POLYTUNNEL DEVELOPMENT; BARON'S PLACE FARM.
MEREWORTH (ME18 5NF)
PLANNING APPLICATION TM/08/03739/FL
FLOOD RISK ASSESSMENT.

1 GENERAL.

1.1 The following notes have been prepared in response to questions raised by Simon Evans of Tonbridge/Malling District Committee (Ref Doc 1: copy attached of e-mail of 5th December). He is seeking Branch Office views with respect to the effectiveness of the flood regulation measures proposed by the Applicant as a means of mitigating the impact of rainfall runoff from a large area of polytunnel cover.

1.2 Our comments are based on our analysis of the flood risk assessment of August 2009 carried out by Consultants JDIH Envireau on behalf of the Applicants, Hugh Lowe Farms Ltd Mereworth.

1.3 This is a retrospective application for an existing polytunnel (PT) development at Baron's Place Farm; a total cultivated area of 561 ha, of which the maximum polytunnel coverage in any one year will not exceed 171 ha. (Ref Map 1 – copy of consultants' Map of 26/11/08). All polytunnel covers are removed during the winter months.

2 SITE CHARACTERISTICS.

2.1 The development is centred at approx TQ 657525; extending from Kings Hill, south west through Mereworth to W. Peckham and south through Nettlestead to E. Peckham. Elevations range from 142 to 22m AOD with gradients varying from 0.1° to 5.2°. There are two main natural drainage channels within the area; both tributary to the River Medway system.

Local geology comprises:-
Head, Brickearth and Alluvium.
Hythe Beds
Atherfield Clay
Weald Clays and Sandstones
(Ref Geological Survey Sheet 287 (Sevenoaks)).

2.2 Soil types are classified in accordance with the Soil Survey of England and Wales and four types have been described (Ref: Map II).

- Category 571c – Malling Cretaceous sand, loam and limestone; well drained, non-calcareous fine loamy soils over limestone at depth.
- Category 573a – Waterstock. River Terrace Drift.
- Category 581e – Marlow. Plateau and river terrace deposits; well drained fine loam over clayey soils. Some coarse loam over clayey soils with slowly permeable, seasonally waterlogged silt over clayey soils.
- Category 711e – Wickham 1. Drift over cretaceous mudstone, slowly permeable, seasonally waterlogged silt over clayey soils.

Map I shows the full extent of the land selected for polytunnel cultivation and Map III gives some indication of the situation of the plots relative to the local land drainage and catchment divides. The report also includes larger scale maps detailing the site drainage and slope contours.

2.3 The consultants have concluded, on the basis of their field surveys, that the combination of soil characteristics, natural vegetation and slope contours makes for "*a relatively low runoff velocity system*". As shown in Map III there appear to be no development areas falling within the indicative 1000 year Flood Zone (zone 2); all of the PT covered sites lying within zone 1 (>1000 year). On this basis the consultants conclude that the development satisfies the sequential test.

3 RAINFALL/RUNOFF MANAGEMENT.

3.1 The polytunnels are used for the propagation of soft fruits (currently strawberries and raspberries) by one of two methods: in-ground or table-top. In the former case, rainfall on the PT covers drains to a system of grass and straw-lined channels (swales) following the line of the tunnel leg stands (referred to as 'leg rows'). Sand bags placed at intervals across each swale create a stepped storage system allowing sufficient head and retention time to induce infiltration and reduce the residual runoff from each PT to a rate equal to or less than that which would have obtained for the same area in its greenfield state. (The Defra / Environment Agency guidance for calculating Long Term Storage has adopted a standard maximum greenfield runoff rate of 2 litres/sec/ha).

3.2 Conditions in the table-top system differ to the extent that irrigation is confined to the growing trays, and there is no wetting of the soil. The moisture content of the soil beneath the PT covers is therefore generally lower than that of the surrounding uncovered grassland. The Applicants conclude from this that as the covered areas do not need to be actively drained, there is no need for the additional retention storage provided by the leg row swales used for in-ground cultivation. Rainfall is therefore allowed to accumulate in the leg rows and subsequently runoff – following the natural gradient as overland flow beneath the PT covers; the grass cover providing sufficient retention to induce infiltration and reduce flow velocities to greenfield rates. Where the PT alignment is less than 45º to the natural slope, additional runoff control is provided by "restrictors" placed across the line of the leg row stands to divert flow beneath the PT covers. Runoff from both in-ground and table-top PTs discharges via site drains which in turn connect with hedge row ditches or tree-lined field boundaries. The consultants report that the PTs have been in place for "several years" with no recorded instances of flooding or soil loss.

4 SUMMARY OF FLOOD RISK ASSESSMENTS.

4.1 The objective of the consultants' assessment is to demonstrate that the amount and rate of runoff from the PT area will not exceed that arising from the same area in its uncovered 'greenfield' state. Assessments have been carried out in accordance with Defra/EA Technical Report W5 – 074/A/TR1; *User Guide to Preliminary Rainfall Runoff Management for Developments (September 2005)*. The guide is compliant with PPG 25 and applies to the management of storm water drainage, and to assist in sizing the control and storage elements. Input, storage and runoff calculations are carried out for each soil type and topographic setting; and also take account of the installed site drainage and natural surface water courses together with any collection and storage facilities.

4.2 The assessment comprises the evaluation of three main functions:-

- Conveyance of storm water on site
- Treatment of storm water runoff (not summarised in this note)
- Storm water storage.

Calculation of the long term storage requirement has been carried out for a 6 hour, 1 in 100 year storm event (plus 20% for climate change) as outlined in PPS 25 and in accordance with EA/Defra Tech Report WS – 074/A/TR/1. Defra/EA also specify a limiting discharge of 2 litres/sec/ha for runoff from the site and the Applicant is required to show that sufficient on-site storage has been created to ensure that this rate is not exceeded under the design storm conditions.

