

Reference: ST-2981/210802-LLFA Response

Response to the LLFA's comments to
Planning Application Number 210965

This document is prepared in support of a planning application for the proposed development of Land Behind Broadfields in Wivenhoe, Essex. This document seeks to provide further information relating to the Lead Local Flood Authority (LLFA) comments, dated 22nd July 2021.

The following information has been provided in support of this document:

- **Appendix A:** Micro Drainage Output Files

The objections raised by the LLFA and Stomor's related replies are as follows:

"A climate change allowance of 40% should be applied to 100 year critical storm for modelling of the basin and the drainage network as per LLFA Essex SuDS guidance whilst the calculations provided in the applicant's response to the LLFA shows application of 30% climate change allowance."

The Micro Drainage model has been updated for a 40% allowance for climate change. The output files demonstrating that the system provides sufficient storage during the 1 in 100 year storm event plus 40% allowance for climate change is provided in Appendix A.

"At least 300mm freeboard should be provided in the basin for critical 100 year plus 40% climate change event."

The Micro Drainage output files identify a freeboard of 300mm within the basin during the 1 in 100 year storm event with a 40% allowance for climate change. Extract below:

Pipe Number	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Infiltration Vol (m ³)	Total Infil. Vol (m ³)	Maximum Vol (m ³)	Pipe Flow (l/s)	Status
1.003	S6	15 minute 100 year Winte	31.764	31.182	1.390	0.000	1.42				7.679	312.6	SURCHARGED
1.004	S7	15 minute 100 year Winte	31.731	31.038	1.303	0.000	1.45				6.014	361.3	SURCHARGED
1.005	S8	15 minute 100 year Winte	31.590	30.826	1.196	0.000	1.14				8.511	409.1	SURCHARGED
1.006	S9	15 minute 100 year Winte	31.222	30.645	1.144	0.000	1.47				11.790	460.6	SURCHARGED
4.000	S10	15 minute 100 year Winte	30.868	30.624	0.824	0.000	0.87				1.265	60.7	FLOOD RISK
4.001	S11	15 minute 100 year Winte	31.039	30.549	0.877	0.000	0.66				3.924	113.3	SURCHARGED
1.007	S12	15 minute 100 year Winte	31.209	30.400	0.964	0.000	1.59				9.508	610.8	SURCHARGED
1.008	S13	15 minute 100 year Winte	31.264	30.163	0.788	0.000	1.66				8.642	661.7	SURCHARGED
1.009	S14	1440 minute 100 year Winte	31.272	30.017	0.712	0.000	0.12				10.623	48.5	SURCHARGED
5.000	S16	15 minute 100 year Winte	31.336	30.538	0.338	0.000	0.97				0.716	74.7	SURCHARGED
5.001	S17	15 minute 100 year Winte	31.203	30.437	0.347	0.000	1.47				1.807	147.6	SURCHARGED
5.002	S18	1440 minute 100 year Winte	30.912	30.017	0.211	0.000	0.04				2.875	10.6	SURCHARGED
1.010	S19	1440 minute 100 year Winte	31.222	30.017	0.743	0.000	0.07				10.326	61.9	SURCHARGED
6.000	S20	1440 minute 100 year Winte	30.570	30.017	0.647	0.000	0.05				1.066	3.5	SURCHARGED
6.001	S21	1440 minute 100 year Winte	30.844	30.017	0.732	0.000	0.06				3.236	6.6	SURCHARGED
1.011	S22	1440 minute 100 year Winte	30.876	30.017	0.890	0.000	0.06				44.907	71.5	SURCHARGED
7.000	S23	1440 minute 100 year Winte	30.276	30.017	0.925	0.000	0.02				2.421	3.5	FLOOD RISK
1.012	S24	1440 minute 100 year Winte	30.805	30.017	1.217	0.000	0.10				23.782	78.0	SURCHARGED
8.000	S25	1440 minute 100 year Winte	30.511	30.017	1.005	0.000	0.03				1.471	3.4	SURCHARGED
1.013	S26	1440 minute 100 year Winte	30.686	30.017	1.302	0.000	0.15				28.135	84.6	SURCHARGED
1.014	Basin	1440 minute 100 year Winte	30.350	30.017	2.117	0.000	0.12		0.000	0.000	2697.412	3.8	SURCHARGED
1.015	F/C	1440 minute 100 year Winte	30.300	27.661	-0.239	0.000	0.09				0.392	3.8	OK

