APPENDIX 1

AECOM Design + Planning
MidCity Place
71 High Holborn
London WC1V 6QS
United Kingdom
www.aecom.com

To	**Neal Kalita, Lee Collins & Michelle Drewery**
CC	**Rosie Vetter**
Subject	**Peterborough City Council Renewable Energy Project (PCC) Technical Note – Renewable Energy and Farming Integration**
From	**David Cassells**
Date	**13/11/21013**

Introduction

This Technical Note has been prepared in response to the Cabinet's resolution for the development of ground mounted solar photovoltaic (PV) panels (solar farms) and wind turbines; in particular on the integration of farming with renewable energy generation.

The note sets out AECOM's response to a report commissioned to provide independent advice on the feasibility of integrating farming with renewable energy generation. It also assesses the findings of the report against the Solar PV renewable energy proposals submitted to the LPA, and identifies potential issues, concerns and implications for the Proposals.

Background

At the Cabinet meeting held on 5 November 2012, Cabinet received a report seeking its approval to move to public consultation and final preparation stage culminating in the submission of planning applications for solar farms at America Farm, Morris Fen and the Farms of Newborough, all sites within the council's ownership and farming estate.

Cabinet considered the report and, amongst other things, requested that officers prepare a report assessing the feasibility of integrating farming with ground mounted solar.

AECOM was subsequently instructed by Peterborough City Council (PCC) to investigate the possibility of integrating farming and ground mounted solar on the aforementioned sites, and if the principle was deemed possible, suggest what types of farming would be suitable and complement the development, should planning permission be granted.

Farming Integration – Independent Report by Dr John Feltwell

It is important to note that in planning terms, the continued use of parts of each site for farming purposes (arable or grazing) does not require planning permission.

AECOM does not have a specific capability on farming techniques. Therefore, in determining the feasibility of farming integration, AECOM approached the National Farmers Union (NFU) to ascertain whether they were aware of any renewable energy generation and farming 'dual use' operations. The NFU advised that this kind of duel use operation is a relatively new concept in the UK but there are a few examples in Europe. Although the NFU considered that the principle was acceptable, they were not prepared to provide any assistance to PCC while their members were being affected by the renewable energy proposals.

Therefore, AECOM commissioned an independent report to investigate the feasibility of integrating ground mounted solar panels with either arable farming or grazing. This report, now referred to as "the Report" was prepared by Dr John Feltwell from 'Wildlife Matters'; a copy of which is attached at Appendix A.

The organization Wildlife Matters was set up in 1978 by Dr John Feltwell to further the work of conservation of the environment. As a consultant, John Feltwell is highly qualified in the disciplines of botany, zoology and EU law, and has published a number of books on the environment, ecology and conservation, and has extensive experience in the construction of solar farms in the UK.

A comprehensive review the Report is set out below.

Assessment & Consideration

The Report concludes that it would be economically beneficial and good for site biodiversity for PCC to have the solar sites grazed and cropped.

Area of land available for farming

Section 3 of the report discusses the constraints on a typical solar farm with regard to pursuing an integrated farming solution. The following points are noted:

- *Soil type is important as this can limit the stock or crops that can be used.* It is suggested that the results of the ongoing agricultural land classification survey may provide useful information in determining the soil type.
- *Areas around the edges of solar farms can become wildlife buffers.* This is expanded further in Section 4 of the report. The use of buffers has been central to the design of the three solar farms with buffers being provided in particular from drains (also incorporating the North Level Internal Drainage Board's requirements for access to their drains) and other features of biodiversity interest as well as areas which are difficult to populate with solar arrays. The Environmental Statements for the three solar sites outline habitat creation proposals within these buffers which are a key component of the mitigation and enhancement strategy. This strategy will form part of the Operational Environmental Management Plan (OEMP); and this Plan is to be secured by way of a suitably worded planning condition, should planning permission be granted.

It is the area outside of these buffers that can be exploited for grazing or arable farming. The section on arable farming provides further consideration for growing crops between the panels.

Grazing

The Environmental Statements currently refer to grazing as a potential option for controlling vegetation. If it is decided that grazing will be integrated with the generation of renewable energy the sites will need to be drilled six months prior to installation to ensure the vegetation is fully established prior to being shaded by the panels. Any grazing animal will not be introduced to the site until the installation is complete and the PV system is fully operational.

Which animals?

Section 11 of the Report discusses the stock that could be raised on the solar farms. From the table in Section 11.1, it is suggested that sheep grazing is preferable although llamas and apiaries could also be considered. The breed of sheep would need careful consideration and shorter breeds would be preferable as suggested in Section 8.9 of the Report.

Stocking rate

As Section 8.5 of the Report suggests, the stocking rate would be up to the competent farmer and would need to comply with welfare standards.

The biodiversity aims of the sites should also be taken into account when determining stocking levels. This would need to be set out in the OEMP. Section 8.13 refers to reduced stocking levels for sites which are important breeding areas for ground nesting birds. The sites do support birds which nest in open arable habitats therefore this may be relevant. However, it is uncertain if some birds would continue to use the sites if solar panels were in place and the habitat was changed from arable to grassland.

Protecting sheep and wiring

Appropriate controls would be put in place to prevent damage to wiring by sheep and in turn protect sheep from electrocution. All of the wires installed will be insulated and protected from animals, either via the specification of armored cabling or an appropriate cable conduit or duct. All elements of the PV mounting frame, cable ducts and associated metal work will be earthed for the purpose of lightning protection.

Timing / rotation of grazing

As suggested in Section 8.11, the timing and rotation of grazing will need to be considered carefully to balance the biodiversity aims of the sites with the economics of sheep grazing. Sections 8.12 and 8.15 discuss timing of grazing and rotation and these considerations would need to be set out in the OEMP alongside the biodiversity aims that will need to be achieved. In addition, AECOM has previously suggested a controlled paddock system which could be used to maintain structural diversity for biodiversity benefits. This could be considered alongside the rotation suggested in Section 8.15.

