

Surface Water Management Plan

Proposed Solar Park, William's Farm,
Wrexham, LL13 0UT

Prepared for: Solar Ventures Limited

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Non technical summary

A Flood Risk Assessment (FRA) was supplied with the planning application for the development of a solar park on on land at William's Farm, Wrexham, LL13 0UT on national grid reference SJ 37993 48290. A condition was applied to the subsequent permission which called for a surface water management plan to be created to control overland flows during construction. The opportunity was taken to also create additional habitat for Greater Crested Newts, GCN, which also serves as additional attenuation storage during the operational life of the development.

The area within the redline of the site is designated as FZ1.

Standard operating procedures must be followed with regard to refueling and storage of liquids on the site with the use of spill trays and fuel spill kits must be available at all times on site. Silt fences must be erected prior to any site work commencing. Concrete plugs are recommended for trenches if they are to be left open to prevent them from becoming unintentional drainage channels during construction.

We also recommend that swales and/or filter trenches, which ever the contractor deems most appropriate, are formed to the downward slope edge (in most cases here, northern), edge of the temporary access roads and further reinforced by the use of silt fencing as there is a high risk of discharge of suspended solids to the adjacent water course.

Prior to construction, swales are recommended to be excavated between rows, with the final size is to be determined once detailed construction drawings are available, which were not at the time of writing. Swales must be edged with silt fencing on the downward slope. The estimated interception volume based on the available information would be 100m³. This figure must be reassessed by a competent person within the drainage contractors team prior to commencement. A final assessment based on construction drawings is strongly recommended prior to site work commencing.

A further assessment for the impact on site runoff following the end of the operational phase must be conducted to ensure that it takes into account updated climate, legal framework and methodologies in the future.

Instruction & limitations

The Magnificent Science Company Limited (MSC) were instructed by Solar Ventures Limited to carry out a surface water management assessment in response to a condition of the application for the development of a Solar PV array on land at William's Farm, Wrexham, LL13 0UT on national grid reference SJ 37993 48290.

It is to be read in conjunction with and with direct reference to the following reports:

- 1) Flood Risk Assessment: Proposed solar farm development at Williams Farm, Wrexham, LL13 0UT (The Magnificent Science Company Limited, 2015).
- 2) Phase 1 Land Quality Report: Proposed solar farm development at Williams Farm, Wrexham, LL13 0UT (The Magnificent Science Company Limited, 2015a).
- 3) Phase 2 Land & Soil Sampling Report: Proposed solar farm development at Williams Farm, Wrexham, LL13 0UT (The Magnificent Science Company Limited, 2016).
- 4) Whole Life Drainage Management Plan: Proposed solar farm development at Williams Farm, Wrexham, LL13 0UT (The Magnificent Science Company Limited, 2016).

A literature review was carried out based on MSC records including published maps and data, a review of prior flood risk reporting for the area, with site specific flood risk and flood water depth data from the Natural Resources Wales and GroundSure were reviewed along with an assessment of any proposed changes in site cover with respect to permeable and impermeable areas, drainage, discharge from the site and stormwater disposal for this site.

The assessment is based on the assumption the site is for a Less Vulnerable end use as classified by the Natural Resources Wales flood risk publication.

This report is a response to a specific instruction for a specific end use, specific site layout with regard to habitat and land cover as present at the time of the site visit and proposed development. It is prepared for the sole use of Solar Ventures Ltd. It is based on drawing number: [file name 'SITE LAYOUT (1-1250 on A0)'].

For the avoidance of doubt, any duty of care to any other end users or third parties is specifically excluded. The findings will require a reassessment in the case of any change of boundaries, plans, location of amenity areas or buildings, planting schemes, changes of use of the wider area or buildings and/or end use to ensure its fitness for purpose. The assessment is based on the development plans presented at the time of the assessment.

The report is not to be used for construction purposes, a detailed assessment for Swale sizing must be conducted prior to construction by a competent person. All calculations presented herein are based on the plans presented and standard operation procedures for a typical solar park development. A new calculation based on figures for actual site compaction must be conducted to ensure that the assumptions made are valid prior to site work commencing.

Assignment of this report without the written consent of Magnificent Science Company is forbidden. An assignment can be easily arranged but will require a reassessment in the case of any change of boundaries, plans, location of amenity areas or buildings, changes of use of the wider area or buildings and/or end use to ensure its fitness for purpose. Please contact MSC for assignments at projectmanager@magnificentscience.com.

