Three Rivers District Council
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WD3 1RL

Our Ref: 233574-BWB-ZZ-XX-T-W-0005_LLFA
Date: 8th April 2025
Contact: Craig Crowe
Direct Dial: 0115 851 7410

REPONSE TO LEAD LOCAL FLOOD AUTHORITY CONSULTEE COMMENTS ON OUTLINE PLANNING APPLICATION REFERENCE: 24/2073/OUT – LAND TO NORTH OF LITTLE GREEN LANE, CROXLEY GREEN, WD3 3SP

We are writing in response to the comments received from Hertfordshire County Council, as the Lead Local Flood Authority (LLFA), regarding a proposed development at Land to North of Little Green Lane, Croxley Green (planning reference 24/2073/OUT).

This letter details the initial response and any actions undertaken to address the comments received. The LLFA's comments have been provided below in **bold** with BWB Consulting's response provided below in *italic*.

"Include evidence of appropriate freeboard to finished floor levels from the design flood levels. Design flood level has not been calculated. We cannot be certain that the 150mm proposed levels are above the design flood level."

The Flood Risk Assessment (FRA) (reference: 233574-BWB-ZZ-XX-T-W-0002_FRA) concludes that the site is at a low risk of flooding from fluvial flooding. The nearest Flood Zones are located approximately 500m east of the site and intervening topography is raised approximately 23m above the Flood Zones. Due to the distance from site and the significant intervening topography, It is therefore not considered necessary to calculate the design flood level for fluvial sources.

The EA's Risk of Flooding from Surface Water mapping, for the '2050s' epoch, shows that in the east of the site, during the 1 in 100-year event, flood depths can reach up to 0.3m at an approximate elevation of 57metres Above Ordnance Datum (mAOD). A review of existing ground levels shows that the lowest development is set at a level of approximately 63mAOD and therefore the development is considered to be raised above the surface water level.

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"Infiltration storage drainage design should be recalculated to either only discharge through the sides of the structure or apply the appropriate factor of safety. Further calculations are required for infiltration. Half drain down time has not been provided."

*A Safety Factor of 5 has been applied in the calculations, as outlined by the LLFA through correspondence detailed in **paragraph 1.8** and **Appendix 3** of the Sustainable Drainage Statement (SDS) (reference: 233574-BWB-ZZ-XX-T-W-0001_SDS). As an appropriate safety factor has been applied, it is not considered necessary to undertake calculation only discharging through the side of the structure. The half drain down time been provided **Appendix 10** of the SDS and outlines that the time to half empty is 941 mins for Catchment 1 and 852 mins for Catchment 2.*

"Infiltration drainage storage has half drain down time greater than 24 hours and an alternative design or mitigation is required. Further calculations are required for infiltration. Half drain down time has not been provided"

*As detailed in **paragraph 3.17** the calculated half drain down time does not exceed 24 hours (1,440 mins). **Appendix 10** of the SDS (reference 233574-BWB-ZZ-XX-T-W-0001) includes the time to half empty which is 941 mins for Catchment 1 and 852 mins for Catchment 2. This demonstrates that the infiltration drainage strategy has a half drain down time of less than 24 hours (1,440 mins). Therefore, alternative design or mitigation is not considered to be required.*

"Include appropriate climate change allowance for the lifetime of the development (including 3.33% AEP design) for drainage modelling storage volumes. Calculations have not been provided. Full network calculations should be supplied for review."