Arable farming

Land available for farming

The area of land within each site that could be used for arable farming has been calculated post construction. This is illustrated in the attached plan, Appendix B, which shows a typical section layout of the site, post installation, based on the drawings submitted with the planning applications. In detail, the gaps between the rows of panels are approximately 11.8m. Sufficient space will be required for the operator of the site to pass down either side of the panels (they will need to get in front and behind the rows) and for these purposes we have assumed a standard vehicle width of 2.5m. A 0.5m wide buffer was also included to protect the panels from damage by the vehicles. This would leave 5.8m wide area for arable farming between rows. Section 10.3 of the Report considers that this strip of land is *"sufficient to grow crops, subject to the soil being suitable, even though there will be some shading from the arrays to the south"* (shown as the red arrow in the attached plan).

Crop type

Section 10 of the Report considers which crops could be grown. Section 10.8 states that any crops grown would need to be restricted to a height of 0.7m to avoid to prevent overshadowing onto the panels. The table in Section 10.9 provides a list of crops which could be grown. Wheat and red/blackcurrants appear to be the least favorable options whereas vegetables seem to be preferred.

The Report also suggests other crops which could be grown including climbing fruit plants on security fences and fruit trees along hedgerows. These could be considered as part of the landscaping plan.

Risk of damage to panels

There is a risk of damage to panels from all crop types from both farm workers and vehicles if any of the listed crops are grown. Section 10.10 of the Report highlights that the turning and maneuvering skills of farmer operating the required farm machinery will be an important consideration as every effort will need to be made to avoid damage to the panels. This section also refers to narrow machines which could be used to work within the arable strips. Therefore through discussion and agreement with the farmer, it is considered that this risk could be managed.

Weed control

One point that Dr Feltwell's report does not address is that of weed control outside of the 5.8m arable strips, particularly if PCC do not wish to use herbicides. This issue would require careful consideration if arable farming between the panels was taken forward.

Impacts upon biodiversity gain

The key habitat loss is the arable farmland itself. This is likely to impact on farmland birds which currently use the sites for foraging and nesting. The current ecological mitigation strategy is to establish neutral grassland beneath and between the panels and enhance the existing habitat at the edges of the sites including field margins, hedgerows and woodland[1]. This is the preferred ecological mitigation strategy as it not only compensates for loss of the arable habitat by replacing it with neutral grassland but also benefits a number of protected species such as badgers, bats and water voles.

If arable strips were put in place between the panels, this may be beneficial for the farmland birds, however, the habitat that would be created would be less optimal than the existing situation. Some farmland birds prefer open sites and may be deterred by the presence of the solar panels. They are likely to select adjacent fields for nesting and foraging.

The arable land could be managed for biodiversity gain, for example, by providing over-wintered stubble which would provide a food source for birds and small mammals during the winter[2]. Therefore it is considered that with appropriate management, additional land would not be required to mitigate for habitat loss. If arable farming between the strips is taken forward, Natural England and RSPB would need to be consulted on an alternative ecological mitigation strategy, including confirmation that additional land is not required to compensate for habitat loss, and this would need to be included in the ES addendums.

In addition, arable strips are unlikely to be as beneficial for protected species as neutral grassland therefore the overall biodiversity gain could be reduced from the preferred ecological mitigation strategy.

Conclusion

It is quite clear from this technical note and the Report, that it is feasible to integrate farming into the proposals using either option; arable or grazing, or by a joint farming package, and that these practices will benefit the Projects.

It is important to note however that neither the Report nor this note takes into consideration the potential operational issues such as site insurance; whether suitable insurance can be obtained for a solar farm site that incorporates farming is at this stage unknown. This and other operational issues can only be answered once it has been determined who will manage the sites.

[1] NB: Dr Feltwell's report refers to the security fence as the site boundary. This is not the case and areas outside of the security fence, which are within PCC's landownership, are integral to the ecological mitigation strategy.

[2] RSPB Farming for Wildlife: Over-wintered stubble (http://www.rspb.org.uk/Images/owstubble_england_tcm9-207535.pdf)

APPENDIX A: Farming Integration Report by Dr John Feltwell

'Farming Integration - The feasibility of solar PV renewable energy generation with either arable or grazing farming – with reference to Peterborough City Council's three solar farms.'

By

Dr John Feltwell, Wildlife Matters, Battle, East Sussex

1.0 Executive Summary

1.1 A review of the options indicates that it would be economically, sustainably and good for biodiversity for Peterborough City Council to have its solar sites grazed and cropped.

2.0 Introduction

2.1 This consultant was instructed by AECOM on behalf of Peterborough City Council to review the feasibility of the solar farms with arable and/or grazing in respect of three potential solar farms proposed by Peterborough County Council. It is understood that there is little published on the topic at the present time as it is a new concept.

3.0 The basic constraints on a typical solar farm

3.1 'Solar agriculture' has to work with the basic elements that are within a solar farm field which is essentially a farm field that reflects the different farming techniques that have been used for thousands of years.

3.2 The elements that farming on solar farms have to work with and around, on a typical solar farm field are a network of field(s), hedgerow(s), trees, ditches, streams, ponds. The original farm gate(s) access is also important, and sometimes insufficient for construction and on-going management.

3.3 The soil type is important, especially on marshy ground, which can limit what stock or crops can be used.

3.4 The soil grade is immaterial for solar farms though the tendency is to use poor grade soils, old airfields or other brownfield sites. There is also a move to use higher graded lands.[1]

3.5 The solar farm is really an open field with solar panels elevated off the ground on relatively small pedestals, leaving nearly all the field available for arable or stock. Depending on the proprietary type of solar arrays purchased at PCC they may be supported on either one or two pedestals per panel. There are always a few inverter buildings

[1] Roundtable conference on solar farms held at the National Trust headquarters, 17 September 2013.