The above demonstrates that the proposed drainage system has sufficient capacity to cater for the 1 in 100 year storm event plus 40% climate change, and provides 300mm freeboard during the same event. Therefore, it is considered that the information required by the LLFA has been provided for them to remove their holding objection to the application.



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Micro Drainage		Network 2020.1



Existing Network Details for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	56.894	0.285	199.6	0.129	5.00	0.0	0.600	o	300	Pipe/Conduit
2.000	12.781	0.060	213.0	0.129	5.00	0.0	0.600	o	300	Pipe/Conduit
1.001	46.862	0.231	202.9	0.129	0.00	0.0	0.600	o	525	Pipe/Conduit
3.000	28.687	0.691	41.5	0.129	5.00	0.0	0.600	o	300	Pipe/Conduit
1.002	21.380	0.117	182.7	0.129	0.00	0.0	0.600	o	525	Pipe/Conduit
1.003	14.401	0.057	252.6	0.129	0.00	0.0	0.600	o	525	Pipe/Conduit
1.004	26.193	0.105	249.5	0.129	0.00	0.0	0.600	o	525	Pipe/Conduit
1.005	32.331	0.129	250.6	0.129	0.00	0.0	0.600	o	600	Pipe/Conduit
1.006	16.111	0.065	247.9	0.129	0.00	0.0	0.600	o	600	Pipe/Conduit
4.000	25.696	0.128	200.8	0.129	5.00	0.0	0.600	o	300	Pipe/Conduit
4.001	24.030	0.236	101.8	0.129	0.00	0.0	0.600	o	375	Pipe/Conduit
1.007	18.451	0.061	302.5	0.129	0.00	0.0	0.600	o	675	Pipe/Conduit
1.008	20.972	0.070	299.6	0.129	0.00	0.0	0.600	o	675	Pipe/Conduit
1.009	9.310	0.031	300.3	0.129	0.00	0.0	0.600	o	750	Pipe/Conduit
5.000	16.482	0.110	149.8	0.129	5.00	0.0	0.600	o	300	Pipe/Conduit
5.001	28.395	0.284	100.0	0.129	0.00	0.0	0.600	o	300	Pipe/Conduit
5.002	27.353	0.751	36.4	0.129	0.00	0.0	0.600	o	375	Pipe/Conduit
1.010	58.684	0.147	399.2	0.129	0.00	0.0	0.600	o	900	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	30.050	0.129	0.0	1.11	78.4
2.000	29.900	0.129	0.0	1.07	75.9
1.001	29.615	0.387	0.0	1.57	339.6
3.000	30.300	0.129	0.0	2.45	173.0
1.002	29.384	0.645	0.0	1.65	358.0
1.003	29.267	0.774	0.0	1.40	304.1
1.004	29.210	0.903	0.0	1.41	306.0
1.005	29.030	1.032	0.0	1.53	433.6
1.006	28.901	1.161	0.0	1.54	436.1
4.000	29.500	0.129	0.0	1.11	78.2
4.001	29.297	0.258	0.0	1.80	198.3
1.007	28.761	1.548	0.0	1.50	537.4
1.008	28.700	1.677	0.0	1.51	540.0
1.009	28.555	1.806	0.0	1.61	711.1
5.000	29.900	0.129	0.0	1.28	90.6
5.001	29.790	0.258	0.0	1.57	111.1
5.002	29.431	0.387	0.0	3.01	332.5
1.010	28.374	2.322	0.0	1.56	993.7