*The SDS (reference: 233574-BWB-ZZ-XX-T-W-0001_SDS) and supporting calculations (**Appendix 10**) demonstrate that there is capacity within the proposed surface attenuation for the 1 in 100-year +40% climate change event. The SDS, in **paragraph 1.10**, notes the requirement for this event to be considered during the detailed design of the surface water drainage network. Given attenuation is sufficient for a greater storm event it is not considered necessary to run calculations for the 1 in 30 year event. Through detail, when the network is designed this will become a material consideration in sizing the pipes. An appropriately worded condition can secure this requirement, if necessary.*

"Outline drainage modelling calculations should be resubmitted and demonstrate how 10% urban creep has been included in the volume of SuDS storage required. Calculations have not been provided. Full network calculations should be supplied for review"

*The application of urban creep to the calculated impermeable areas of the proposed development is detailed in **paragraph 3.1** of the SDS (reference: 233574-BWB-ZZ-XX-T-W-0001_SDS) and is restated below:*

- *Residential – 65% + 10% urban creep*

- *School & Local Centre – 70% (urban creep not considered to be required as it is non-residential)*

- *Proposed Attenuation SuDS – 100% (urban creep not considered to be required as it is non-residential)*

These areas correspond to the subdivision of surface water drainage catchments shown on the Illustrative Drainage Strategy (reference: 233574-BWB-ZZ-XX-D-W-0001) included as ***Appendix 11*** *of the SDS.*

"Outline drainage modelling calculations should be resubmitted using a CV value of 1. Calculations have not been provided. Full network calculations should be supplied for review."

Although this requirement was also not raised during correspondence with the LLFA, included in ***Appendix 3*** *of the SDS, further discussions with the LLFA has confirmed that a CV value of 1 is required within attenuation calculations. Therefore, the calculations and drainage strategy has been updated on this basis and are included as* ***Appendix 2*** *and* ***Appendix 1*** *respectively. At this outline stage, full network calculations are not typically required, and following discussions with the LLFA would look to be conditioned.*

"Use up to date FEH 2013 or FEH2022 rainfall parameters in any drainage modelling scenarios. Calculations have not been provided. Full network calculations should be supplied for review."

Calculations have been provided within ***Appendix 10*** *the SDS (reference: 233574-BWB-ZZ-XX-T-W-0001). The calculations demonstrate that the latest FEH22 data has been used. As stated above, at this outline stage, full network calculations are not typically required and we would therefore propose that these are conditioned for the detailed design stage. Therefore, no additional calculations are required to be provided.*

"Masterplan drawings need to show the high-level location of all SuDS and demonstrate that the volume of storage can be achieved within the layout. This includes the consideration for constraints (e.g., pipeline crossings and how gravity drainage can be achieved). Whilst we acknowledge that the location of SuDS has been outlined (Appendix 11), it is unclear how the principles of drainage would operate. The connections between the features are unclear (i.e. swale does not connect to anything) and the outfall is unclear."

The Illustrative Drainage Strategy (reference 233574-BWB-ZZ-XX-D-W-0001) has been updated to show all connections between all SuDS features and highlight flow pathways to clarify the drainage principles. The updated Illustrative Drainage Strategy is included as ***Appendix 1*** *of this letter. An infiltration based solution is proposed and therefore no formal outfall is required.*

"High level assessment of the maintenance of any SuDS features and structures and who will be adopting these features for the lifetime of the development. The responsibility of maintenance has not been outlined"

An Operation and Maintenance Plan is included as ***Appendix 13*** *of the SDS (reference: 233574-BWB-ZZ-XX-T-W-0001) and includes a high level assessment for the maintenance of the SuDS features included within the Illustrative Drainage Strategy. At this outline stage, it is recommended that the responsibility of maintenance is conditioned.*

"Indicative vehicular access route and offroad parking needs to be provided to ponds, basins and swales within the masterplan. It is currently unclear where the off-road parking will be for the swales and basins"

The Illustrative Drainage Strategy (reference 233574-BWB-ZZ-XX-D-W-0001) has been updated to illustrate vehicular access routes to the proposed infiltration basins and is included as ***Appendix 1*** *of this letter. Swale features are to be accessed via the public highways or surrounding public open spaces and therefore off-road parking is not considered to be required.*

"Due to the likely long duration build out time (including phased development proposals), supporting drainage calculations and drawings are required to show a timeline of how temporary measures will be put in place to protect the water environment and any newly built SuDS features. This will include any temporary water quality and water quantity flow control devices required. This development is likely to be phased. There is no information on the phasing requirements."

