# Solar Reuse Assessment

**Marshall Landfill Superfund Site, Boulder County, Colorado**

January 2026

## Introduction

The Environmental Protection Agency (EPA) Region 8 and EPA's Superfund Redevelopment Program (SRP) sponsored an energy assessment in 2025 to identify the potential for renewable energy generation at the Marshall Landfill Superfund site (the Site) in Boulder County, Colorado.

To support the energy production assessment, EPA's SRP and Region 8 coordinated with a group of site partners including the site owner, responsible parties, state and local government and consultants. Through regular stakeholder group discussions held in summer 2025, Region 8 and SRP confirmed site research findings, discussed energy production options and defined solar alternative energy as the focus of the assessment. EPA, state and local partners clarified site remedy considerations and areas suitable for solar, then conducted a site visit in August 2025.

This report outlines remedial features, inspection and maintenance requirements, and suitability considerations to support renewable energy development at the Site.

Site partners included:

- EPA Region 8
- EPA SRP
- Boulder County Community Planning & Permitting
- Colorado Department of Public Health and Environment (CDPHE)
- City of Boulder, Water Utilities
- BFI/Republic Services, Inc.
- Property Owner – the Cowdery Company
- Engineering Management Support, Inc. (EMSI)
- National Renewable Energy Laboratory (NREL)

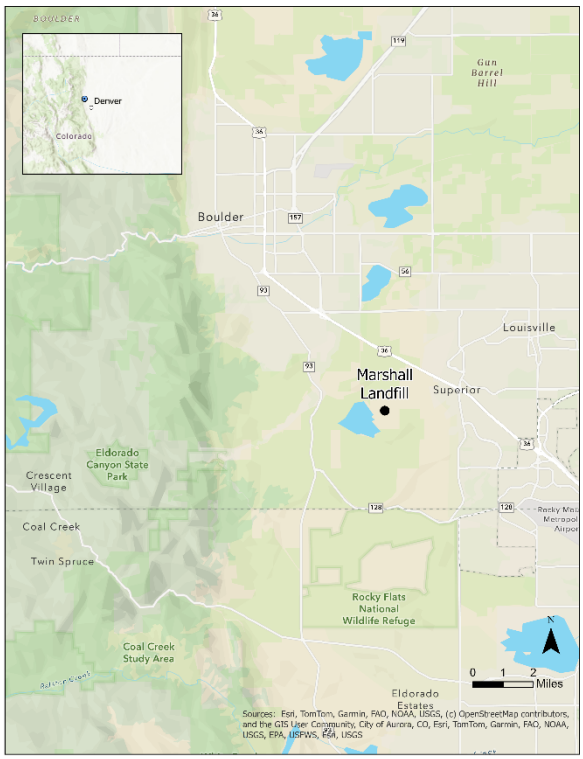


*Figure 1. Marshall Landfill Location*

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# Site Background and Remedial Considerations

## Site Location

The 160-acre Marshall Landfill site is located one mile from the town of Marshall and three miles from the cities of Boulder and Louisville in Boulder County, Colorado. It consists of two adjacent 80-acre landfills. The northern landfill is Marshall Landfill, and the southern landfill is Boulder Landfill.

## Site History

Marshall Landfill began operations in 1965 as a solid waste composting and disposal operation. Between 1969 and 1974, Marshall Landfill accepted municipal waste, sewage sludge, and unknown wastes.