4.3 The minimum additional storage required (as m^3/ha of PT coverage) is given by the expression:-

V = R x SF x I

Where :-

V = additional long term storage volume m^3/ha,

R = rainfall mm (100 year 6 hour storm),

SF = long term storage factor (derived from *EA Tech. Report W5 – 074/A/TR/1 Fig 10* – copy attached) expressed as m^3/ha/mm.

I = ratio of impermeable PT cover to total area.

The Consultants' report includes worked examples for the calculation of the long term volume required for leg row swales on various soil classes. The following is an example for WRAP soil class 3 (soil zone 711e – slowly permeable silts over clay soils):-

In V = R x SF x I

R = 63mm

SF = 4.4 (Ref TRW5 Fig 10 using the curve for SOIL 3 against an impermeability ratio of 84.7)

I = 84.7

Hence

V = 63 x 4.4 x 84.7 = <u>235 m^3/ha</u> (which implies an infiltration total of 630 – 235 = 395m^3)

V represents the <u>potential</u> storage requirement, assuming zero infiltration via the leg row swales and zero discharge, from the PT area during the period of the

storm. In the worked example, actual infiltration in the leg rows is estimated, on the basis of field trials, at 62 m^3/ha and it is assumed that runoff from the PT area will be controlled at a maximum of 2 litres/sec/ha; equivalent to a cumulative total of 43m^3

Hence the final net storage requirement (S) can be given as:-
S = 235 – (62 + 43) = <u>130 m^3</u>

5 CONSULTANTS' CONCLUSIONS.

5.1 In their report the consultants conclude that the assessment "*has demonstrated that the use of polytunnels at Baron's Place Farm will not have a detrimental impact on drainage and flooding, providing that flow restrictions in the form of dams are provided within the polytunnel leg row swales to accommodate the additional storage requirement*".

5.2 They add that "*it is important that the drainage system is actively managed to reduce flow velocities and provide storage in the leg row swales. With active water management, runoff rates for storm events will be equivalent to or less than the 'Greenfield' runoff rate*".

5.3 They also conclude that the development is considered to be appropriate for Flood Zone 1 (Ref Tables D2 and D3 PPS 25) insofar as the polytunnels "*will remain operational and safe during times of flood; will result in no net loss of flood-plain storage; will not increase the flood risk elsewhere*". And flow restrictors within the leg row swales "*will mitigate the potential for localised flooding during future storm events.*"

6 PROTECT KENT'S CONCLUSIONS AND RECOMMENDATIONS.

6.1 The effectiveness of the drainage management system rests, at least, in part, on the accuracy of the estimates of natural infiltration rates obtained from the field trials. We would need to take expert opinion but my initial impression is that the estimates, ranging from approx. 0.012 to 0.025mm/sec, seem to be on the high side; notwithstanding that the lowest "worse case" values were selected from the tests carried out at each of the 4 representative sites. Until verified, there must remain some doubt as to whether these give us a true picture of the variations across the development area; amounting as it does to just one sample per soil zone.

6.2 Also, for any given site, actual rates of infiltration can vary on a daily, seasonal or annual basis; and wide variations can be recorded for a single storm event, depending on the prevailing soil moisture content and water table level. A 'wetted' top layer can, for example, create a strong capillary potential supplementing the gravitational force; and this can give an erroneously high infiltration capacity reading. Conversely, for storms of long duration, any colloids present in the soil are likely to swell and progressively reduce the infiltration rate; and the question then arises as to whether the relatively short tests carried out at the sample sites (with durations of between 74 and 108 minutes) would necessarily replicate such conditions.

6.3 I would recommend therefore that the results from the field trials be referred for specialist opinion. If the tests are shown to have produced unrepresentatively high infiltration capacity values, the corresponding estimates of the required long term storage would need to be increased accordingly. In this event, a case could be made for the creation of fully instrumented demonstration plots, (one for each Soil Zone) incorporating a representative section of paired polytunnels with facilities for simulating the equivalent of a 100 year 6 hour storm and measuring the resultant runoff from the plot for a range of soil moisture levels.

6.4 The consultants have referred to the need for effective management and this must be a pre-condition for planning consent. There should be clear, unambiguous instructions relating to the monitoring of site conditions and the routine maintenance of all storage and drainage facilities including the individual swales and associated water retention structures; the objective being to ensure that the full storage and water conveyance capacity of the development site is serviced to the standard required to sustain the greenfield status under the prescribed design storm conditions. Provision should also be made for periodic 'spot' inspections by either Local Authority or EA personal to ensure that the storage and flow control facilities fully comply with the planning conditions.

6.5 Designing the system for the 100 year, 6 hour storm does not, of course, protect it from the influence of more frequent events of even greater rainfall intensity; albeit of less than 6 hours duration. Such storms could give rise to significant local flooding and some provision should therefore be made for protecting neighbouring interests at the more sensitive locations. Examples might include areas of relatively dense polytunnel development on the steeper slopes above West Peckham and Mereworth where there have been reports of localised flooding in recent years.

G.D.W, 3.1.2011

ATTACHMENTS.	
DOC.	
1	Copy Simon Evan's e-mail to G Warren 5/12/2010
2	Map I Farm Drainage (Copy of Consultant's Map of 26/11/2008)
3	Map II Soil Zones. (Copy of Consultants' Map Fig 2)
4	Map III Catchment Divides and EA Flood Risk Zones (Copy of Consultants' Map Fig 1)
5	Copy of Fig 10 of Defra / EA R&D Technical Report W5 – 074/A/TR1 Long Term Storage Volume Based on Soil Type