(about 3x3m) and generators, but these occupy a very small footprint compared to the whole.

3.6 Around the edges of solar farms are often open grassy areas that become wildlife buffers.

4.0 How buffers work for nature conservation and arable

4.1 Buffers are areas of the field not used by the solar arrays, but are often ameliorated for wildlife.

4.2 One way or another the nature conservation on site revolves around buffers, where they can be accommodated and what can be done in them. In a sense each solar farm is different, but the principles of what can be done are explored here.

4.3 Buffers compliment the overall setting of the solar farm 'cushioning-it' into the countryside. If it sits well all its elements of nature conservation and grazing are harmoniously integrated with the solar arrays and the impact on the landscape is minimised.

4.4 There are three major areas that make up buffers,

i) around the edges
ii) between the array rows
iii) the oddly-shaped corners of fields or areas that are permanently like quagmires, that are difficult to populate with arrays.

4.5 The area under the arrays still remains green after construction and has some potential for agriculture, and the vegetation can grow up and through the gaps between each array panel. PCC are pursuing a non-chemical solution to vegetation control such as mowing or grazing.

4.6 Some companies put arrays right up to hedgerows, whilst others have a gap around the edges of the solar farm sufficient to drive around.

4.7 The nature conservation opportunities of buffers are great. Without any enhancements the buffer areas will sprout with vegetation immediately and will get out of control very quickly, sometimes with thistles, rushes and rough grasses (depending on what the soil and water content and disturbance of the land) which will trigger some means of control.

4.8 The abrupt change in land use from agriculture to solar farm is a benefit for nature conservation whether it is assisted by man or not.

4.9 How these buffer areas are exploited by farmers and how much is left for nature conservation are important considerations. The truth is that farming solar arrays is better for wildlife than the tradition of leaving headlands and beetle banks for wildlife since more acreage is available.

4.10 It is the commercialisation of these green buffer areas that is the subject of this report.

4.11 So what about the solar farm being a buffer as itself?

4.12 It could be said that the whole of the solar farm is a buffer with just the solar panels elevating above it. If left alone, or enhanced, the buffers contribute significantly to nature conservation and can assist colonisation of adjacent sites with wildlife.

4.13 Solar farm can also, *in toto,* be regarded as a buffer for any conserved area adjacent to the solar farm, for instance a Site of Special Scientific Interest (SSSI), ancient woodland or local wildlife site. Not only does the solar farm act as a buffer into which the wildlife of the adjacent habitat can infiltrate (almost immediately) but it saves the land from any other form of development (e.g. housing) for the next 20-30 years.

4.14 The oddly-shaped areas left on solar farms are perhaps the most interesting for nature conservation, as they are left for a variety of reasons such as

Reasons why marginal areas become buffer zones.
to avoid an area of archaeological interest,
to providing a 20m 'buffer' distance between the solar arrays and an ancient woodland or other nature conservation site,
to providing a 30m buffer for a badger set.
to avoid a high hedge or woods on south or west that gives shade
to give a good margin around an existing pond,
to working around the root protection area of a tree in the field,
to avoid marshy ground
to avoid a particularly tight corner
to create a 'generous' wildlife corridor[2]
to avoid drainage channels[3]

4.15 Whatever the nature conservation constraint, what is left is the area that can be exploited for arable or agriculture, though some of the protected features above can still be used for agriculture as before (when it was perhaps an intensively worked field).

4.16 The three PCC sites do have marginal areas and buffer areas around the margins that can be usefully used for nature conservation purposes.

[2] Community ownership of 7.8MW solar farm (Baden-Württemberg, Germany) May 2013. Renewables International, The Magazine. http://www.renewablesinternational.net/community-ownership-of-78-mw-solar-farm/150/510/62654/

[3] As per PCC's America Farm which has four main 'drains' crossing the site.

5.0 Addressing statutory body requirements, before considering farming use.

5.1 Generally speaking there are no constraints upon solar farms from statutory bodies after planning permission is granted, as Natural England (NE) would have channelled their views on wildlife via the Local Planning Authorities (LPA) and the LPA would have conditioned any nature conservation works that they deemed necessary. These conditioned works may have included such things as boxes for wildlife, hedge-planting with native species and the sowing of wildflower seed.

5.2 The grazing by animals is not often conditioned, if at all. However, the grazing by animals is regularly submitted as part of the planning application, and is presented as a dual use of the proposed solar farm, as electricity and sheep farming. The Environment Agency (EA) will have already made their consultations known to the LPA through the planning process for any watercourses, but rarely, if at all, are there conditions imposed to affect the solar farm, and which could affect arable or agriculture.

5.3 It is important to note that most (but not all) solar farms have gone through planning on the basis that a Site Environmental Management Plan (SEMP) has been drawn up which will have included any consideration for nature conservation. This is more likely, but not exclusively, on solar farms which have been the subject of Environmental Impact Assessments (EIA), or where the solar farm may have received more attention and searching questions from NE or EA, or both, because the potential site is close to an internationally important nature conservation site such as a Special Protection Area (SPA), Special Area for Conservation (SAC) or Ramsar site.

5.4 'Close' in this instance is regarded as being up to 15km from any EU site and generally affects sites that present potential grazing sites for wetland birds that are associated with SPAs[4].

6.0 Access is essential for services

6.1 There are two authorities that need access to the solar farm, whether it is stocked with animals or used for agriculture, the EA and the Fire Services. This consultant is informed by the Technical Department of AECOM that *'full access routes have been incorporated into the design for all three sites that will provide adequate access for both the EA and the fire service*.'

