This document outlines the response to the 'Pre-Application Query: Tully De'Ath Flood Risk Assessment for The Hyde Group; Further Evidence Review' written by Ray Drabble of West Sussex County Council (dated 28th February 2017)

1.1

Tully De'Ath have taken the most onerous set of conditions; assuming no infiltration and taking the worst case scenario in terms of storm events; climate change and tide lock and have demonstrated that the development can be delivered.

For this scenario we have undertaken further detailed analysis and the results show a reduction from the original storage requirement of 11,950m³ to a revised figure of 8,990m³ using the Micro Drainage design suite allowing detail design of a fully integrated storm water drainage system.

In practice infiltration is likely to be available which will contribute to the reduction in the volume of storage required.

Results of insitu infiltration testing undertaken on 7th and 8th of March 2017 have shown that infiltration rates are variable across the site with values ranging between $3.18x10^{-5}$ to $2.6x10^{-6}$m/s. These infiltration rates are suitable for pervious pavement design.

Additional testing will be undertaken as further areas of the site are deigned to produce 'area specific' solutions.

In response to concerns stated later in this Pre-Application Query response (Section 1.4) revised detention basin base levels have been derived using both Tully De'Ath and LLFA storage volume figures

1.2

The raising of levels in the south west corner of the site relates to finished floor levels to 3 or possibly 4 houses (and associated garages) and not general ground levels in that area.

The general ground levels around the buildings will remain as existing and it should be noted that in accordance with the Flood Risk Assessment there will also be opportunity for any 'exceedance' surface water to move freely within the sub-floor void therefore not increasing the risk of flooding to adjacent existing properties. Under these circumstances it is considered that the boundary condition remains as existing.

However, if during the detailed design process, any issues arise at specific locations these can be overcome by the introduction of localised bunds, probably no more than 200-300mm high to protect adjacent dwellings.

1.3

The ground water level data for WLS108 is included within the Excel file previously issued to WSCC. For the ease of reference, we have added the data to Table 1.

Date	Time	Level 107AOD	Level 108AOD	Level109AOD	Level5AOD
13/01/2017	02:00:00	1.364	0.929 - #	1.374	1.316
20/11/2016	06:00:00	1.31	0.751	1.262	1.267
14/01/2017	03:00:00	1.296	0.681	1.219	1.335
12/01/2017	14:00:00	1.271	0.663	1.219	1.236
17/11/2016	04:00:00	1.201	0.571	1.072	0.94
20/11/2016	07:00:00	1.199	0.840	1.258	0.906
16/10/2016	14:00:00	1.185	0.429	0.979	1.167
19/10/2016	16:00:00	1.184	0.380	0.9	1.271
12/01/2017	13:00:00	1.183	0.451	1.001	1.552
16/11/2016	15:00:00	1.179	0.463	1.052	1.096
13/01/2017	03:00:00	1.179	0.997 - #	1.34	0.91
17/11/2016	16:00:00	1.177	0.513	1.072	0.996
16/11/2016	03:00:00	1.17	0.479	1.077	0.962
17/11/2016	03:00:00	1.167	0.367	0.794	1.345
14/01/2017	04:00:00	1.16	0.885	1.249	0.891
17/10/2016	15:00:00	1.143	0.466	0.989	1.015
17/10/2016	02:00:00	1.14	0.358	0.83	1.285

Table 1; Selected analyses of borehole data

= same tide event

1.4.1

The detention basin sits directly over WLS108 where high ground water levels have consistently been below the 0.9m A.O.D. Over the monitoring period there was only one 3-hour occasion where the ground water levels were recorded above 0.9m A.O.D., which reached a level of 0.997m A.O.D.

However, with reference to point 1.1 it is proposed to raise the base level of the detention basin to 1.20m A.O.D. (based on the Tully De'Ath storage calculation of 8,990m^3) or 1.35m A.O.D. (based on the WSCC storage calculation of 6,853m^3). In addition, the detention basin could be lined which will add further protection to infiltration from very high ground water events.

1.4.2

It is recognised that there a time lag between high tide level and high ground water level; however, all the ground water levels are recorded on an hourly basis across the site. The data shows that high water levels recorded in WLS108 are typically 1 hour later than WSL107 & WLS109

1.4.3

It is agreed there is a tidal influence across the site, although it does vary across the development area, however it does not affect the proposed drainage strategy for the site.

1.4.4

The drainage strategy has been developed with the main aim of providing pervious pavements so that all external hardstanding areas such as access roads and car parking would infiltrate into the natural soils with the aim of replicating existing conditions and achieving the key message contained in the CIRIA SuDS Manual 2015 *"SuDS should be designed to maximise the opportunities and benefits that can be secured from surface water management".* In the occurrence of exceedance events swales are provided adjacent to these areas to perform a dual function of infiltration and also conveyance to the detention basin(s).

