be concluded that the existing surface water runoff discharges in a west to east direction, into the ditch / watercourse which runs parallel with and adjacent to the development's southern and eastern boundaries.

11.0 Calculations of Current Runoff from Site

11.1 The calculated Greenfield runoff rates for the site are Q_{Bar} – 6.1 l/s, Q_{1year} – 5.2 l/s, Q_{30year} – 11.9 l/s and $Q_{100year}$ – 15.2 l/s. See *'Table 3.1: Existing Run-off Rate Calculation Parameters and Results'* of the submitted FRA for further details.

12.0 Calculations of Allowable Runoff from Site

12.1 It is proposed to discharge the development site at the calculated Q_{Bar} rate of 6.1 l/s.

13.0 A Calculation of Storage Volume

13.1 The storage volume for the site has been calculated using Causeway's Flow software; together with a site-specific FEH-13 dataset obtained from the UK Centre for Ecology & Hydrology website https://fehweb.ceh.ac.uk/GB/map.

13.2 The model simulation represents a step beyond the 'Quick Storage Estimate' tool, therefore is considered sufficient for an Outline planning application. The Flow model simulates a single node as a storage structure, with a depth of 1m and an area of 1449m^2. The node is restricted to a discharge rate of 6.1 l/s (See paragraph 12.1 above).

13.3 The storage node has been simulated for the 100 year +40% climate change event, for all available storm durations above 60 minutes i.e. 180 minutes through to 10,080 minutes. The simulation results confirm that the worst-case event would cause in the node to have a flooded volume of 1,462m^3.

13.4 For the purpose of providing an Outline surface water drainage strategy, it can be concluded that the storage requirement for the development site is 1,462m^3. See **Appendix F** for a full copy of the Flow results.

13.5 The proposed detention basin shown in **Appendix E**, provides a storage volume of 1,496m^3, which exceeds requirement calculated above. Therefore, the proposed surface water attenuation strategy is considered sufficient for Outline planning application 21/03426/OUT.

14.0 Plans Showing a Logical Location of Storage within the Proposed Development

14.1 Chapter 2 of the submitted MAC Pre-planning Engineering FRA report, concludes that the proposed development site is located within Flood Zone 1 and is at a low risk of flooding from all other sources.

14.2 Given the level of flood risk identified for the development site, it is considered acceptable to place a SuDS feature anywhere within the extent of the red line application boundary; subject to the SuDS feature of concern achieving the recommended design parameters.

14.3 Refer to the following paragraph **15.0 Explanation of Likely Forms of SuDS for the Site** as well as the plan included in **Appendix E** for further details.

15.0 Explanation of Likely Forms of SuDS for the Site

15.1.1 The following **Table 15.1**, provides a summarised assessment for a range of SuDS features which have been considered for implementation at the development site, based on viability and a cost benefit analysis.

Table 15.1: SuDS Technique Viability Assessment for Development Site

SuDS Feature	Design Considerations	Will this Implemented?
Rainwater Harvesting	This will be incorporated in the form or rainwater butts attached to rainwater pipes, which can reduce future residents' dependence on a clean water supply when using water for garden related purposes.	**Yes** To be reviewed at the detailed design stage.
Green Roofs	This type of feature should typically be used for betterment as opposed to implementation on a Greenfield site. The hydraulic performance of this roof during extreme events is similar to a standard roof; therefore, additional attenuation would still be required. The cost of providing and maintaining green roofs on a large scale is likely to exceed the benefit it will bring to the site.	No
Filter Strips/ Filter Drains	The longitudinal slope for a filter strip should be constrained between 1% and 5%. Where filer strip slopes are great than 5%, a series of level spreaders can be used to maintain sheet flow as runoff flows over the strip. The longitudinal slope for a filter drain should not exceed 2% because low velocities are required for stable conveyance through the filter medium and or pollutant removal processes to occur (CIRIA C753). The existing overland flow path and gradients noted on MAC drawing no 340-FRA04, illustrate that the developable extent of the site slopes between 8.33% (1:12) and 11.1% (1:9). Therefore, the proposed development site would need to undergo a cut/fill exercise to enable the installation of these features. To review the implementation of these SuDS feature fully, it is considered best to wait until a fixed layout and proposed ground levels have been produced at the detailed design stage. See **Appendix E** for further details.	Maybe To be reviewed at the detailed design stage.
Swales	The longitudinal slope for a swale should be constrained between 0.5% and 6% (CIRIA C753). The existing overland flow path and gradients noted on MAC drawing no 340-FRA04, illustrate that the developable extent of the site slopes between 8.33% (1:12) and 11.1% (1:9). Therefore, the only suitable location to install a swale would be within the immediate vicinity of the designated outfall where the gradient range is between 3.33%(1:30) and 6.25% (1:16). See **Appendix E** for further details.	**Yes**

