Eroding soils, eroding image, eroding profits – why erosion control and drainage matter in solar

Design | A little more time and money spent upfront on properly understanding site drainage and soil conditions and designing solar projects accordingly can avoid much larger profit losses and reputational damage further down the line. HDR's Gretchen Dolson looks at some of the methods for ensuring PV sites stay afloat

In the race to build utility-scale solar at reduced capital costs and at record speeds, stakeholders are increasingly faced with tough decisions during initial project planning and financing—decisions that influence long-term profitability.

An area under intense scrutiny is improperly planned drainage and erosion control at large solar PV facilities. In an effort to save on up-front costs, many have overlooked the benefits of a well-planned drainage and erosion control approach. The result is an increase in post-construction site drainage and erosion control issues resulting in negative public perception and reduced profits.

Historically, the industry has focused on maximising electrical production to benefit from power purchase agreement (PPA) terms. This has driven industry improvements in panel, inverter and energy storage technologies. Tracker manufacturers have improved performance with enhancements to layouts and detailed evaluations of location-specific criteria, while increasing flexibility of the topographic grade tolerances for their systems. All of this has driven efficiencies in site layout to minimise electrical wire sizing, lengths and overall material use, while increasing the pace of systems installation nationwide. The missing link for our industry is in improving drainage and erosion control.

Time for a new approach

As the industry continues with hyper price competition for PPAs and construction, it's approaching site-specific challenges in the same manner as electrical and structural systems: applying a "less is more" approach to the manner in which site drainage and erosion control are evaluated, designed and constructed. In many areas of the US, less is not more when it comes to water and erosion management. It creates risk for all parties, leading to reduced profits over the life of a facility.

Proper installation of erosion control materials is critical for function during and after construction of PV power plant, particularly in regions with high rainfall

So how does lack of a site-specific drainage and erosion control management plan create risk, and whom does that impact?

The developer's perspective

Developers typically acquire only the land needed to construct a facility of a target size, and perform initial assessments:

- Siting;
- High-level environmental reviews to ascertain the ability of a site to transition from current land use to use as a solar PV facility;
- Preliminary estimates for a site layout;
- Estimated production to assess potential revenues and return on investment.

If those high-level assumptions do not consider the impact of events such as flash flooding in the southwest or hurricane potential in the Gulf and Atlantic regions, or the risk of not being able to contractually meet a utility interconnection accessibility obligation, the developer's investment model may overlook critical aspects that could affect land purchase or use.

Consultants assisting third parties in the

Depending upon the location of facility installation, the figure shows some common challenges associated with site drainage and erosion control

Design for high water flow diversion. Do not assume large, sudden storm events can pass over a facility without water depth and velocity damage. Consider conveying large flows around the site rather than flow over land

diligent evaluation of a site for sale review these high-level assumptions to validate the decision to construct a solar PV facility on the site. It's vital to include evaluation of a site's drainage and erosion control risks in these transactions, as well.

CASE STUDY: the lost customer

Improper design and construction of facilities places the solar industry at risk with some of our industry's largest preferred customers – utilities and corporate buyers. As they engage to own or directly oversee operating facilities, these customers are critical of the lack of quality and foresight in sustainable development for currently operating systems.

In one instance, a utility purchased assets as well as PPAs with third parties nationwide, and later learned the facilities developed by others did not properly address grading and drainage. To resolve the issues, protect the utility's reputation and prevent potential lawsuits, it's planning to invest more than US$1 million over the next few years on grading and drainage improvements. As a result of the experience, the utility is considering self-development of all future solar PV.

As an industry, we are in a limited time window to turn around the construction quality of facilities on the market for utilities and corporate buyers. If construction quality does not improve, utilities and corporate buyers will construct themselves and bypass the many long-term developers and contractors who have helped build the solar industry.

Urgency isn't just confined to those working in the industry: shareholders are requiring greater value for their investments, which means greater diligence at the time of sale or contract closure to ensure facilities are built with sustainability in mind; for example, not just producing carbon-free power, but also making minimum impacts on the environment.