6.2 Watercourses (with or without water) are of keen interest for the EA for potential flooding implications, and for perpetual access considerations in the event of flooding, so there are implications on solar farms for access that have to be considered for arable and agriculture.

[4] Habitats Directive, 1992. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

6.3 Solar farms can burn[5] and do burn[6] so there is a need to permit access for the fire services though this is a rare event. If the solar farm is down in part to wheat in summer the effect of burning could be considerable.

6.4 The source of fire from possible electrical malfunction is not the only potential for fire, but there is a strong risk from grazing animals eating the leads that hang underneath the modules. It is clearly important to know if grazing will be part of the scenario before construction as it is easier to tie up the wires beforehand than after. Sheep feed and rest underneath solar farms and this consultant is not aware of any sheep causing fires on solar farms. On the contrary goats should never be run under solar farms as they would nibble everything and climb onto of the modules. This consultant is informed by the Technical Department of AECOM that '*The technical specification for the sites will require full conduit protection for all cables to prevent sheep or other wildlife from eating the cables*.'

6.5 Fire is clearly one item that needs to be considered on solar farms, if only for insurance purposes.

6.6 Watercourses (including ponds) are important to NE for the protected otters, protected Great Crested Newts, protected native crayfish and protected water voles but these species, properly considered in the planning process with suitable 'buffer' zones along the watercourses where necessary can live quite harmoniously with grazing and agriculture; as is the case of water voles at the Ebbsfleet solar farm in East Kent.[7]

6.7 NE, who provides advice as to how solar farms can be suitably created in the countryside[8], does not ordinarily have reasons to inspect waterways on solar farms.

6.8 Generally speaking there is plenty of space around and within a solar farm for wildlife to flourish. With the increasing trend to incorporate a suite of enhancement measures there needs to be a good balance between sheep stocking levels, and arable whichever way is chosen.

---

[5] The Alternative Energy eMagazine. http://www.altenergymag.com/emagazine/2012/08/anything-can-go-wrong-on-a-solar-farm/1948. Lists 16 things that can go wrong on solar farms, including fire, under its item 'Anything can go wrong on solar farms')

[6] 650,000 solar panels declared fire risk http://www.solarpowerportal.co.uk/news/650000_solar_panels_declared_fire_risk_2356 They list 15 fires in Europe.

[7] Feltwell, J. 2013. Are photovoltaic solar arrays an influencing factor in avian mortality? The Newsletter of The Kent Field Club. February 20123. Number 77, p.18-27.

[8] Natural England, 2011. Solar parks: maximising environmental benefits. Natural England Technical Information Note TIN101. First edition 9 September 2011. On-line from www.naturalengland.org.uk.

6.9 PCC might consider providing controlled access to schools and colleges for educational purposes, and to serve the communities, to explain how local taxes have been used in implementing integrated solar, agriculture and biodiversity initiatives.

7.0 Biodiversity considerations

7.1 The biodiversity of a standard field used for growing a mono-crop such as wheat, oilseed rape, maize or field beans is species-poor.

7.2 Introducing solar panels into a field and not continuing with agriculture will result in an increase in biodiversity, but assisting the natural processes of plant succession will increase the biodiversity so that the original field will become biodiverse, or species-rich over time.

7.3 It has already been proven that solar parks can result in an increase in biodiversity, and can create new habitat (where before there might have been old military fields or intensive agriculture) that is then exploited by endangered plants and animals. [9]

8.0 Grazing

8.1 The management challenge is to get the balance right between promoting biodiversity and using the buffer areas for agriculture. Clearly growing crops and having grazing animals is not compatible on a solar farm unless the two are separated (by a simple wire fence) which is entirely feasible, and is being done on some farms.

8.2 There is a risk however that arable can hinder nature conservation objectives if over-done.

8.3 It is best to get the wildflower seeding established before grazing animals are put into a solar farm field as all biodiversity gains may be wiped out. The colour plan showing '*Best Practice Recommendations'* [10] as promoted in Germany, presents a vibrant and biodiverse habitat in a solar park within the countryside (showing otters, golden eagles, hares and squirrels). To this mix can be added grazers, carefully.

8.4 This consultant is informed by the Technical Department of AECOM that '*It is proposed that the sites will be drilled (assuming the sites will be used for grazing and not arable production) 6 months prior to the installation, to ensure the vegetation is fully established prior to being shaded by the panels. Any grazing animal will not be introduced to the site until the installation is complete and the PV system is fully operational.*'

---

[9] German Renewable Energies Agency, 2010 Solar Parks – Opportunities for Biodiversity. Agentur fur Erneuerbare Energien http://www.unendlich-viel-energie.de/uploads/media/45_RenewsSpezial_Biodiv-in-Solarparks_ENGL.pdf

[10] http://www.unendlich-viel-energie.de/uploads/media/BiodivSolar_Best_practice_recommendations.jpg

8.5 The stocking rate for sheep on solar farms is up to the competent farmer and depends on the suitability of the existing habitat. Some solar farms do not have a water supply and one must be provided, the farmer being responsible to abide by defra's '*Code of Recommendations for the Welfare of Livestock: Sheep'* published in 2003[11]. The code does not stipulate the number of sheep per hectare, but it says:

> *'The number and type of sheep kept and the stocking rate and/or housing density should depend on the suitability of the environment, the capacity of the farm, the competence of the shepherd and the time available to carry out his or her duties. Good stockmanship is of paramount importance in all systems of sheep production.*

8.6 Sheep have been grazing solar farms for the last seven years, for instance in the city of Pocking (Lower Bavaria, Germany) (completed March 2006)[12], though it appears not to be a widespread practice.[13]

8.7 Shepherds with their flocks on solar farms can be seen on line on popular on-line sources of images, as well as[14], or for Germany.[15]

8.8 In the UK sheep grazing is often put down on the planning application as an option as the farmer may wish to continue with sheep grazing on the solar farm (if that was a previous land use, or as a future option). However that option has not always been taken up immediately so there are few examples. The issue of farming land use is not changed with solar, as it is often conditioned through the planning process to be returned to its former arable use, as inserting solar panels into a field is only a temporary measure, and sheep farming is a continuation of farming as normal.