SuDS Feature	Design Considerations	Will this Implemented?
Bioretention Systems (including rain gardens)	Subject to the requirements of the Local Highway Authority, these features can be implemented adjacent to the main spine which passes through the site, as it will be tree lined. However, due to the topography of the site, it is likely that these features would be incorporated purely for additional treatment/ conveyance and not storage.	Maybe To be reviewed at the detailed design stage.
Pervious Pavements	Subject to the adoption requirements of the Local Highway Authority, these features can be implemented; however, may be limited to private areas only such as private drives. See **Appendix E** for an indicative extent of permeable paving used on all shared surface roads. Given the site's topography permeable paving should be installed parallel to the direction in which contours fall across the site (i.e. north to south), to ensure a minimum level difference across the surface. It should also be noted that it is not recommended to install permeable paving at gradient any steeper than 1:20, as it is unlikely rainfall will be able to infiltrate permeable surface during an extreme rainfall event.	**Yes** To be reviewed at the detailed design stage.
Attenuation Storage Tanks	This feature can be used; however, it is considered more sustainable to incorporate other SuDS features listed in this Table.	No
Detention Basins	The existing overland flow path and gradients noted on MAC drawing no 340-FRA04, illustrate that the developable extent of the site slopes between 8.33% (1:12) and 11.1% (1:9). Therefore, the most suitable location to install a detention basin without needing a significant amount of local land raising would be immediately upstream of the designated outfall where the gradient range is between 1.89% (1:53) and 3.70% (1:27). See **Appendix E** for further details.	**Yes**
Ponds and Wetlands	This feature can be installed; however, it is acknowledged that the placement of a large open water SuDS feature would be impractical within the developable extent of the development site. As a result, a pond/ wetland would need to be immediately upstream of the designated outfall where the topography I flattest. The location of this feature would be out of view from the majority of the proposed residential development; therefore, a detention basin is considered to be a better alternative in this site-specific instance.	No

15.2 Based on **Table 15.1** above, it can be concluded that the majority of the SuDS features which are considered viable for the development site have already been included in the proposed surface water drainage strategy which was submitted for Outline planning. Therefore, the submitted surface water drainage strategy is considered robust.

15.2.1 Based on the proposed setting out of the SuDS features to be implemented for the development, all parts of the development will discharge via an online swale and detention basin prior to discharging into the designated outfall. Given that this surface water conveyance route represents the minimum number of treatment trains site generated runoff will pass through, it is possible to determine the sufficiency of pollution mitigation indices for the selected SuDS components to be implemented on site.

Table 15.2: Pollution Hazard Indices – Proposed Residential Development

Runoff Area Land Use Description	Hazard Level	Suspended Solids	Metals	Hydrocarbons
Residential Roofing	Very Low	0.2	0.2	0.05
Residential Parking	Low	0.5	0.4	0.4
Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/ motorways)	**Medium**	**0.7**	**0.6**	**0.7**

15.2.2 Based on **Table 15.2** above, it can be concluded that the roads associated with the proposed development, can be attributed with the highest pollution hazard indices.