This design is preliminary and a final assessment must be conditioned to ensure its fitness for purpose on analysis of the build program, the time of year the construction commences and the actual site compaction.

Site description and drainage characteristics

The site at Williams Farm, Wrexham, North Wales is approximately 4.75km to the south-east of the centre of the town of Wrexham, and 2.65km from the outskirts of the urban boundary, at national grid reference SJ 38041 48342. It is situated within an industrial estate area, to the south of the main Wrexham Industrial Estate. Industrial units flank an approximate 180 degree circumference of the site from the north-north-east to the west-south-west; with a smaller industrial unit to the south of the site. The surrounding landscape is low-lying/flat grazed grassland of improved and semi-improved character, with some arable fields and woodlands.

The site itself is approximately 12.3 hectares in area and comprises predominantly sheep-grazed improved and semi-improved neutral grasslands, with semi-natural broadleaved woodland and large standard trees. The River Clywedog runs west to east just beyond the north-western side of the site and is a tributary of the River Dee.

The proposal is for a 5MW Solar PV Array centred on national grid reference SJ 37993 48290.

Development characteristics

The proposed development comprises arrays of solar panels, supported by driven steel posts. In addition there will be buried AC cables, set at a depth of approximately 1m. The rows of arrays will be set approximately 2.0m to 5.0m metres apart depending upon the final layout with one GRP housing to enclose electrical equipment which has a footprint of approximately 10m² set on a concrete plinth.

The solar arrays are raised up to approximately 2.5 metres from the ground at the highest point to the rear of the panels.

Individual solar modules within the arrays have rain gaps allowing rainwater to pass through the arrays and disperse evenly see drawing number [file name 'SITE LAYOUT (1-1250 on A0)'].

Site specific surface water risk assessment

Compaction of green field sites is normally a further consideration for solar arrays during construction, with the English Environment Agency guideline figures of approximately 10% along with removal of vegetation which could increase site runoff rates beyond the suggested 5l/second. We recommend that a final check and recalculation is completed based on the final construction management plan and site layout. The model is based on the total area which may be affected not just the site area within the red line to ensure that a robust assessment was conducted.

The estimated additional impermeable ground measures approximately 1.23ha from 12.3ha total area of the site.

Site specific greenfield runoff model:

The site lies in FZ1.

Greenfield run-off & interception storage assessment

Total site area:	12.3 ha
Significant public open space:	11.07 ha
Area positively drained:	1.23 ha
Impermeable area:	1.23 ha
Percentage of drained area that is impermeable:	100%

Impervious area drained via infiltration:	1.23 ha
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Return period for infiltration system design:	10 year
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Impervious area drained to rainwater harvesting system:	0 ha
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Return period for rainwater harvesting system design:	10 year
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Compliance factor for rainwater harvesting design:	66%
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Net site area for storage	
volume design:	0.43 ha
Methodology	
Greenfield runoff method:	IH124
Qbar estimation method:	Calculate from SPR and SAARS
SPR estimation method:	Calculated from SOIL type
SOIL type:	4 - evidenced from trial pits on site
HOST class:	N/A
SPR:	0.47
Hydrological characteristics	
SAAR:	680
M5-60 Rainfall Depth:	17
'r' Ration M5-60/M5-2 day:	0.3
Hydrological Region	9
FEH/FSR Conversion factor 1 year:	0.88
FEH/FSR Conversion factor 10 year:	1.42
FEH/FSR Conversion factor 30 year:	1.78
FEH/FSR Conversion factor 100 year:	2.18
Design criteria	
Climate change allowance factor:	1.3
Urban creep allowance factor:	1.1
Interception rainfall depth:	5mm
Greenfield runoff rates	
Qbar:	5.74
1 in 1 year:	5.05
1 in 30 years:	1.22
1 in 100 years:	12.51
Estimated storage volumes	
Interception storage:	48.71m³
Attenuation storage:	0.00m ³
Long term storage:	246.85m ³
Treatment storage:	51.46m ³
Total storage:	295.56m ³

We recommend a factor of safety of 2 on the interception storage volume to reduce the risk of release of solids to the water course, giving a figure of 100m³.

Prior to construction, swales are recommended to be excavated between rows, as a guide at least 100m³ of swale capacity should be excavated, distributed between the fields and to cross the site at 90 degrees to the expected direction of overland water flows. This design is preliminary and a final assessment must be conducted to ensure its fitness for purpose on analysis of the build program, the time of year the construction commences and the actual site compaction. This ensures that there will be no increase in runoff rates or volumes from the site, and no changes to the upstream or downstream hydrology and flood risk as a result of the proposed solar farm.