8.9 The National Farmers Union (NFU) in their 2013 Conference told delegates that some farmers were being forced to register their solar

[11] Code of Recommendations for the Welfare of Livestock: Sheep'.2003. 28pp. http://adlib.everysite.co.uk/resources/000/015/571/PB5162.pdf

[12] Pocking. The world's largest photovoltaic solar power plant is in Pocking. http://www.solarserver.com/solarmagazin/anlage_0606_e.html

[13] The German Solar Industry Association has nothing on their website referring to grazing http://www.solarwirtschaft.de/en/media/browse/7.html

[14] Huff, J. (likely to be late 2011 or 2012) Solar Farm Grounds Management Vegetation Control. A blog by James Huff CEO, Abakus Solar USA http://www.abakus-solar.us/blog/solar-farm-pv-power-plant-grounds-management-vegetation-control/

[15] Pocking, *ibid.*

farms as industrial use, but suggested that the use of smaller sheep breeds would be suitable for continuation of farming methods.[16]

8.10 However, the preferable scenario for conserving the structure of the fabric of the habitat, and its flora, would be to have a shepherd on site with the sheep – a system which is more likely to happen on Continental Europe than the UK where the tradition is not widespread – to prevent over-grazing. If PCC choose the option of grazing they would need to ensure that the sheep are managed on site for short periods by an experienced livestock farmer.

8.11 A balance has therefore to be set between i) avoiding too much grazing, ii) nature conservation aims (especially if the site is open to the community from time to time – and needs to be biodiverse and look 'floristically nice') and iii) the economics of sheep farming on a solar farm. It is preferable to have an intermittent shepherd controlled grazing regime – in and out with sheep for short periods during the spring and summer, rather than putting sheep in all year which would destroy the habitat. It is appreciated that shepherding might be factor that is difficult to source in Peterborough. Stocking levels should err on the low to very low side, rather than high. Lambs could be put in for fattening for a few weeks during the summer.

8.12 According to the ADAS the following advice is given for the virtues of grazing at different times of the year.[17]

- *Light winter grazing which can increase bare ground allowing seeds, particularly from annuals, to germinate.*
- *Early spring grazing maintains areas of bare-ground and can check the growth and abundance of competitive herbaceous dicotyledons and grasses allowing seedlings to compete.*
- *Excluding grazing from mid-April to late-June will help annual flowering plants to set seed and help ground-nesting birds.*

8.13 Stocking levels for marshy ground (as the PCC sites appear to be) is recommended to be about 8 ewes/ha with ewes and lambs in early spring, or if it is, or the PCC sites become, '*an important breeding area for ground nesting birds, grazing should either be removed or at best reduced to 4 ewes/ha during mid-May and mid-July'*.(ADAS, 2009).

8.14 A successful integrated mix of the grazing and biodiversity enhancement would be economically viable. Remember that grazing is a vital part of the management of the site, and is a tool to obviate the

[16] NFU, 2013. Small sheep breeds solution to solar land use. http://www.fwi.co.uk/articles/01/03/2013/137937/small-sheep-breeds-solution-to-solar-land-use.htm

[17] ADAS, 2009. Management Guideline for Grassland in Environmental Schemes. http://www.eblex.org.uk/wp/wp-content/uploads/2013/04/managementguidelinesforgrasslandinenvironmentalschemes_210710-final-report.pdf

necessity to spray herbicide to control the rampant growth. PCC has opted for no chemical intervention. The correct balance will aspire to PCC's sustainability credentials as a 'sustainable city' and a UK Environment City'.

8.15 In an ideal scenario the sheep would be brought onto site at suitable times of the year to control the rampant growth of plants, perhaps before the spring growth and at the end of the summer to remove old stems and 'thatch'. Other options are available. Sheep could also be rotated around each of the three sites. Sheep could also be kept within certain quarters of each site by wire fences, so that all parts of each site are sequentially grazed.

8.16 Clearly there is a risk of electrocution that needs to be addressed. The defra code also says the following:

> *The law requires that sheep should have access to suitable feed in sufficient quantity and sufficient fresh, clean water each day. Ideally, water should be available at all times and most particularly during lactation. It is not acceptable to rely on the water content of feedstuffs, including roots.*

8.17 Agricultural management of solar farms is a new industry and very little is published on the subject, sufficient for James Huff, CEO Abakus Solar USA (who also install in Europe) to note that *'a google search for 'solar farm grounds management' did not yield any comprehensive data*.[18] James Huff mentioned that the sheep '*exist in a sort of symbiotic relationship'* with the PVs as they rest in the shade under the PVs and feed there as well, and continues..

> *Economically, a solar/sheep farm provides the investors with a multiple-use investment property that will not interfere with the agricultural zoning of a property and provides a secondary income stream.*

8.18 Huff states that sheep need to be protected from the solar wiring, and the wiring needs to be protected from the sheep; the best scenario at PCC would be for all wires to be within a conduit.

8.19 In the UK one major solar construction company, Lightsource started to introduce its '*Lightsource Grazing Policy'* across its sites in early 2013.[19] Lightsource says that '*the solar farm panel and infrastructure typically occupy about 30% of the total rented area'.*[20] This is the case where developers do have a space between arrays,

[18] Huff, J. *ibid.*

[19] Solar Power Portal. 18 February 2013. http://www.solarpowerportal.co.uk/case_studies/local_wildlife_left_undisturbed_by_devon_solar_farm_development

[20] Sheep grazing on Solar Farms. http://www.lightsource-re.co.uk/sheep-grazing-on-solar-farms/

as the PCC are proposing, but in some cases the arrays are sited very close together and not accessible by a tractor.