15.2.3 The following Tables (**Table 15.3** and **Table 15.4**), list the proposed treatment trains in the order in which surface water will be conveyed through them. Using the values in **Table 15.3** enables the total SuDS mitigation index to be calculated. It should be noted that a factor of 0.5 is used to account for the reduced performance of secondary and tertiary components associated with already reduced inflow concentrations (CIRIA C753). **Table 15.4** provides

Table 15.3: Pollution Mitigation Indices – Proposed Residential Development

Treatment Train	SuDS Component Description	Suspended Solids	Metals	Hydrocarbons
First	Swale	0.5	0.6	0.6
Second	Detention Basin	0.5	0.5	0.6

Table 15.4: Combined Pollution Mitigation Indices for the Runoff Area

Treatment Train	SuDS Component Description	Suspended Solids	Metals	Hydrocarbons
First	Swale	0.5	0.6	0.6
Second	Detention Basin	(0.5 x 0.5) = 0.25	(0.5 x 0.5) = 0.25	(0.5 x 0.6) = 0.3
Total SuDS Mitigation Indices		**0.75**	**0.85**	**0.9**

15.2.4 By comparing the total SuDS mitigation indices provided in **Table 15.4**, against the pollution hazard indices above noted for 'Roads' in **Table 15.2**; it can be confirmed that the implementation of an online swale and detention basin will provide a sufficient level of mitigation against the pollution hazard indices associated with the development roads. Therefore, the proposed drainage strategy is considered to provide an acceptable level of water quality treatment.

15.2.5 Notwithstanding the above, it should be noted that the use of additional SuDS features such as permeable paving, and rain gardens in the form of tree pits will also be reviewed at the detailed stage. The implementation of these features would further increase the level of water quality treatment being provided to surface water runoff, which would ensure the development site's drainage strategy is operating above the accepted thresholds enforced by the Lead Local Flood Authority.

15.2.6 Dependent on the adoption procedures for the Local Highway Authority, it is likely that the use of permeable paving and tree pits may be limited to use within private land areas only. As a result, this may reduce the available area that at can used to construct these SuDS features

16.0 Explanation of who will Maintain the Drainage System

16.1 See '*3.6 Maintenance Requirements'* of the submitted FRA for further details. During the reserved matters stage, the precise contact details of the person/s responsible for maintaining the various elements of the surface water drainage strategy will be provided, alongside a detailed maintenance schedule.

17.0 Phasing

17.1 To ensure that onsite construction works will not result in additional surface water run-off, the proposed detention basin and associated flow control chamber will be built at the very early stages during the construction phase of the development.

17.2 Implementing the downstream end of the proposed drainage strategy at the early stages of the construction phase, will not increase the existing site's impermeable surface area. Therefore, it is considered reasonable to construct the attenuation facility without risking an increase in surface water runoff.

17.3 Once the attenuation feature is in place, the swale proposed to be situated immediately upstream can be constructed, followed by the setting out / excavation of the trenches for the upstream piped surface water network, which will provide a continuous irrigation channel connecting the developable extent of the site to the detention basin, which will be restricted to a discharge rate of 6.1 l/s by a flow control device.

17.4 Following the implementation of the above, it would be considered safe to start works on all outstanding upstream elements of the proposed development, as they would be able to discharge via a suitably sized attenuation facility; whilst having surface water flows conveyed through at least two treatment trains, ensuring a sufficient level of water quality treatment is provided prior to discharging into the adjacent ditch / watercourse.

18.0 Summary

18.1 Based on the information provided within this Technical Note, it is considered that a sufficient level of additional detail has been provided to enable Oxfordshire County Council (LLFA) to undertake a thorough review of the residential development's (Outline application 21/03426/OUT) proposed drainage strategy.