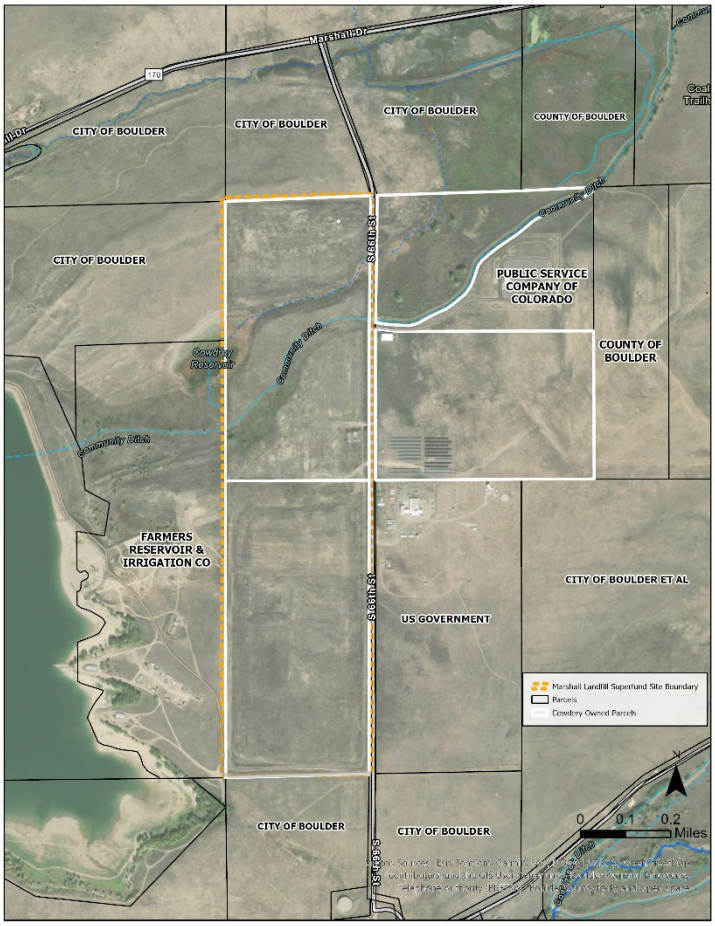


*Figure 2. Marshall Landfill Site Parcels*

Boulder County stopped waste disposal at Marshall Landfill in 1974, and the Boulder Landfill directly to the south opened. In January 1992, the Boulder Landfill closed. Landfill operations contaminated surface water and shallow groundwater. The Superfund Site consists of the two former landfills. The Cowdrey Drainage is dry for most of the year but runs through the northern part of the Site. The Community Ditch runs through an enclosed pipe on the northern part of the Site. It carries water from Marshall Lake east for the city of Louisville's drinking water and irrigation for agriculture.

Before 1970, wastes were also disposed of on the east side of South 66th Street between the Community Ditch and the Cowdrey Drainage (pre-1970 landfill and late 1960s land disturbance area). Septic wastes and possibly liquid industrial wastes were also disposed of in the closed septic ponds located east of South 66th Street and south of the Community Ditch (Historic Septic Ponds). The east side parcel is not part of the Superfund Site but is subject to institutional controls and a materials management plan, as described below.

Adjacent land uses include a storage facility for the National Center for Atmospheric Research, the Cowdery Meadows 500-kilowatt (kW) community solar garden on the east side of South 66th Street, Marshall Lake to the west of the Site, and a natural gas compressor station operated by Xcel Energy to the east of the Site.

### EPA Superfund Redevelopment Program Support

EPA's SRP provides reuse planning and technical assistance to communities, stakeholders and EPA site teams. These regional support projects help facilitate redevelopment opportunities, remove barriers to productive reuse, and ensure the future uses of Superfund sites are well aligned with the cleanup and removal/remedial process. These activities are in support of the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund). EPA's SRP provided technical assistance to EPA Region 8 through its contractor Skeo to develop an energy production assessment for the Marshall Landfill Superfund site.

## Site Remedial Status

EPA issued the Site's Record of Decision (ROD) in September 1986 and two Explanation of Significant Differences (ESDs) in 1993 and 2003. The Site's remedy included a groundwater collection and treatment system, landfill improvements and environmental monitoring programs. Landfill improvements included closure of two on-site lagoons, regrading and revegetation of the landfill, and installation of site fencing. Collection of groundwater was to be accomplished via a shallow groundwater system along the eastern and southern perimeters of the Site. Operation of the groundwater extraction and treatment plant began in 1993. With EPA approval, operation of the treatment plant was discontinued in November 2004 after it consistently met the discharge standards. The treatment plant was demolished in 2025.

EPA has completed six Five-Year Reviews for the Site; the most recent review was issued in August 2021. EPA determined that the remedy is protective of human health and the environment in the short term. The site is monitored annually to assess contaminants in groundwater and to ensure the remedy remains protective.