Given the outline nature of the proposals the phasing of the development is not yet established and hence we cannot commit to a phasing plan. Given the stage of the project an appropriately worded condition can secure this requirement.

"As it is a phased development, a surface water management and construction phasing plan is required. This must show how each phase can be provided independently (in terms of surface water drainage) and how any infrastructure which it relies on will be constructed prior to any housing or commercial development. There is no water management and construction phasing plan."

Given the outline nature of the proposals the phasing of the development is not yet established and hence we cannot commit to a phasing plan. Given the stage of the project an appropriately worded condition can secure this requirement.

"A high-level assessment of how water quantity and water quality will be managed during the construction phase is required. Identifying high level assumptions of a construction management plan, such as the need to discharge to a sewer or watercourse with appropriate pollution measures. There is no high level assessment of how water quantity and quality will be managed during the construction phase.

Given the outline nature of the proposals the phasing of the development is not yet established and hence we cannot commit to a phasing plan. Given the stage of the project an appropriately worded condition can secure this requirement. Initially it is anticipated that the infiltration basins will be included within the first phase of construction works.

I hope this additional information supplied is sufficient. We would request a meeting with yourselves to discuss these comments at your earliest convenience.

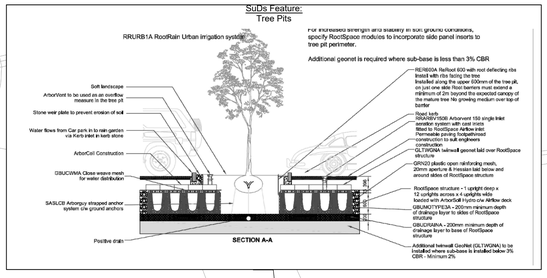
Kind regards,

Craig Crowe BSc (Hons) MSc GradCIWEM

APPENDICES

Appendix 1: Updated Illustrative Drainage Strategy

SuDs Feature:
Tree Pits



SuDs Feature:
Road Side Swales

Inset B: Roadside swale

CCTV Survey by Solumn Surveying LTD (Reference: 12862) has confirmed the route of the existing foul water sewer.

FW Connection Point
MH 1101
CL: 58.09
IL: 56.39

Infiltration Basin 1
CL: 59.00mAOD
IL: 57.60mAOD
Maximum water depth*: 1m
Minimum freeboard*: 400mm
Maximum water volume*: 4,540m³
Total approximate footprint: 5,700m²
Infiltration rate: 0.1764m/h
Safety factor: 5
CV Value: 1
*During the 1 in 100-year + 40% critical storm.

3m maintenance walkway buffer.
1:4 minimum internal side slopes.

Catchment 1
Total Developable area: 6.78ha
Estimated Residential Area: 6.37ha
Estimated Primary School Area: 0.41ha

Estimated Residential Impermeable Area (65% + 10% urban creep): 4.55ha
Estimated Primary School Impermeable Area (70%): 0.29ha
Estimated SuDs footprint: 0.57ha

Total estimated impermeable area: 5.41ha

Vehicle Parking for Basin Maintenance

Infiltration Basin 2
CL: 57.50mAOD
IL: 56.10mAOD
Maximum water depth*: 1m
Minimum freeboard*: 400mm
Maximum water volume*: 5,830m³
Total approximate footprint: 7,200m²
Infiltration rate: 0.19476m/h
Safety factor: 5
Cv: Value 1
*During the 1 in 100-year + 40% critical storm.

3m maintenance walkway buffer.
1:4 minimum internal side slopes.

Infiltration rate based on SA103 test, which was only taken at a 1m depth. Additional testing to confirm the infiltration rate at deeper depths to be taken at detailed design stage.