Appendix A

Oxfordshire County Council
Response to Consultation on Outline Application 21/03426/OUT
Lead Local Flood Authority comments only

Application no: 21/03426/OUT
Location: Land Opposite Hanwell Fields Recreation Adj To, Dukes Meadow Drive, Banbury

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Lead Local Flood Authority

Recommendation:

Objection

Comments:

The information submitted is not detailed enough to review the strategy. detailed surface water management strategy must be submitted in accordance with the Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire

In line with this guidance, runoff must be managed at source (i.e. close to where it falls) with residual flows then conveyed downstream to further storage or treatment components, where required. The proposed drainage should mimic the existing drainage regime of the site as much as possible.

Proposed development needs a water quality assessment in accordance with Section 4 and Section 26 of SuDS Manual.

Proposed development must meet local standards, L19, “At least one surface feature should be deployed within the drainage system for water quality purposes, or more features for runoff which may contain higher levels of pollutants in accordance with the CIRIA SuDS Manual C753. Only if surface features are demonstrated as not viable, then approved proprietary engineered pollution control features such as vortex separators, serviceable/ replaceable filter screens, or pollution interceptors may be used”`

The applicant is required to provide a Surface Water Management Strategy in accordance with the following guidance:

The Sustainable Drainage Systems (SuDS) Policy, which came into force on the 6th April 2015 requires the use of sustainable drainage systems to manage runoff on all applications relating to major development. As well as dealing with surface water runoff, they are required to provide water quality, biodiversity and amenity benefits in line with National Guidance. The Sustainable Drainage Systems (SuDS) Policy also implemented changes to the Town and Country Planning (Development Management

Procedure) (England) Order 2010 to make the Lead Local Flood Authority (LLFA) a statutory Consultee for Major Applications in relation to surface water drainage. This was implemented in place of the SuDS Approval Bodies (SAB's) proposed in Schedule 3 of the Flood and Water Management Act 2010.

All full and outline planning applications for Major Development must be submitted with a Surface Water Management Strategy. A site-specific Flood Risk Assessment (FRA) is also required for developments of 1 hectare or greater in Flood Zone 1; all developments in Flood Zones 2 and 3 or in an area within Flood Zone 1 notified as having critical drainage problems; and where development or a change of use to a more vulnerable class may be subject to other sources of flooding.

Further information on flood risk in Oxfordshire, which includes access to view the existing fluvial and surface water flood maps, can be found on the Oxfordshire flood tool kit website. The site also includes specific flood risk information for developers and Planners.

The National Planning Policy Framework (NPPF), which was updated in July 2021 provides specific principles on flood risk (Section 14, from page 45). National Planning Practice Guidance (NPPG) provides further advice to ensure new development will come forward in line with the NPPF.

Paragraph 159 states; "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere."

As stated in Paragraph 160 and 161 of the NPPF, we will expect a sequential approach to be used in areas known to be at risk now or in the future from any form of flooding.

The Non-statutory technical Standards for sustainable drainage systems were produced to provide initial principles to ensure developments provide SuDS in line with the NPPF and NPPG. Oxfordshire County Council have published the "Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire" to assist developers in the design of all surface water drainage systems, and to support Local Planning Authorities in considering drainage proposals for new development in Oxfordshire. The guide sets out the standards that we apply in assessing all surface water drainage proposals to ensure they are in line with National legislation and guidance, as well as local requirements.

The SuDS philosophy and concepts within the Oxfordshire guidance are based upon and derived from the CIRIA SuDS Manual (C753), and we expect all development to come forward in line with these principles.

In line with the above guidance, surface water management must be considered from the beginning of the development planning process and throughout – influencing site

layout and design. The proposed drainage solution should not be limited by the proposed site layout and design.

Wherever possible, runoff must be managed at source (i.e. close to where it falls) with residual flows then conveyed downstream to further storage or treatment components, where required. The proposed drainage should mimic the existing drainage regime of the site. Therefore, we will expect existing drainage features on the site to be retained and they should be utilised and enhanced wherever possible.

