Meridian Solar Farm

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Environmental Statement

6.3 ES Appendix 11-3: Flood Risk Assessment - Annex C

APFP Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Annex C - Impact of Vegetation and Solar Panel Infrastructure on Rainfall Runoff and Time to Peak

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Research on the hydrological impacts of solar farms, including studies by Cook and McCuen and Pennsylvania State University, suggests that the presence of solar panels and vegetation has a minimal effect on runoff characteristics, including time to peak, compared to the existing site conditions, primarily in relation to a vegetated surface.

Cook and McCuen Study (2013) (Ref. 30)
The research, published in the *Journal of Hydrologic Engineering*, aimed to understand the hydrological impacts of solar panels to determine whether stormwater controls are required to manage peak runoff volume and rates.
Cook and McCuen developed a hydrological model which simulated runoff for pre-panel and post-panel conditions. The study conducted a sensitivity analysis to examine the effect of different ground cover types, including grass, gravel, and bare soil, on the surface water runoff characteristics.

The key elements of the study are discussed below:

Impact on Runoff Characteristics: The study found that the introduction of solar panels caused only minor changes in peak runoff volumes, peak discharge rates, and times to peak. When grass was maintained under the panels, there was a non-significant increase in runoff, with peak volume increasing by approximately 0.35% and peak runoff rate by approximately 0.31%.

Time to Peak Delay: The study observed a slight delay in the time to peak—by one time increment, or 12 seconds. This was attributed to the impact of the panels on runoff velocity, although the effect was such that it did not have a significant hydrological impact.

Vegetation and Runoff: The roughness coefficient for grass (0.15) was considered typical for short-grassed areas, such as meadow grass typically used for grazing. The study concluded that with proper vegetation under and between the solar panels, runoff characteristics, including time to peak, remained largely unaffected by the presence of solar infrastructure.

Effect of Panel Angle: The study also examined the impact of solar panel angle on runoff. Runoff velocities increase with slope, so the angle of the solar panel was considered a potential factor influencing hydrologic responses. An analysis was completed for panel angles of 30°, 45°, and 70°, with the assessment representing a range of conditions from winter to summer. The study found that the panel angle had only a slight effect on runoff volumes and discharge rates. Specifically, comparisons between a 45° base condition and angles of 30° and 70° showed only minor variations (less than 0.5%) in results for peak runoff and volume, indicating that panel angle, while it may affect runoff velocities to some degree, does not significantly alter the overall hydrologic response of the DCO Site.

The research by Cook and McCuen noted boundary swales, as well as good, vegetated ground cover, is a suitable mitigation measure to counter any non-significant increase in runoff from a solar panel field.

Pennsylvania State University Study (2024) (Ref. 31)

The more recent study by Pennsylvania State University, titled "*Quantifying Soil Moisture and Evapotranspiration Heterogeneity within a Solar Farm*," examined how solar farms affect soil moisture distribution, evapotranspiration rates, and stormwater management.

The study conducted field investigations of two existing solar farms in Pennsylvania USA where they tested the soil moisture content for various ground covers, including bare soil, gravel, and grassed areas distributed throughout the farms. It was concluded that the introduction of solar panels and vegetation led to no significant change in runoff characteristics and that healthy vegetation can successfully manage surface water runoff from solar farms.

Key findings included:

Vegetation Establishment: The research showed that vegetation established well beneath the solar panels, which would typically be equivalent to a short meadow grass or a grazed field .

Soil Moisture and Evapotranspiration: The study noted that while solar panels can reduce evapotranspiration and alter soil moisture beneath them, these effects were offset by maintaining healthy vegetation and implementing engineered stormwater controls.

Additionally, the Building Research Establishment (BRE) National Solar Centre guidance document "*Agricultural Good Practice Guidance for Solar Farms*" (2014) (Ref. 15supports the idea that solar farms, particularly those with vegetation maintained underneath the panels, have minimal impacts on runoff.

According to the BRE guidance, solar panel infrastructure typically disturbs less than 5% of the ground. This leaves approximately 95% of the ground area accessible for vegetation growth, which can help maintain or enhance stormwater management, similar to the pre-existing regime.