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Existing Network Details for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
6.000	19.570	0.085	230.2	0.129	5.00	0.0	0.600	o	300	Pipe/Conduit
6.001	39.462	0.158	249.8	0.129	0.00	0.0	0.600	o	375	Pipe/Conduit
1.011	17.591	0.327	53.8	0.129	0.00	0.0	0.600	o	900	Pipe/Conduit
7.000	54.222	0.217	249.9	0.129	5.00	0.0	0.600	o	450	Pipe/Conduit
1.012	33.812	0.085	397.8	0.129	0.00	0.0	0.600	o	900	Pipe/Conduit
8.000	32.323	0.324	99.8	0.129	5.00	0.0	0.600	o	300	Pipe/Conduit
1.013	17.073	0.042	406.5	0.129	0.00	0.0	0.600	o	900	Pipe/Conduit
1.014	47.628	0.000	0.0	0.170	0.00	0.0	0.600	o	300	Pipe/Conduit
1.015	63.952	0.100	639.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
6.000	29.070	0.129	0.0	1.03	72.9
6.001	28.910	0.258	0.0	1.14	126.1
1.011	28.227	2.709	0.0	4.28	2721.0
7.000	28.642	0.129	0.0	1.28	203.8
1.012	27.900	2.967	0.0	1.56	995.5
8.000	28.712	0.129	0.0	1.57	111.3
1.013	27.815	3.225	0.0	1.55	984.7
1.014	27.600	3.395	0.0	0.00	0.0
1.015	27.600	3.395	0.0	0.61	43.4



PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	S1	31.880	30.050	1.530	Open Manhole	1200
2.000	o	300	S2	31.800	29.900	1.600	Open Manhole	1200
1.001	o	525	S3	31.800	29.615	1.660	Open Manhole	1500
3.000	o	300	S4	31.858	30.300	1.258	Open Manhole	1200
1.002	o	525	S5	31.744	29.384	1.835	Open Manhole	1500
1.003	o	525	S6	31.764	29.267	1.972	Open Manhole	1500
1.004	o	525	S7	31.731	29.210	1.996	Open Manhole	1500
1.005	o	600	S8	31.590	29.030	1.960	Open Manhole	1500
1.006	o	600	S9	31.222	28.901	1.721	Open Manhole	1500
4.000	o	300	S10	30.868	29.500	1.068	Open Manhole	1200
4.001	o	375	S11	31.039	29.297	1.367	Open Manhole	1500
1.007	o	675	S12	31.209	28.761	1.773	Open Manhole	1500
1.008	o	675	S13	31.264	28.700	1.889	Open Manhole	1500
1.009	o	750	S14	31.272	28.555	1.967	Open Manhole	1800
5.000	o	300	S16	31.336	29.900	1.136	Open Manhole	1200
5.001	o	300	S17	31.203	29.790	1.113	Open Manhole	1200
5.002	o	375	S18	30.912	29.431	1.106	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	56.894	199.6	S3	31.800	29.765	1.735	Open Manhole	1500
2.000	12.781	213.0	S3	31.800	29.840	1.660	Open Manhole	1500
1.001	46.862	202.9	S5	31.744	29.384	1.835	Open Manhole	1500
3.000	28.687	41.5	S5	31.744	29.609	1.835	Open Manhole	1500
1.002	21.380	182.7	S6	31.764	29.267	1.972	Open Manhole	1500
1.003	14.401	252.6	S7	31.731	29.210	1.996	Open Manhole	1500
1.004	26.193	249.5	S8	31.590	29.105	1.960	Open Manhole	1500
1.005	32.331	250.6	S9	31.222	28.901	1.721	Open Manhole	1500
1.006	16.111	247.9	S12	31.209	28.836	1.773	Open Manhole	1500
4.000	25.696	200.8	S11	31.039	29.372	1.367	Open Manhole	1500
4.001	24.030	101.8	S12	31.209	29.061	1.773	Open Manhole	1500
1.007	18.451	302.5	S13	31.264	28.700	1.889	Open Manhole	1500
1.008	20.972	299.6	S14	31.272	28.630	1.967	Open Manhole	1800
1.009	9.310	300.3	S19	31.222	28.524	1.948	Open Manhole	1800
5.000	16.482	149.8	S17	31.203	29.790	1.113	Open Manhole	1200
5.001	28.395	100.0	S18	30.912	29.506	1.106	Open Manhole	1500
5.002	27.353	36.4	S19	31.222	28.680	2.167	Open Manhole	1800



PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.010	o	900	S19	31.222	28.374	1.948	Open Manhole	1800
6.000	o	300	S20	30.570	29.070	1.200	Open Manhole	1200
6.001	o	375	S21	30.844	28.910	1.559	Open Manhole	1500
1.011	o	900	S22	30.876	28.227	1.749	Open Manhole	1800
7.000	o	450	S23	30.276	28.642	1.184	Open Manhole	1500
1.012	o	900	S24	30.805	27.900	2.005	Open Manhole	1800
8.000	o	300	S25	30.511	28.712	1.499	Open Manhole	1200
1.013	o	900	S26	30.686	27.815	1.971	Open Manhole	1800
1.014	o	300	Basin	30.350	27.600	2.450	Open Manhole	1800
1.015	o	300	F/C	30.300	27.600	2.400	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.010	58.684	399.2	S22	30.876	28.227	1.749	Open Manhole	1800
6.000	19.570	230.2	S21	30.844	28.985	1.559	Open Manhole	1500
6.001	39.462	249.8	S22	30.876	28.752	1.749	Open Manhole	1800
1.011	17.591	53.8	S24	30.805	27.900	2.005	Open Manhole	1800
7.000	54.222	249.9	S24	30.805	28.425	1.930	Open Manhole	1800
1.012	33.812	397.8	S26	30.686	27.815	1.971	Open Manhole	1800
8.000	32.323	99.8	S26	30.686	28.388	1.998	Open Manhole	1800
1.013	17.073	406.5	Basin	30.350	27.773	1.677	Open Manhole	1800
1.014	47.628	0.0	F/C	30.300	27.600	2.400	Open Manhole	1200
1.015	63.952	639.5	S29	29.114	27.500	1.314	Open Manhole	1200

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.015	S29	29.114	27.500	0.000	1200	0

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Online Controls for Surface Network 1


Hydro-Brake® Optimum Manhole: Basin, DS/PN: 1.014, Volume (m³): 16.7

Unit Reference	MD-SHE-0077-4000-2600-4000
Design Head (m)	2.600
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	77
Invert Level (m)	27.600
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.600	4.0	Kick-Flo®	0.682	2.2
Flush-Flo™	0.335	2.7	Mean Flow over Head Range	-	3.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.2	0.800	2.3	2.000	3.5	4.000	4.9	7.000	6.4
0.200	2.6	1.000	2.6	2.200	3.7	4.500	5.2	7.500	6.6
0.300	2.7	1.200	2.8	2.400	3.8	5.000	5.4	8.000	6.8
0.400	2.7	1.400	3.0	2.600	4.0	5.500	5.7	8.500	7.0
0.500	2.6	1.600	3.2	3.000	4.3	6.000	5.9	9.000	7.2
0.600	2.4	1.800	3.4	3.500	4.6	6.500	6.1	9.500	7.3

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Storage Structures for Surface Network 1

Complex Manhole: Basin, DS/PN: 1.014

Tank or Pond

Invert Level (m) 27.600

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	602.3	0.601	873.3	1.601	1354.8
0.600	754.3	1.600	1211.5	2.750	1824.5

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000	Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0	MADD Factor * 10m ³ /ha Storage 2.000
Hot Start Level (mm) 0	Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500	Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000	