Although we acknowledge it will be hard to determine all the detail of source control attenuation and conveyance features at an outline stage, we will expect the Surface Water Management Strategy to set parameters for each parcel/phase to ensure these are included when these parcels/phases come forward. Space must be made for shallow conveyance features throughout the site and by also retaining existing drainage features and flood flow routes, this will ensure that the existing drainage regime is maintained, and flood risk can be managed appropriately.

Drainage Pro-Forma

Officer's Name: Sujeenthan Jeevarangan
Officer's Title: LLFA Planning Engineer
Date: 23 November 2021

Appendix B

Flood Risk Assessment
MAC report reference 340-FRA-01-0, Planning Issue dated 23/09/21

Flood Risk Assessment

Proposed Residential Development
Land North of Dukes Meadow Drive
Banbury

Revision 0: September 2021
Report Reference: 340-FRA-01-0

Martin Andrews Consulting Limited | Regents Pavilion, 4 Summerhouse Road, Northampton, NN3 6BJ
T: 01604 340544 | E: info@mac-ltd.co.uk | W: preplanningengineering.co.uk

Report Originator(s)

Martin Andrews MEng (Hons) CEng MICE MCIHT
Director
martin.andrews@mac-ltd.co.uk

Alexander Nelson BEng (Hons)
Senior Engineer
alexander.nelson@mac-ltd.co.uk

Revision Record

Revision	Date	Description	Written	Approved
0	24/08/21	Draft issue	MJA	MJA
0	20/09/21	Draft issue 2	MJA	MJA
0	23/09/21	Planning Issue	AN	MJA

Appendix C

Oxfordshire LLFA
Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire
Appendix C: Information Required for Outline Planning Applications

APPENDIX C: INFORMATION REQUIRED FOR OUTLINE PLANNING APPLICATIONS

The following information should be provided for every drainage strategy submitted to the LLFA for consideration as part of an **Outline Planning Application**.

Detail required for Outline Applications	Provided?
Non-Technical Summary Non-technical summary of the proposed drainage strategy.	
Description of the type of development Description of the type of development proposed and where it will be located. Include whether it is new development, an extension to existing development or change of use etc. State the area of the development site itself, how much of the site is currently hard standing, the proposed area to be hard standing post-development, and any proposed areas of public open space. Note that in calculations proposed values of impermeable area should include a 10% allowance for Urban Creep, as taken from CIRIA C753 (version 6) paragraph 24.7.2.	
A location plan Location plan at an appropriate scale should be provided with the application, showing site outline and other adjacent land under the applicant's control.	
Plans Plans showing the existing site layout, its topography, any water features, and how the site currently drains. Plans should also be provided of the proposed layout if available and demonstration that the proposed drainage system and other mitigation measures are achievable and that adequate space has been made for water.	
Assessment of all flooding risks to the site This should include groundwater, overland surface water flows, sewer flooding, infrastructure flooding (from reservoirs/ponds/canals), watercourse flooding and the risk posed by the proposed development.	
Explanation of how each of these flood risks will be mitigated This may require modelling of some sources where significant flood risk is shown on high level datasets. It might mean applying the sequential approach to the site by avoiding building on one part of the site where there is known flooding.	
Explanation of how the drainage discharge hierarchy has been followed, providing evidence why any are inappropriate: • Firstly, to infiltration/soakaway • Secondly, to a watercourse or highway ditch (with permission) • Thirdly, to a surface water sewer or highway drain (with permission) • Lastly, to a combined sewer (with permission)	
Evidence that the site has an agreed point of discharge - If a significant portion of surface water is to be infiltrated on site, provide a BRE365 infiltration assessment to prove that this will work effectively. At outline stage it may be acceptable to base infiltration values on typical values for the local geology, as long as an alternative drainage design and agreed point of discharge is provided should infiltration	