The buyer's perspective

Two main scenarios can play out with many buyers in the solar industry: a PPA or the buyer taking primary ownership of the facility.

In a PPA scenario, the buyer is purchasing power and environmental credits from a facility owner. Risk is carried by the facility owner (developer or whomever they sold the facility/PPA to), and the buyer is typically contractually protected from a facility that violates any permits. However, buyers risk social and political fallout if their name is tied to a facility with a known issue. Utilities and corporations' shareholders demand ethical business practices. If their name is tied to a facility called out for a violation or damage to surrounding property, it can quickly create a public relations issue. Once a utility or corporation experiences this situation, it may be hesitant to invest further in solar, particularly with a past development partner.

The second scenario is an asset transfer where the buyer is taking primary ownership of a facility. When this occurs, it often spurs investigation and investment. Few utilities' operations divisions are satisfied with the quality of construction at a typical solar PV facility, particularly in regard to facility access and site drainage.

When our key clients invest in solar and don't meet expected returns, they will not continue to voluntarily invest in the technology for the long term.

When utilities acquire these assets, addressing issues up-front helps avoid the inherent social and political risk of doing nothing where there is a drainage or erosion control problem. However, the dollars spent decrease the economic value of the asset purchased to the utility as a whole.

CASE STUDY: more time or more money

An independent power producer (IPP) is developing a site for a corporate buyer. As part of this work, the utility interconnection will be owned, constructed and maintained by the utility. Access to the site is the responsibility of the IPP. The site access route was determined by the engineer-procure-construct contractor without regard to existing site drainage and soil conditions. With excessive weather events, the access route was not passable and will not be for the foreseeable future. This affects the utility's ability to build its interconnection substation on schedule, and potentially puts the project at risk of not meeting contractual obligations to the corporate buyer. While there is a solution that will work to remain on schedule, the additional US$500,000 cost of this solution to overcome saturated soil conditions is affecting project profitability; it could have been avoided with some early project planning to avoid this low area.

To protect project value and our industry's reputation, focus needs to be placed on enforcing sound design and construction approaches that support sustainable site development practices, without breaking the bank on initial capital costs. Correctly designed drainage and erosion control systems integrated into site layout can enhance the functionality of sites for greater sustainability and public benefit, and reduce life cycle costs. Failure to recognise the increasing cost impact of neglected site drainage and erosion control will create long-term impacts to profits on individual sites, and long-term damage to the solar industry, which claims to be more environmentally sensitive than other power-generation technologies.

Promising profit draws financers

Not evaluating a site for water management is a liability most project financers prefer to avoid. In the long-term need for project return, reduced profits not only result from lower production on a site, but also through additional, unscheduled maintenance and engineering study costs required to resolve ongoing regulatory and operational permit violations. As important, if surrounding landowners make a claim for damage, all parties are at risk of having to defend themselves, regardless of contractual terms.

Reduced warranty claims motivate epc contractors

An EPC (engineering, procurement and construction) contractor's contractual requirement is to build a facility that meets the priced terms and conditions. If an owner in a hurricane-prone region does not require its EPC contractor to consider lifecycle costs, or does not acknowledge there may be additional capital costs to build a road to withstand hurricane rain volumes, there is little incentive for the EPC to do otherwise. However, EPC contractors are beginning to push for greater consideration of facility design that considers the operations phase to prevent warranty

claims once they have demobilised from the site. Regardless of the claim's outcome, the result is lost profit.

CASE STUDY: taking one for the team

A facility already in operation has consistent roadway access issues during seasonal rain events. The facility was designed and built to the minimum standards contractually required by the developer and allowed by permit. The EPC contractor continues to receive requests to repair the site access road by the third-party operations management company on-site. While there is no contractual reason to provide the service, the EPC contractor's reputation is at risk.

It's discouraging for the developer, EPC contractor and operations company to spend profits working through an item that was not included in their design, and to experience reputation fallout as a result of the ongoing roadway access issues. Reviewing the long-term facility requirements post-award may have uncovered the need and opportunity to build a more durable roadway within the contracted price, given the seasonal water management requirements.