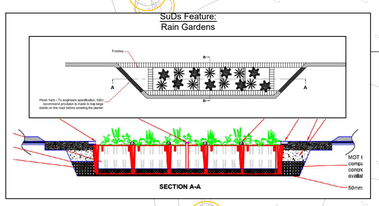
FW Connection Point
CL: 57.00
IL: 55.00

Catchment 2
Total Developable area: 8.92ha
Estimated Residential area: 6.40ha
Estimated Primary School Area + Local Centre Area: 2.52ha

Estimated Residential Impermeable Area (65% + 10% urban creep): 4.58ha
Estimated Primary School + Local Centre Impermeable Area (70%): 1.76ha
Estimated SuDs footprint: 0.72ha

Total estimated impermeable area: 7.06ha

SuDs Feature:
Rain Gardens



ROUSEBARN LANE

Dell Wood

Path (um)

57.3m

Legend

- Infiltration Basin
- Infiltration Basin 3m Maintenance Buffer
- Proposed Surface Water Sewer
- Indicative Site Boundary
- Headwall
- Catchment 1 - Residential area
- Catchment 1 - Primary School/ Local Centre
- Catchment 2 - Residential area
- Catchment 2 - Primary School/ Local Centre
- Swales
- Road side Swales
- Ancient Woodlands Buffer (15m)
- Ancient Woodlands Buffer (30m)
- MP Gas Main Easement (6m total)
- MP Gas Main
- Tree Pits
- Rain Garden
- Surface Water Flood Risk
  - High Chance (1 in 30 year)
  - Medium Chance (Between 1 in 30-year and 1 in 100 year)
  - Low Chance (Between 1 in 100 -year and 1 in 1000-year)
- Assumed Existing Sewer Easement (6m total)
- Existing Foul Water Sewer
- Proposed Foul Water Sewer
- Overland Flow Routing
- Tree RPA's

Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Enclosed Topographical Survey based on drawing reference LGL-BWB-00-ZZ-M2-G-0001_Existing_Site_2D_Model' dated 20/06/2024.
6. Enclosed Masterplan based on Pegasus Group drawing dated 18/09/2024 'P24-1200_DE_021_01C ILLUSTRATIVE MASTERPLAN'
7. Surface Water Extents are extracted from the Environment Agency's Risk of Flooding from Surface Water Mapping (Yearly chance of flooding between 2040 and 2060).
8. The proposed design and discharge rate of basins 1 and 2 is based on the infiltration rate of SA101: 0.17640m/hr (4.9x10^{-5}m/s) and SA103: 0.19476m/hr (5.41x10^{-5}m/s) respectively, which is taken from the 3rd result of the soakaway tests that can be found in the PJS report 'PJSG20-01-R02 - Preliminary Permeability Assessment' dated '28/02/2020'.
9. Sewer Locations are approximate and taken from Thames Water Sewer Records and CCTV survey undertaken by Solumn Surveying (Reference: 12862).
10. Due to the site being located within a Source Protection Zone, the LLFA have confirmed that a treatment train is required. Therefore, a treatment train to include tree pits, rain gardens and swales has been incorporated within the drainage strategy.
11. The cross sections shown for the additional SuDs features are taken from 'GreenBlue Urban' drawings. 'GBU 2119' and 'GBU 2121' for Tree Pits and Rain gardens respectively .
12. All basins have been designed to accommodate the 1 in 100-year + 40% critical storm event with a 400mm freeboard. The attenuation calculations has been undertaken using Flood Estimation Handbook (FEH) rainfall data. A Cv value of 1 has been used. A safety factor of 5 has been used for the design. The safety factor has been confirmed with the LLFA.
13. The impermeable area is assumed to be 65% of the developable area. A 10% allowance has been included for urban creep. The primary school and local centre area are assumed to be 70% impermeable. 100% of the SuDS footprints are added to the total impermeable area.
14. All infiltration basins to have minimum 1:4 internal side slopes. Basin forebays and erosion protection should be considered at detailed design.
15. This strategy is a proof of concept only and all details are to be confirmed at the detailed design stage in agreement with all relevant statutory consultees. Do not construct based on this drawing.
16. Sewer easements are subject to confirmation.
17. Foul strategy based on findings of Solumn Surveying Ltd CCTV survey of Thames Water sewers located within site.
18. Tree Root Protection Area's (RPA's) based on drawing reference '11702_P11' by Tyler Grange.
19. The ecologist has advised that SuDS features will be accommodated in some areas of the woodland buffer but outside of the woodland RPA's.