Silt fences must be installed at appropriate locations and distances prior to the commencement of any construction work or enabling work on the site. Temporary silt fences should be advanced across the site as work progresses.

As a precautionary measure to prevent water ingress to the plant room, this will be set 600mm above site level. No plant rooms or switchgear should be placed within FZ2 or FZ3.

Climate change risk analysis

It is assumed that there is a potential for a 30% increase in precipitation due to climate change, which must be taken into consideration in flood risk modelling. Using the IH24 greenfield methodology as shown above, there was no identified increase in Qbar beyond 5 l/sec. This is taken into account in the above calculations and recommendations for swale storage capacity.

Therefore the risk from increased flood water volume breaching the 0.6m level below the proposed operational floor level from climate change is considered low and is discounted for this site.

Soakaway testing

5 No. pits were excavated using a JCB 3CX and testing in general accordance with BRE365 undertaken. Each pit of 0.6 x 1.6 x 2.5m and filled to 75% with water and the test run to gather the levels and calculate the infiltration rate. Each test pit showed no significant signs of water levels having dropped over the period of a day, with levels generally remaining no more than 0.02m below that first measurements. They were then abandoned. In this case, soakaway pits would not be suitable for drainage on the site and swales with a much greater surface area should be used to control water on the site.

Surface water management

Management during construction: Piled mounts, fencing installation, plant & trenching operations

This phase of the development is programmed to last for approximately 12 weeks, during which time it is proposed the developer would install additional drainage measures of swales prior to this development.

As long as the attenuation pond, silt fencing and swales are constructed prior to commencement of ground works, it is considered that the construction phase will result in no significant increase to the risk of water leaving the site providing the Construction and Site Management Plan and standard operational procedures are adhered to during the construction, operation and decommissioning phases of the proposed development.

Trenching and laying of cables

If required, concrete plugs could be placed within trenches to prevent them from acting as a drainage channels while they are open. Soils excavated during cable trenching will be backfilled to ensure subsoils are returned to the correct depth and topsoil placed over. Ecological watching briefs will be required to monitor the impacts of the installation of swales and cable trenching. Care must be taken to batter back the edges to allow small mammals to exit the trench.

Contractor facilities

Toilets and a rest area will be in a self-contained portable building and are of such a small area there are no significant runoff risks associated with this site activity.

Risks from potentially contaminative liquids

During site operations, small quantities of fuel or oil will be stored on site in a bowser and stored according to the Construction Management Plan.

The standard operating procedures must be adhered to. Drip trays must be used when refuelling plant to prevent pollution from leaking oils or liquids as detailed within the Myers Construction Management Plan. In the event of oil spill or leak from vehicles there will be adequate on-site availability of oil spill clean-up equipment including absorbent material and inflatable booms as outlined in the Construction Management Plan.

Spillage incident reporting, response and action plans we be prepared by the client's contractors and will be included by the client within the site pack.

Assessment of impacts post construction

Accidental incidences of fuel or oil spills are highly unlikely given the nature of the development, the controls in place for the management of such materials on site, and the low maintenance requirements of a solar farm. However, any such incidents will be cleaned and removed as soon after occurrence as is practicable as per the NRW pollution prevention guidelines.

For vehicle access and site maintenance, mitigation measures are the same as in the construction phase.

Assessment of decommissioning phase

At the end of the solar farm's useful life, piles, panels and transformers are to be removed or another planning application submitted to allow the continued use of the site. At least 1 year before decommissioning, a detailed Decommissioning Method Statement must be prepared for approval of the LPA as this is a condition of the planning consent.

A further assessment for the impact on site runoff following the end of the operational phase must be conducted to ensure that it takes into account updated climate, legal framework and methodologies in the future.

This will also require a re evaluation of the ecology of the site as it is likely that protected species would be present if the Ecological Management Plan is actioned, which must be taken into account.

Summary assessment of residual impact

Residual impacts of construction

This assessment indicates there are no impacts to surface water or groundwater. In fact the installation of swales and seeding of the otherwise bare earth in winter should moderately improve the site runoff characteristics. Therefore there are no negative residual impacts.

Residual impacts during operation

The assessment indicates that there are no significant impacts to surface water run-off characteristics. In fact the installation of swales and seeding of the otherwise bare earth in winter should moderately improve the site runoff characteristics. Therefore there are no negative residual impacts.