Detail required for Outline Applications	Provided?
rates prove to be unsuitable. - If discharge is to an ordinary watercourse, evidence will need to be provided to ensure that the system can accept the proposed flows to an acceptable downstream point without increasing risk to others. If the watercourse is not within the boundary of the site, evidence will be required that the developer has a right to cross 3rd party land. - If discharge is to a surface water or combined sewer, or highways ditch or drain, letter of confirmation from the Water Company or responsible body will be required, stating their required discharge maximum rates and confirmation that there is adequate capacity in the existing system. This information is generally provided by going through the relevant water company's "Pre-Planning Service". This is a formal process that all developers are expected to go through to inform their planning applications. There is normally an associated cost for this service and a minimum timescale of 15 working days to obtain a response. The advice is then usually valid for a one year period. This process will provide assurance that there are no capacity issues with third party assets, as we as the LLFA are not able to make this type of assumption on behalf of a Water and Sewerage provider. - Thames Water: https://my.thameswater.co.uk/dynamic/cps/rde/xchg/corp/hs.xsl/18710.htm - Anglian Water: http://www.anglianwater.co.uk/developers/pre-planning-service-.aspx - Severn Trent Water: https://www.stwater.co.uk/developers/application-forms-and-guidance-notes/ (> application forms > Development enquiry application form)	
Calculations of current runoff from site • For greenfield sites, existing greenfield runoff rates and volumes can be produced through the UK SuDS website http://www.ukSuDS.com/, or by using the Institute of Hydrology IoH124 method. • If brownfield sites, clearly state the existing impermeable area and calculate the rates of runoff from the site. If a piped drainage system already exists within the site, the existing capacity of these pipes will need to be estimated.	
Calculations of allowable runoff from site Clearly state the proposed impermeable areas for the site and how this compares to existing values. In all calculations, proposed values of impermeable area should include a 10% allowance for Urban Creep, as taken from CIRIA C753 (version 6) paragraph 24.7.2. The Modified Rational Method is considered acceptable only for initial design estimates (i.e. at Outline planning) or for very simple sites (i.e. Minor developments). • Greenfield sites should discharge at no greater than the current greenfield rate so that the site behaves like the original site across the range of events. • Brownfield sites are strongly encouraged to discharge at the greenfield rate wherever possible. As a minimum, brownfield sites should reduce the discharge by 40% to account for the impacts of climate change, from the existing site runoff OR from the original un-surcharged pipe-full capacity of the existing system, whichever is the lowest. • Developers have the option to limit discharge for all events to the QBAR flow rate; or install a complex discharge control which reflects the original discharge for run-off rates from the site across the range of storm events. E.g. QBAR, 3.3% (1in30), 1% (1in100), and provide Long Term Storage for all runoff volume greater than the greenfield volume (as set out in 'Calculation of Storage Volume' below). It is understood that some guidance recommends minimum discharge rates of 5 l/s, to minimise use of small orifice openings that could be at risk of blockages. However, appropriate	

Detail required for Outline Applications	Provided?
consideration of filtration features to remove suspended matter and suitable maintenance regimes should minimise this risk and therefore the minimum limit of 5l/s does not apply in Oxfordshire. • Due to the additional datasets that have been added to the Flood Estimation Handbook (FEH) since design rainfall events were developed originally in the Flood Studies Report (FSR) (NERC, 1975), rainfall depths obtained using FEH show significant differences from those obtained from FSR in some parts of the country. Within Oxfordshire, rainfall depths are often greater using more up to date FEH datasets than those using FSR, therefore for various storm events, greater run-off is produced and additional attenuation is likely to be required. As FEH rainfall data is more up to date, calculations should use FEH data for surface water drainage design, except where the critical storm duration is less than 60 minutes, as it is recognised that FEH data is less robust for short duration storms. If FEH rainfall data is not used as described above, then sensitivity testing to assess the implications of FEH rainfall must be provided. This should demonstrate that the development proposals remain safe and do not increase flood risk to third parties.	
A calculation of storage volume Volume of storage required on site for the 1% (1in100) plus climate change storm, in order to meet the controlled discharge rate or available infiltration rate. Where appropriate this should specify the volumes of both attenuation storage and Long Term storage. See also note above about use of FEH rainfall data. An estimation of storage (acceptable only for outline applications) can be produced through the UK SuDS website http://www.ukSuDS.com/, or using the WinDes Quick Storage Estimate tool.	
Plans showing a logical location of storage within the proposed development Attenuation storage within areas at risk of flooding will not be acceptable.	
Explanation of likely forms of SuDS for the site and reasons for the use of these features. If no SuDS methods are proposed then justification and evidence will need to be provided as to why they are not appropriate for the site.	
Explanation of who will maintain the drainage system over the lifetime of the development and evidence that all elements of the drainage system will be fully accessible for maintenance without entering 3rd party land. Ideally, SuDS features should be located within public space.	
Phasing An explanation of how the site will adequately consider flood risk at all stages of the development.	