It was also considered that where localised areas would possibly not allow for infiltration the pervious pavement could be lined with an impermeable membrane and used as a conveyance system discharging to the detention basin(s).

It is important to reiterate that the current drainage strategy allows for both options in line with SuDS Manual which offers guidance on the selection of pervious pavements (ref Chapter 20 and Table 20.1) i.e. a Type A 'total infiltration' system where ground conditions allow or a Type C 'no infiltration' system where infiltration is not suitable

The High Groundwater Scenario (No Infiltration) assessment assumes a Type C pervious pavement.

1.4.5

This statement does not accurately reflect the site conditions/constraints. It is possible to set the detention basin base level lower than 1.3m A.O.D. However, based on WSCC storage calculations of 6,853m^3 the detention basin could be set at 1.35m A.O.D. which meets their requirements.

1.5

The areas of surface ponding are known to us and future layouts will take this into account. These areas will be set aside for open space.

1.6

This point is not referenced in the letter.

1.7

Ground water monitoring has been ongoing for over 12 months on the eastern side of the site, which started in December 2015. Based upon the Met Office data for the south coast area the annual rainfall for 2012 & 2014 was recorded as above average, and average for 2013 & 2015. In addition, the rainfall in January of 2016 was also above the normal levels. As a consequence, it would be reasonable to assume that the water levels recorded at the start of the monitoring period would be at or above the seasonal average. In reviewing the ground water levels over the 12-month period levels do not appear to have dropped.

The monitoring across the site will continue and will be used to inform the design moving forward as LLFA have established.

1.8

With reference to Chapter 8 within our Flood Risk Assessment, permeable paving does provide sufficient surface water treatment to comply with the guidance within Chapter 26 of the SuDS Manual

1.9

The swales have been incorporated in the drainage strategy as an additional benefit to the principal of either 'total infiltration' system or a 'no infiltration' system for the external hardstanding areas. If the 'total infiltration' system is utilised the pervious pavement is designed to hold the required storm event within the sub-base of the road/parking whilst infiltration occurs. The 'no infiltration' system is designed to convey the surface water to the detention basin(s) within the sub-base.

Both systems work independently without the need for swales, the reason for their inclusion is to provide an additional element of protection for either attenuation or conveyance for some exceedance events.

It is therefore considered that as the swales do not form a fundamental part of the drainage network a departure from the guidance relating to the longitudinal gradient is appropriate.

2.1 – 2.6

Information updated in Appendix A – Flood Estimation Report.

In their letter dated 28/02/17 the LLFA dispute the catchments used in the modelling as being representative of the inputs to the Lancing Brooks (2.2), and requests robust evidence be prepared to support the extent of the model domain used in this study (2.5).

To this end additional modelling has been undertaken to sensitivity test the assumption on catchment and drainage paths as discussed in section 2.1 to 2.6 of the letter. This is outlined in the updated Flood Estimation Report. Notably Sections 1, 2 and Appendix B have been updated to provide more evidence for the approach taken.

To test the assumption of contributing area for the direct rainfall approach a larger extent model was developed. The Design domain was increased in area from 6.7km^2 to approximately 11.6km^2. Both the design model domain and the sensitivity model domain were run 2D only (without any embedded 1D channels or culverts) for the 1:100 AEP event with runoff based on SPRHOST throughout the active domain.

This sensitivity test was undertaken to identify flow paths into the contributing area that may not have been accounted for within the original design domain.

Two of these flow paths have been identified to drain outside of the previous domain.

Two other flow paths have been identified to drain to inside the previous domain. Of these, the southern flow path flowing Monks Avenue, has potential to contribute a small volume of additional flow to the top of Brook in this location. This brook drains to the south and then passes east across the study site. Given the small area concerned and the noted presence of urban drainage infrastructure in this area connected to soakaways (Chapter 5 of Surface

Water Management Plan) it is considered that the additional volume of flow this are may contribute to flooding at the site to be negligible.

The second red flow path runs parallel to the south of the A27 carriageway. This flow path runs east and crosses Marsh Barn Lane where it would be picked up by the network of brooks to the west of Shoreham Airport. These brooks continue to drain east and outfall to the estuary. They do not flow though study site, therefore their omission from the model domain is considered immaterial.

In conclusion, it is considered that the design model domain is appropriate of the study site.

3.0

Re: 1.7 - observation answered in section 1.4 of revised report.

Re: 1.8 - observation answered in section 1.5 of revised report.

Re: 2.1-2.2 – note added in section 2.1 of revised report.

Re: 5.2 – information updated in section 5.2 of revised report.

4.1

Noted.

4.2

Noted.

In summary, having reviewed the points raised in the letter, additional analysis and modelling has been undertaken.

The results demonstrate that there is a viable technical solution to develop the site for residential housing without increasing the risk of flooding within and beyond the site.