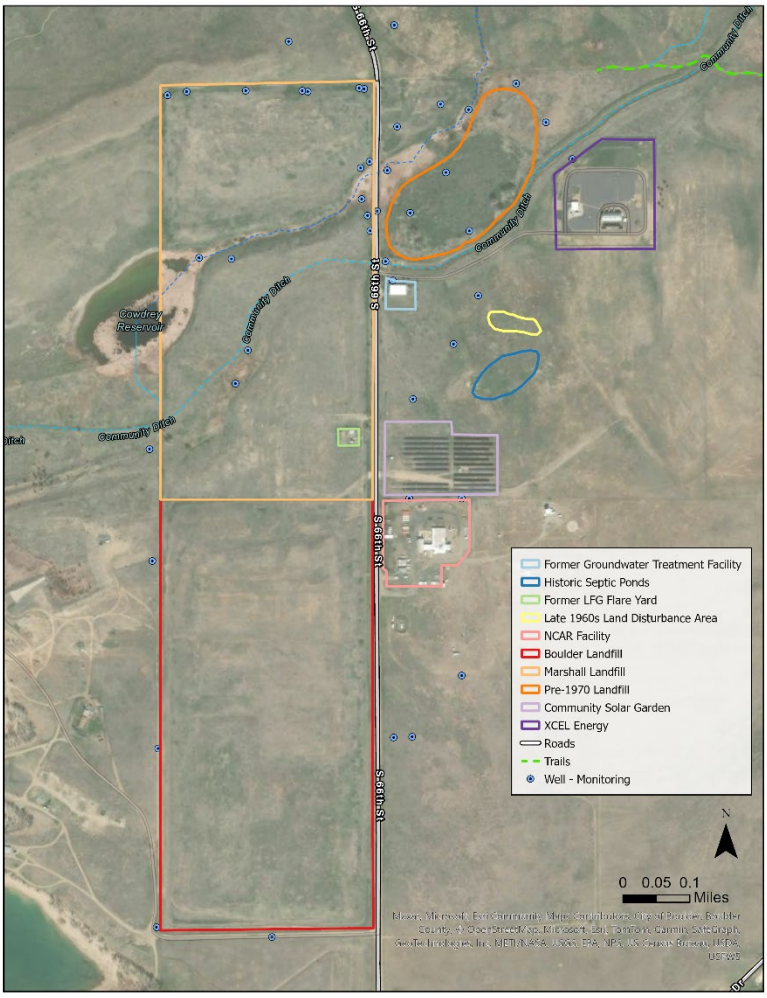


*Figure 3. Marshall Landfill Site Remedial Features and Adjacent Land Uses*

## Remedy Features

Remedy features at the Site include:

- Vegetative landfill cover.
- Landfill improvements including closure of two on-site lagoons, regrading and revegetation, and installation of perimeter site fencing.
- Implementation of drainage features, and pipeline to replace the open portion of the Community Ditch.
- Groundwater system and monitoring wells.

## Institutional Controls (Notification of Environmental Use Restrictions)

The Site's remedy also requires a notice of environmental use restrictions. In 2025, the Cowdery Company, state of Colorado and EPA established Notices of Environmental Use Restrictions for three site parcels (see Figure 2) for the Superfund Site and one parcel to the east. These environmental covenants or "institutional controls" ensure that future owners are notified of the Superfund site and detail the use restrictions and obligations for the three parcels. In the state of Colorado, CDPHE requires a materials management plan[1] for properties with a Notice of

[1]Materials Management Plan: https://oitco.hylandcloud.com/cdphermpop/docpop/docpop.aspx?docid=30933355

Environmental Use Restrictions. The materials management plan includes all three parcels and details requirements for safely managing site risks, ensuring future land use changes or development activities are compatible with site cleanups. The materials management plan details handling, segregation and disposal requirements for site material potentially impacted by chemical contaminants that may be disturbed during excavation or other soil disturbing activities within the three parcels.

### Inspection and Maintenance Requirements

Inspection and maintenance at the Site are ongoing. A Long-Term Monitoring Plan (LTMP) for the Site was first finalized in 2023, with slight revisions in 2024, which describes procedures for water quality monitoring and inspection and maintenance activities at the Site. The LTMP guides all future monitoring and maintenance activities. The Site will be inspected annually, generally in late winter/early spring. This plan was designed to support collection of data necessary to detect any significant changes in water quality at the Site; detect significant changes in the cover system at the Site; ensure site security measures are maintained; and demonstrate the ongoing protectiveness of the remedy. The LTMP also guides personnel on monitoring procedures for groundwater and surface water at and near the Site, and maintenance procedures for the landfill cover and fencing at the Site.