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
Region England and Wales	Ratio R 0.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1	15 Winter	100	+40%	100/15 Summer				31.593	1.243
2.000	S2	15 Winter	100	+40%	100/15 Summer				31.503	1.303
1.001	S3	15 Winter	100	+40%	100/15 Summer				31.407	1.267
3.000	S4	15 Winter	100	+40%	100/15 Summer				31.502	0.902
1.002	S5	15 Winter	100	+40%	100/15 Summer				31.287	1.378
1.003	S6	15 Winter	100	+40%	100/15 Summer				31.182	1.390
1.004	S7	15 Winter	100	+40%	100/15 Summer				31.038	1.303
1.005	S8	15 Winter	100	+40%	100/15 Summer				30.826	1.196
1.006	S9	15 Winter	100	+40%	100/15 Summer				30.645	1.144
4.000	S10	15 Winter	100	+40%	100/15 Summer				30.624	0.824
4.001	S11	15 Winter	100	+40%	100/15 Summer				30.549	0.877
1.007	S12	15 Winter	100	+40%	100/15 Summer				30.400	0.964
1.008	S13	15 Winter	100	+40%	100/15 Summer				30.163	0.788
1.009	S14	1440 Winter	100	+40%	100/15 Summer				30.017	0.712
5.000	S16	15 Winter	100	+40%	100/15 Summer				30.538	0.338
5.001	S17	15 Winter	100	+40%	100/15 Summer				30.437	0.347
5.002	S18	1440 Winter	100	+40%	100/15 Winter				30.017	0.211
1.010	S19	1440 Winter	100	+40%	100/15 Summer				30.017	0.743
6.000	S20	1440 Winter	100	+40%	100/15 Summer				30.017	0.647
6.001	S21	1440 Winter	100	+40%	100/15 Summer				30.017	0.732
1.011	S22	1440 Winter	100	+40%	100/15 Summer				30.017	0.890
7.000	S23	1440 Winter	100	+40%	100/15 Summer				30.017	0.925
1.012	S24	1440 Winter	100	+40%	100/15 Summer				30.017	1.217
8.000	S25	1440 Winter	100	+40%	100/15 Summer				30.017	1.005
1.013	S26	1440 Winter	100	+40%	100/15 Summer				30.017	1.302
1.014	Basin	1440 Winter	100	+40%	100/15 Summer				30.017	2.117
1.015	F/C	1440 Winter	100	+40%					27.661	-0.239



Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Volume (m ³)	Flow / Overflow Cap. (l/s)				
1.000	S1	0.000	0.76		56.6	FLOOD RISK	
2.000	S2	0.000	0.91		55.9	FLOOD RISK	
1.001	S3	0.000	0.53		159.1	SURCHARGED	
3.000	S4	0.000	0.44		69.0	SURCHARGED	
1.002	S5	0.000	1.01		265.1	SURCHARGED	
1.003	S6	0.000	1.42		312.6	SURCHARGED	
1.004	S7	0.000	1.45		361.3	SURCHARGED	
1.005	S8	0.000	1.14		409.1	SURCHARGED	
1.006	S9	0.000	1.47		460.6	SURCHARGED	
4.000	S10	0.000	0.87		60.7	FLOOD RISK	
4.001	S11	0.000	0.66		113.3	SURCHARGED	
1.007	S12	0.000	1.59		610.8	SURCHARGED	
1.008	S13	0.000	1.66		661.7	SURCHARGED	
1.009	S14	0.000	0.12		48.5	SURCHARGED	
5.000	S16	0.000	0.97		74.7	SURCHARGED	
5.001	S17	0.000	1.47		147.6	SURCHARGED	
5.002	S18	0.000	0.04		10.6	SURCHARGED	
1.010	S19	0.000	0.07		61.9	SURCHARGED	
6.000	S20	0.000	0.05		3.5	SURCHARGED	
6.001	S21	0.000	0.06		6.6	SURCHARGED	
1.011	S22	0.000	0.06		71.5	SURCHARGED	
7.000	S23	0.000	0.02		3.5	FLOOD RISK	
1.012	S24	0.000	0.10		78.0	SURCHARGED	
8.000	S25	0.000	0.03		3.4	SURCHARGED	
1.013	S26	0.000	0.15		84.6	SURCHARGED	
1.014	Basin	0.000	0.12		3.8	SURCHARGED	
1.015	F/C	0.000	0.09		3.8	OK	