Appendix D

Site Location Plan
Thrive Architects job no. MANO210710, drawing no. SLP-02 Rev P3, dated 23.09.21

A3

Romsey
T: 01794 367703
F: 01794 367276

Portishead
T: 01275 407000
F: 01794 367276

Camberley
T: 01276 749050
F: 01794 367276

www.thrivearchitects.co.uk

Rev	Description	Date	Au	Ch
P1	Preliminary Issue	10.09.21	PM/ci	--/--
P2	Revised redline	22.09.21	PM/hm	
P3	Revised redline	23.09.21	PM/hm	

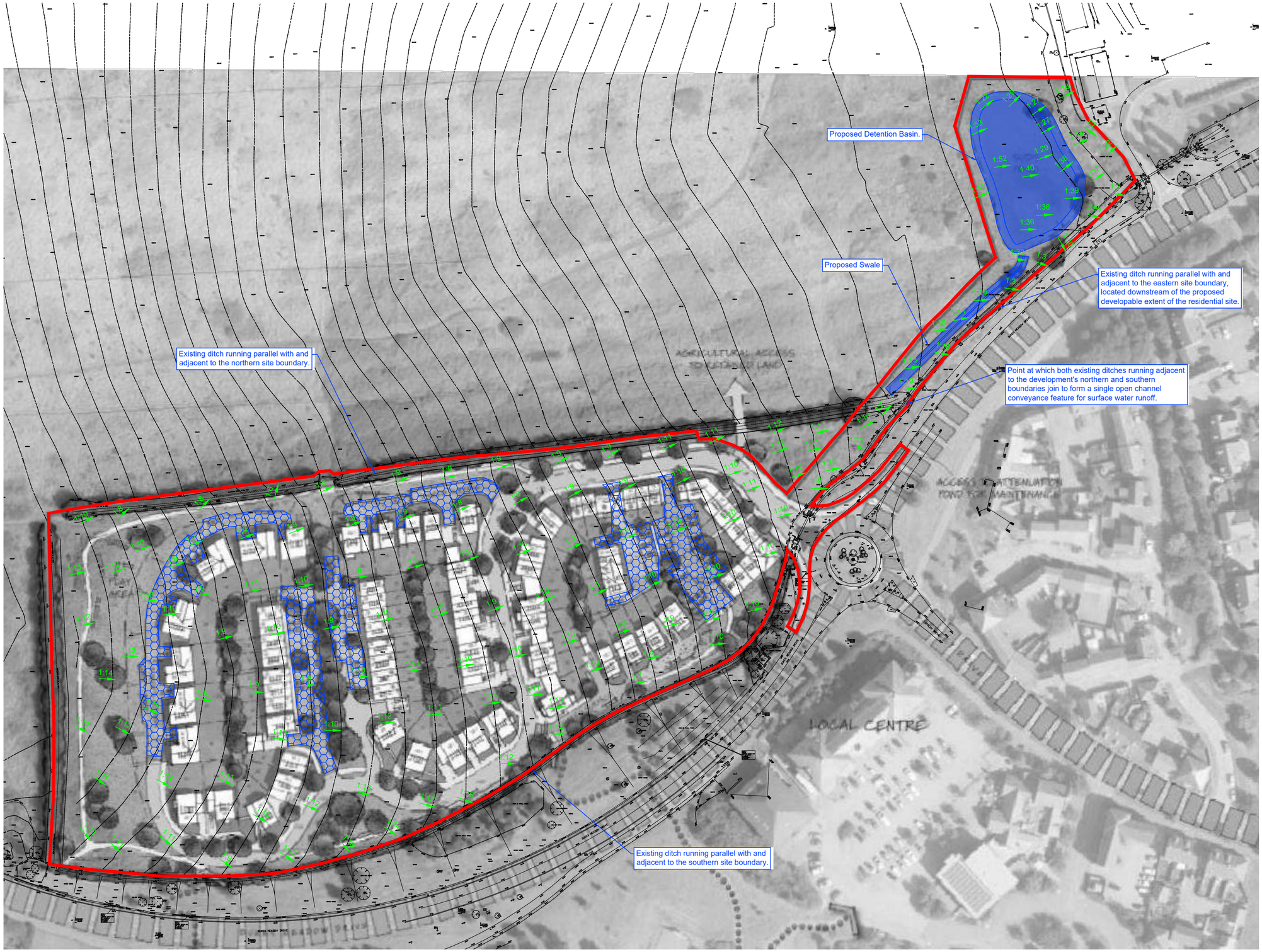
Project	Hanwell Fields, Banbury
Drawing	Site Location Plan - 02
	-