Rev	Date	Details of issue / revision	Drw	Rev
P06	29/04/25	Basins updated to reflect Cv of 1	AS	LR
P05	31/03/25	LLFA Comments	AS	CC
P04	09/12/24	Master plan and calculations updated	AS	LR
P03	04/09/24	Master plan and calculations updated	AS	LR
P02	26/07/24	Preliminary Issue	AS	LR
P01	25/06/24	Preliminary Issue	AS	LR

Issues & Revisions

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Client
RICHBOROUGH

Project Title
LAND TO NORTH OF LITTLE GREEN LANE CROXLEY GREEN

Drawing Title
ILLUSTRATIVE DRAINAGE STRATEGY

Drawn:	A.Shademani		Reviewed:	L.Reeves	
BWB Ref:	233574	Date:	25.06.24	Scale@A1:	1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
233574-BWB-ZZ-XX-D-W-0001	**S2**	**P06**

Appendix 2: Updated Network Calculations

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Design Settings

Rainfall Methodology	FEH-22	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)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	5.410	5.00	59.000	80.974	60.647	1.400
Depth/Area 2	7.060	5.00	57.500	86.298	43.424	1.400

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	360	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	20.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

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

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.17640	Safety Factor	5.0	Invert Level (m)	57.600
Side Inf Coefficient (m/hr)	0.17640	Porosity	1.00	Time to half empty (mins)	941

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	3962.0	3962.0	1.000	5182.0	5182.0	1.400	5699.0	5699.0

Node Depth/Area 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.19476	Safety Factor	5.0	Invert Level (m)	56.100
Side Inf Coefficient (m/hr)	0.19476	Porosity	1.00	Time to half empty (mins)	852

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	5108.0	5108.0	1.000	6591.0	6591.0	1.400	7213.0	7213.0

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
360 minute winter	Depth/Area 1	352	58.579	0.979	635.4	4538.9860	0.0000	OK
360 minute winter	Depth/Area 2	352	57.082	0.982	829.1	5830.2760	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	Depth/Area 1	Infiltration	50.5
360 minute winter	Depth/Area 2	Infiltration	71.0

Design Settings

Rainfall Methodology	FEH-22	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)	Easting (m)	Northing (m)	Depth (m)
Depth/Area 1	5.410	5.00	59.000	80.974	60.647	1.400
Depth/Area 2	7.060	5.00	57.500	86.298	43.424	1.400

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
Rainfall Events	Singular	Skip Steady State	x
FSR Region	England and Wales	Drain Down Time (mins)	360
M5-60 (mm)	20.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.400	Starting Level (m)	
Summer CV	1.000	Check Discharge Rate(s)	x
Winter CV	1.000	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

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

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.17640	Safety Factor	5.0	Invert Level (m)	57.600
Side Inf Coefficient (m/hr)	0.17640	Porosity	1.00	Time to half empty (mins)	941

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	3962.0	3962.0	1.000	5182.0	5182.0	1.400	5699.0	5699.0

Node Depth/Area 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.19476	Safety Factor	5.0	Invert Level (m)	56.100
Side Inf Coefficient (m/hr)	0.19476	Porosity	1.00	Time to half empty (mins)	852

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	5108.0	5108.0	1.000	6591.0	6591.0	1.400	7213.0	7213.0

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
480 minute winter	Depth/Area 1	464	58.452	0.852	439.1	3883.9620	0.0000	OK
360 minute winter	Depth/Area 2	352	56.949	0.849	722.5	4958.3500	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
480 minute winter	Depth/Area 1	Infiltration	48.9
360 minute winter	Depth/Area 2	Infiltration	68.8