8.20 The norm across England and Wales is for static solar farms[21], and across Europe but there is at least one that has trackers (panels that move to track the sun), such as the Gabardan Solar Park[22] in southwest France. In these cases with moveable panels sheep grazing would not necessarily be appropriate or manageable.

9.0 Implications of decommissioning and how it relates to feasibility of PVs

9.1 Decommissioning the solar panels after 25 years is a cost factor that needs to be addressed at the planning stage, as commitments to recycle materials and abide by the WEEE Regulations[23] are important. Often these are proposed at the planning stage, and have to be addressed before planning permission is granted.

9.2 In the case of the three PCC sites the decommissioning expenses are factored into the purchase price from the suppliers.[24] In other cases the manufacturers of the panels agree to take the panels back as part of their recycling measures.[25]

10.0 Which crops?

10.1 The gap between each row of arrays can be harnessed for agriculture, as well as the buffer zones around the outside of the solar farm, as in Figure WM01.

Figure WM01 Cross section through a series of three solar arrays (Plan supplied by AECOM)

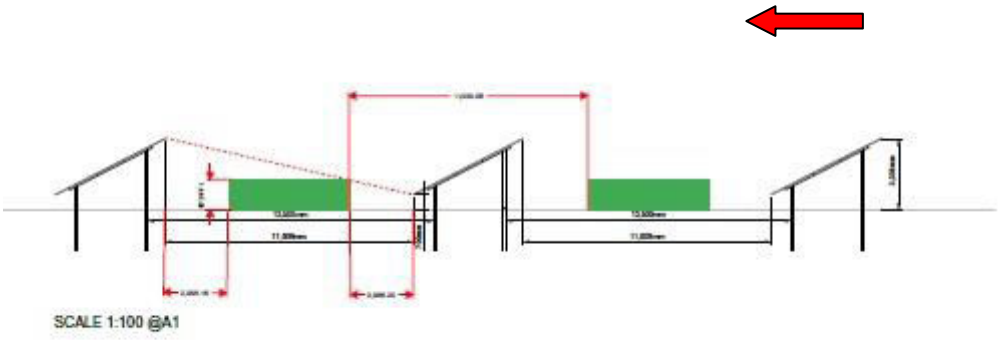
[21] However, a small solar farm at Scotland Farm, Dry Drayton, near Cambridge does track the sun and is claimed to be likely to be the first tracked solar farm in the England. 'Cambridge Farm has Solar Panels which turn to face the sun.' http://www.cla.org.uk/In_Your_Area/East/Regional_News_Archive/Renewable_Energy/Renewable_Energy/

[22] EDF Energies Nouvelles commissions 67.2MW plant in France utilizing First Solar panels http://www.pv-tech.org/news/edf_energies_nouvelles_commissions_67.2mw_plant_in_france_utilizing_first_s

[23] The Waste Electronic and Electrical Equipment Regulations 2006 aim to reduce the amount of WEEE being disposed of and require EEE producers to pay for its reuse, recycling and recovery.

[24] Freedom of Information Request, 2012. FOI-12-0726 http://www.peterborough.gov.uk/PCC/FOI/Docs/foi-12-0726-R.pdf

[25] Lieberose Solar Park (Germany) a juwi installation. http://www.juwi.com/solar_energy/references/lieberose_solar_park.html



10.2 The above plan shows a cross section through three solar arrays with the space available for growing crops coloured in green (5.8m wide for the movement of agricultural vehicles).[26]

10.3 This 5.8m wide central strip between each row is sufficient to grow crops, subject to the soil being suitable, even though there will be some shading from the arrays to the south (shown as red arrow above). This is balanced by the advantages of the panels facing southwards (as all solar farms are – but on these PCC sites the land is flat meaning that shading effects may be significant), and by a natural sprinkler system of water falling off the arrays on the south (low) side of the row when it rains. Although hydrological studies that this consultant has seen suggests that there will be no change in hydrology[27] of the site overall, sudden heavy precipitation may cause some soil erosion on crops which are growing in cultivated soil within the 'drip-zone', rather than a more stable grass mix. However, this is not regarded as an impediment to growing crops between arrays in the opinion of this consultant, as the watering is rather complimentary to the arable task proposed.

10.4 The type of solar panels has not yet been decided yet for the PCC sites (as this consultant is informed), so the water run-off rates and distribution will vary according to the type used. If small thin-films panels are used there are gaps between each panel through which water falls. If other types of panels are used there is a long unbroken slope down which the water runs and a large proportion of water falls off the lowest point of the arrays, on the south side.

10.5 The way that the solar arrays are arranged is that at the down slope of the arrays a lot of water is delivered, and at the back of the arrays there is only the incident rain that falls. This creates a micro-climate that under the arrays is shaded and sheltered but not sufficient to stop plant growth. The vegetation under arrays always grows.

[26] This is based a drawing submitted in the planning application as gaps between the panels being 11.8m and allowing for a standard vehicle width of 2.5m and allowing a 0.5mm wide buffer to protect the arrays from vehicles (from Instructions letter from AECOM).

[27] This consultant is not a hydrologist and this statement would need to be substantiated by a hydrologist.

10.6 Vegetables that could be grown between the arrays

10.7 The following is a non-exhaustive list of crops that could grow between the arrays.

10.8 The only restraint is that they must not reach higher than 700mm which is the height of the lowest point of the solar panels (to avoid obscuring the light that falls on the panels).

10.9 Farm machinery has a width of 5.8m to work to work with between each row, which will permit several rows of the following suggested crops.