Decommissioning Impacts

A further assessment for the impact on site runoff following the end of the operational phase must be conducted to ensure that it takes into account updated climate, legal framework and methodologies in the future.

Conclusions

The site is designated as FZ1.

Surface water drainage impacts were identified - the requirement to construct swales, erect silt fences and to ensure that the standard operating procedures are followed with regard to refueling and storage of liquids on the site.

A further assessment for the impact on site runoff following the end of the operational phase must be conducted to ensure that it takes into account updated climate, legal framework and methodologies in the future.



Peter McCann-Downes BSc (Hons) ACSM

Principal Flood Risk Assessor

For The Magnificent Science Company Limited February 2016

Appendix 1: Site plan with location of trial pits

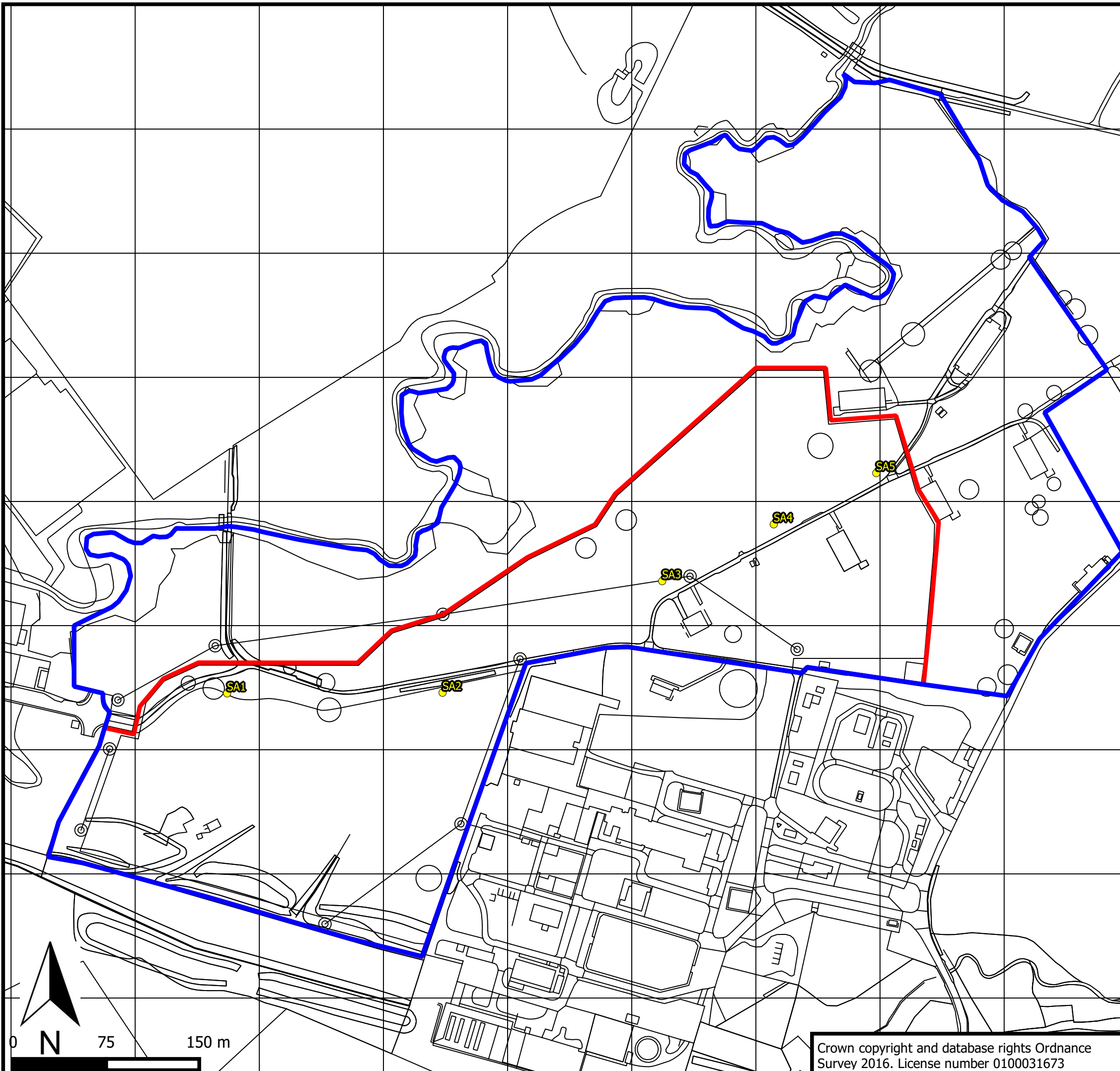
Key

-  Development site boundary
-  Ownership boundary
-  Soakaway pit locations

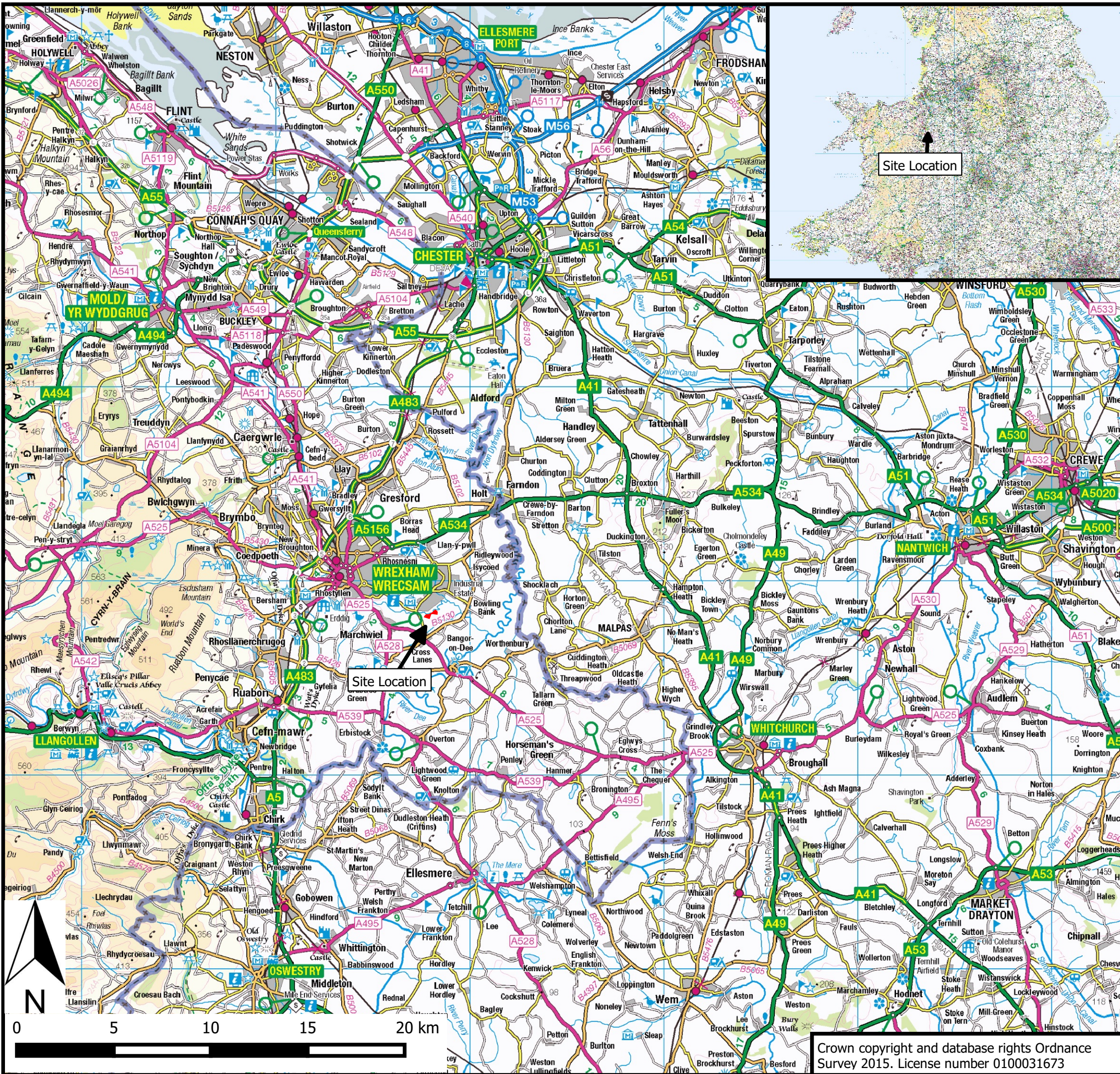
**William's Farm Solar PV Array
Soakaway Locations Map**
Client: Solar Ventures Limited
Location: SJ 37993 48290
GIS mapping: DJH
Issued: 12.2.2016

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Appendix 2: Site Location Plan



Key

Site Boundary

William's Farm
Site Location Map
Client: Solar Ventures Limited
Location: SJ 37993 48290
GIS mapping: DJH
Issued: 14.10.2015

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