Client	MANOR OAK HOMES				
Job no.	MANO210710			Date	10.09.21
Dwg no.	SLP-02			Rev.	P3
Author	PM/ci	Checked	-/-	Scale	1:2000@A3
Status	PRELIMINARY			Office	Romsey
Client ref.	-				

thrive. architects

Appendix E

Existing Overland Flow Path
MAC drawing no. 340-FRA04



NORTH

Notes:

1. Based on 'Topographic Survey Whole Site' by Woods Hardwick, drawing number 17525-7-865 dated 24-03-2016.
2. Drawing based on Ordnance Survey mapping. ©Crown Copyright and database rights 2021 OS Licence no. 100019980.

Key

- Site Boundary
- 1:17 — Existing Overland Flow Path (Direction and Gradient)
- Proposed Surface Water Attenuation (Permeable Paving - Below Ground SuDS)
- Proposed Surface Water Attenuation (Open SuDS)

T: 01604 340544 Northampton Office
E: info@mac-ltd.co.uk W: mac-ltd.co.uk
Martin Andrews Consulting Ltd

- Transport Assessments
- Flood Risk Assessments
- Highway Advice
- Access Design
- Drainage Strategies
- Vehicle tracking

Client: Manor Oak Homes		Project: Land North of Dukes Meadow Drive Banbury	
Title: Existing Overland Flow Path / Proposed Surface Water Attenuation Strategy			Date: 07/12/21
			Drw: AN
			Chk: MJA
Drawing No: 340-FRA04	Revision: -		Scale: 1:1,000
			Size: A2

Appendix F

Drainage Design Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	1.551	5.00	100.000	1200	150.000	150.000	2.000

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	1 year (l/s)	5.2
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	11.9
Winter CV	0.840	Additional Storage (m³/ha)	20.0	100 year (l/s)	15.2
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

60	180	360	600	960	2160	4320	7200	10080
120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	1.410	Betterment (%)	0
SAAR (mm)	639	QBar	6.1
Soil Index	4	Q 1 year (l/s)	5.2
SPR	0.47	Q 30 year (l/s)	11.9
Region	6	Q 100 year (l/s)	15.2
Growth Factor 1 year	0.85		

Node 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	98.000	Product Number	CTL-SHE-0116-6100-1000-6100
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.1	Min Node Diameter (mm)	1200

Node 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	98.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1445.0	0.0	1.000	1445.0	0.0	1.001	0.0	0.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	1	720	99.000	1.000	96.6	1461.7770	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
720 minute winter	1	Hydro-Brake®	6.1	286.4