Three recommendations to build site reliability and profit

For all parties engaged in the development of a new facility, consider the following practical recommendations:

1. **Prior to construction, ensure sufficient technical analysis is completed on the site and surrounding area for both water management and erosion control.** It's important, and it's simple.

The additional cost to complete a detailed hydrology assessment for a large site (50MW+) is negligible compared to the legal fees associated with a claim of water disturbance with a surrounding landowner. A study also protects all parties from unanticipated impacts due to climate change by demonstrating the assumptions and methodologies used for design and construction were reasonable at the time it was completed. Sites should to be evaluated by a technical professional and documented as part of the project development process. A key consideration in regions with high-intensity rain events is the potential for high-water diversion paths on-site that also consider adjoining property impacts.

The standing industry approach for erosion and sediment control has been to install the minimum best management practices (BMPs) required for a permit during construction. A shift to installing the appropriate BMPs to avoid site erosion failures would prevent many issues. Installation of appropriate devices does not have to mean a significant initial capital cost addition if considered during the early development of the site. However, it might require avoidance of marginal lands/agricultural wetlands in areas such as the southeastern US, and may require additional acreage be set aside for water quality buffers in the northwest. Often the cost of the additional acreage is less than the combined cost of capital and operations and maintenance cost challenges on a site where the water has not been adequately planned.

2. **Consider a vegetative management approach or pollinator plan prior to construction.** This applies to every site, regardless of size.

It may be mowing challenges in the southeast, mesquite management in Texas or dust control in the southwest. Every solar PV facility has site conditions that affect erosion control. Each of those challenges can be solved with minimal cost (increasing profit) through site layout and equipment selection. Decisions are typically needed early in the project lifecycle while there is still opportunity to see the full economic benefit. The use of a pollinator plan would provide benefits to a project in many areas of the US and should be considered wherever possible. If vegetative management is not considered until after the site is designed and piles ordered, the additional marginal value is lost.

3. **Evaluate soils on-site during early project planning**. Invest up-front to save down the road.

Preliminary geotechnical borings are valuable in their ability to support a site development approach that solves permanent drainage and erosion control challenges for little additional capital cost. Understanding materials that will be used for trench compaction, roadway construction and general grading activities is important when concerned with long-term site stabilisation. Such knowledge can prevent soil loss or regulatory permit violations for discharges.

Failure to properly evaluate and build solar PV facilities that manage on-site drainage and erosion control is reducing the anticipated profitability of some solar facilities today. Post-construction failures lead to increased maintenance costs and regulatory non-compliance issues. Regulatory notice of noncompliance during the operations phase can negatively affect specific company and broader industry reputation.

Consideration of drainage and erosion control approaches, as part of initial project development, will benefit the long-term functionality of a site and avoid public relations challenges, which emanate from operations and maintenance failures after construction. With sites now being developed specifically for utilities and corporate buyers, there's a need for developers and contractors to adapt and price to accommodate. ■

Develop a vegetation plan for pre- and post-construction erosion control and vegetation stabilisation

Note: scenarios presented in this article are based upon the experiences of the author and co-workers while acting as director of the renewable energy programme at HDR over the past 10 years. Since 2008, the renewables team at global architectural-engineering consulting firm HDR has worked with clients to install more than 5,000 MW of utility-scale solar PV. Project names, exact locations and timelines are omitted in accordance with nondisclosure requirements associated with these scenarios.

Author

Gretchen Dolson leads HDR's renewable energy programme and is a professional civil engineer experienced in the design of renewable energy and industrial land development projects. Her leadership in the renewable energy space includes the development of more than 5,000MW of renewable energy globally. She currently leads business development and technology thought leadership efforts in the areas of solar, wind, and energy storage development at HDR. With HDR renewables staff working in more than 25 offices, Ms. Dolson and HDR's focus is on utilizing global technical expertise and local presence to deliver sustainable facilities to HDR's renewable energy clients.