VEGETABLE CROP	Advantages	Disadvantages
Turnips	Commercially attractive	Damage by workers
Beetroot	Commercially attractive	Damage by workers
Mangle worzels	Commercially attractive	Damage by workers
Parsnips	Commercially attractive	Damage by workers
Wheat (short varieties)	Commercially attractive	Need mini-harvester Damage by workers
Red & Blackcurrants	Commercially attractive	Needs more light than can be provided unless special low light tolerant cultivars available Damage by workers
Spinach	Commercially attractive	Damage by workers
Beet	Commercially attractive	Damage by workers

10.10 The land will need to be tilled, drilled and crops harvested, and access to the rows can be done using a regular tractor towing an appropriate appliance. Turning and manoeuvring by skilled drivers will be important issues to consider to avoid damaging assets. There are narrow machines suitable for being drawn between arrays. For instance the new Kverneland Accord has a telescopic frame which, with the flick of a button, can cultivate a three metre wide strip.[28] There is no need for the traditional wide machines used for agricultural work in large open fields.

10.11 If PCC wish to go organic to meet their sustainability goals then the ground would have to be left for two years to complete conversion and gain organic status. The economics and commercial benefits of the arable exercise along thin strips will have to be adjusted to take into consideration these effects.

10.12 Climbing plants on security fences

10.13 Crops that could be grown up security fences include the following. All solar farms have security fences and they can be used profitably for growing climbing plants; and they would have a dual advantage of helping to screen the solar farm. Having vegetation on the security fences would not have a negative effect on security, but would have a benefit in the landscape helping to providing a screen.

[28] *Farm Machinery*, October 2013, and see supplier, http://www.kvernelandgroup.com/welcome/

CLIMBING CROPS	Advantages	Disadvantages
Grapevines	Commercially attractive	None
Kiwi plants	Commercially attractive	None
Raspberry	Commercially attractive	None
Blackberries	Commercially attractive	None

10.14 Fruit trees along hedgerows

10.15 Screening by native trees and shrubs is nearly always done around solar farms (in gaps of existing hedgerows, or where hedgerows used to be), but there is an opportunity to plant orchard trees instead, as Habitat Aid suggests. [29] There are dwarf forms of nearly all top fruits available commercially, that have been selected for pots and on patios which will be ideal grown in rows in the ground between the arrays.

11.0 Stock that could be raised in the solar farm:

11.1 RSPB believes that grazing by sheep, chickens or geese should be acceptable on solar farms rather than spraying, mulching or mowing.[30] Lightsource have suggested llamas.[31]

ANIMAL STOCK	Advantages	Disadvantages
Apiaries	Commercially attractive. Secure within the perimeter fence; honey production for the community; pollination services provided for the community. Extra income for farmer, or for local beekeeper's society	None
Chickens	Possibly commercially attractive (need to trial them)	Messy birds; perching on struts on underside of panels; pecking wiring.
Geese	Commercially attractive Food; good for warning off Intruders (need to trial them)	Aggressive and a threat to on site workers
Ducks	Commercially attractive (need to trial them)	Need pond
Sheep	Commercially attractive	Can over-graze
Llamas	Commercially attractive	None known

11.2 The three solar farms proposed for PCC are probably committed to the layout design as supplied to this consultant. Much depends on the type of solar panels purchased. The proposals by Fire Energy for solar panels carried high above the ground on large pedestals would

[29] Solar Farms – Biodiversity Hotspots? Blog from Habitat Aid of August 19 2013. http://www.habitataid.co.uk/blog/

[30] Solar Power, RSPB Briefing, March 2011. RSPB 2011 Solar_power_briefing_tcm9-273329

[31] Lightsource display at Solar Energy UK at the NEC Birmingham, 10 October 2013.

appear to make available a significant amount of more field available for arable or grazing – see the photograph in their website.[32]

12.0 Cutting up the conservation cake on solar farms

12.1 Calculating the land use of the solar arrays compared to the total size of the farm estate is sometimes important to understanding how much of the land can be given over to arable, grazing, solar or biodiversity enhancement.

12.2 In the case of a site at Stradishall Airfield Solar Farm (Suffolk) developed by Lark Energy only about 30% of each acre of 150 acres of grassland would be occupied by PVs, '*allowing the natural wildlife and grassland to flourish*'.

12.3 For the PCC sites the security fence is tightly around the arrays, leaving the surrounding fields to be managed as before, and outside any enhancements that could be imposed via the planning process. There are no significant areas of open space within the solar farms proposed that could be used exclusively for arable or grazing; so arable and grazing can take place only between the arrays.

12.4 For the PCC sites which has drains their ecology can be managed and monitored via the SEMP (though outside they would not be subject to either). The advantage of managing the drains for nature conservation is that the fruits of the conservation efforts could tie in well with the initiative promoted by Buglife-The Invertebrate Conservation Trust [33](based in Peterborough) for B-Lines through the countryside.

13.0 How sustainable are solar farms, especially for arable and grazing?

13.1 The three PCC sites are tightly enclosed in a perimeter fence that offers little in the way of marginal areas for exploitation for a range of agricultural practices. All three sites can be grazed successfully between the arrays.

13.2 All three sites can support enhancements for biodiversity, and if they all support grazing, and some arable too, that would address 'sustainability' as being a worthwhile option and on its way of being fully addressed.

13.3 Sustainability is promoted at three different levels, internationally, nationally and locally; as the United Nation states sustainability is "meeting the needs of the present without compromising the ability of

[32] China's Fire Energy to build 50MW solar plant in France. Dated 5 October 2012. http://www.wantchinatimes.com/news-subclass-cnt.aspx?cid=1102&MainCatID=&id=20120510000081

[33] Buglife-The Invertebrate Conservation Trust, www.buglife.org.uk

future generations to meet their own needs".[34] From a national perspective the NPPF has a "presumption in favour of sustainable development", and at a local county or city level there are always local sustainable initiatives, for instance PCC have their own 2010 Policy G03: Building the Sustainable Infrastructure of the Future – so that conditions for business, service and community prosperity and growth are integrated with Policy EC04 which promotes biodiversity. [35]

14.0 Financial feasibility

14.1 This consultant is not a financial expert or economist but the following general principles would seem to be clear.

- PCC will be using the electricity generated from the solar parks to power their buildings thereby reducing their carbon footprint, whilst upholding principles of sustainability.

- That PCC can either graze or cultivate their solar farms to bring crops to the marketplace.

14.2 The payback time to cover the manufacturing energy and transportation can be expected to be less than a year if certain thin-film panels are used; so this is a variable factor depending on type of panel and location, see[36] for further information.

14.3 The' Energy Payback Time (EPY)' has been replaced by the 'Energy Yield Ratio (EYR)'[37] which is the ratio of energy delivered by a system over its lifetime compared to the energy used to make it. In Central Northern Europe the ratio is 4 over a lifetime of 20 years and more than 7 in a sunnier place like Australia (MacKay, 2013).[38]

14.4 As PCC is embarking on a non-chemical use on the three solar farms, it can be expected that higher expenses can be expected for managing the site in the first few years (until an organic system is

[34] General Assembly 42/187. Report of the World Commission on Environment and Development http://www.un.org/documents/ga/res/42/ares42-187.htm

[35] Peterborough City Council, 2010. Local Area Agreement 2008 - 2011 (2010 Refresh). http://www.gpp-peterborough.org.uk/documents/LAARefresh200910GPP.pdf

[36] NFU Response to 'Are Solar Panels Sustainable' (14 Nov 2012) in FARMING FUTURES, NOW PART OF CEUKF. http://www.farmingfutures.org.uk/blog/nfu-response-%E2%80%9Care-solar-panels-sustainable%E2%80%9D. It reports ' a payback of 2-3 years for Northern European deployment. Either way, the majority of competently-installed PV systems will pay back their energy cost at least 10 times, on a timescale that is very relevant to climate change mitigation.'

[37] B.S. Richards_, M.E. Watt. 2007. Permanently dispelling a myth of photovoltaics via the adoption of a new net energy indicator. Renewable and Sustainable Energy Reviews 11 (2007) 162–172. http://www.inference.phy.cam.ac.uk/sustainable/refs/solar/Myth.pdf

[38] MacKay, D.J.C., 2013. Sustainable Energy – without the hot air. http://www.withouthotair.com/c6/page_42.shtml

NB. All web sites accessed 20 Sept 2013 - 2 October 2013.

established if this is regarded as the way forward) as the cultivation of crops between the arrays does not lend itself to economy of scale as the small strips have to be managed individually.

15.0 Conclusions

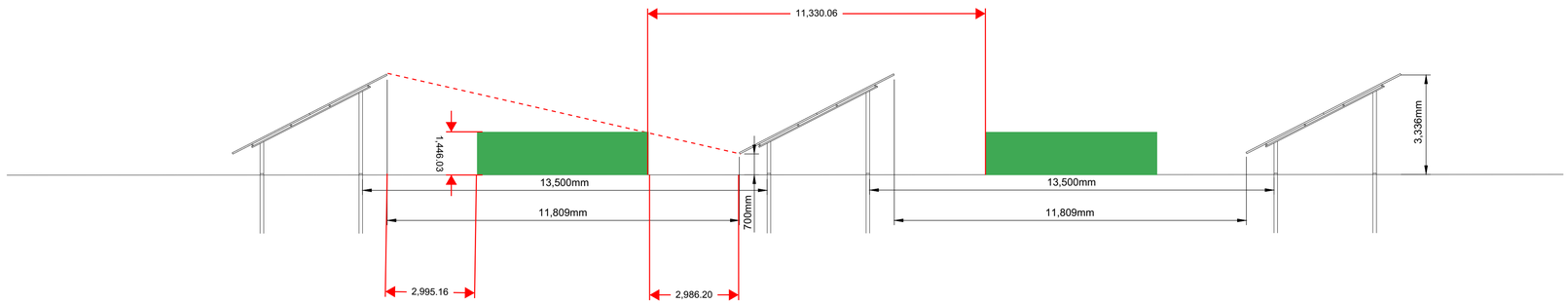
15.1 That PCC have many choices to commercially exploit their solar farms for agriculture.

Acronyms

EPY Energy Payback Yield
EYR Energy Yield Ratio
LPA Local Planning Authority
NPPF National Planning Policy Framework
PCC Peterborough County Council
RSPB Royal Society for the Protection of Birds
SEMP Site Environmental Management Plan
WEEE The Waste Electronic and Electrical Equipment Regulations 2006

Dr John Feltwell
Wildlife Matters Consultancy Unit
01424 830566 **Dated 14 October 2013**

APPENDIX B: Typical Cross Section Plan



SCALE 1:100 @A1

Project Management Initials: Designer: Checked: Approved: ISO A1 594mm x 841mm

53

Filename: F:\PROJECTS\WASTEWATER - PRETEBOROUGH CC SOLAR\PCC WIND AND SOLAR\C A D_ACM-MASTERDETAILS.DWG
Last saved by: LEED6 Last Plotted: 2012-11-12

AECOM

PROJECT

PCC RENEWABLE ENERGY PROJECT

CLIENT

PETERBOROUGH CITY COUNCIL

Town Hall, Bridge Street
Peterborough, Cambs, PE1 1HG
01733 747474 tel DX 12310 Peterborough 1
www.peterborough.gov.uk

CONSULTANT

AECOM
MidCity Place, 71 High Holburn
LONDON, WC1V 6QS
+44 (0)20 7645 2000
+44 (0)20 7645 2099
www.aecom.com

NOTES

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60271594

SHEET TITLE

AMERICA FARM

SHEET NUMBER

60271594-S1-ENG-...

This page is intentionally left blank