## Solar Suitability

Based on site remedy features, transmission access, physical features and topography, site partners identified four potential solar footprints, shown in Figure 4. These include Footprints A and B (Marshall Landfill), Footprint C (Boulder Landfill), and Footprint D (adjacent Cowdery-owned parcel east of the Site).

### Remedy Compatibility

Solar development would need to ensure that installation and operation do not interfere with integrity of the cap surface. The Site's remedy features are inspected annually, and site access is required for inspecting monitoring wells and the cap.

- Areas A and B situated on the Marshall Landfill have an 11-inch earthen cap.
- Area C includes the top-deck of the Boulder Landfill and has a clay cap.
- Area D is uncapped but subject to the same notice of environmental use restrictions and soil management plan requirements as areas A, B and C.

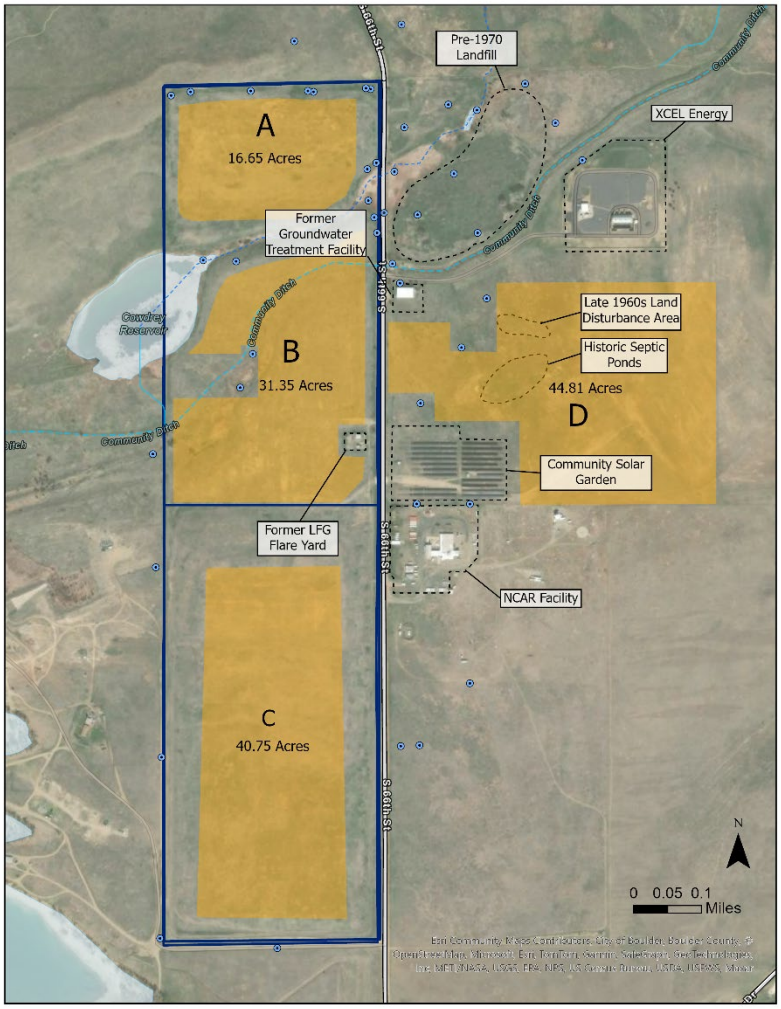


*Figure 4. Potential Solar Footprint Areas*

### Topography and Physical Features

Solar siting requires slope considerations for installation. Each of these footprints lie on flat or very gently sloping land.

- Area A is south sloping.
- Areas B and D are gently sloping to the north.

## Electric Transmission and Infrastructure Access

Connection to electric transmission lines is a key factor in identifying areas suitable for solar. The area surrounding the Site along South 66th Street includes a combination of open space, utility and public service uses. The area is served by 3-phase power lines that run along the east side of South 66th Street. The Community Solar Garden located next to Area D (see Figure 4) ties into this transmission line and likely offers the nearest access point.

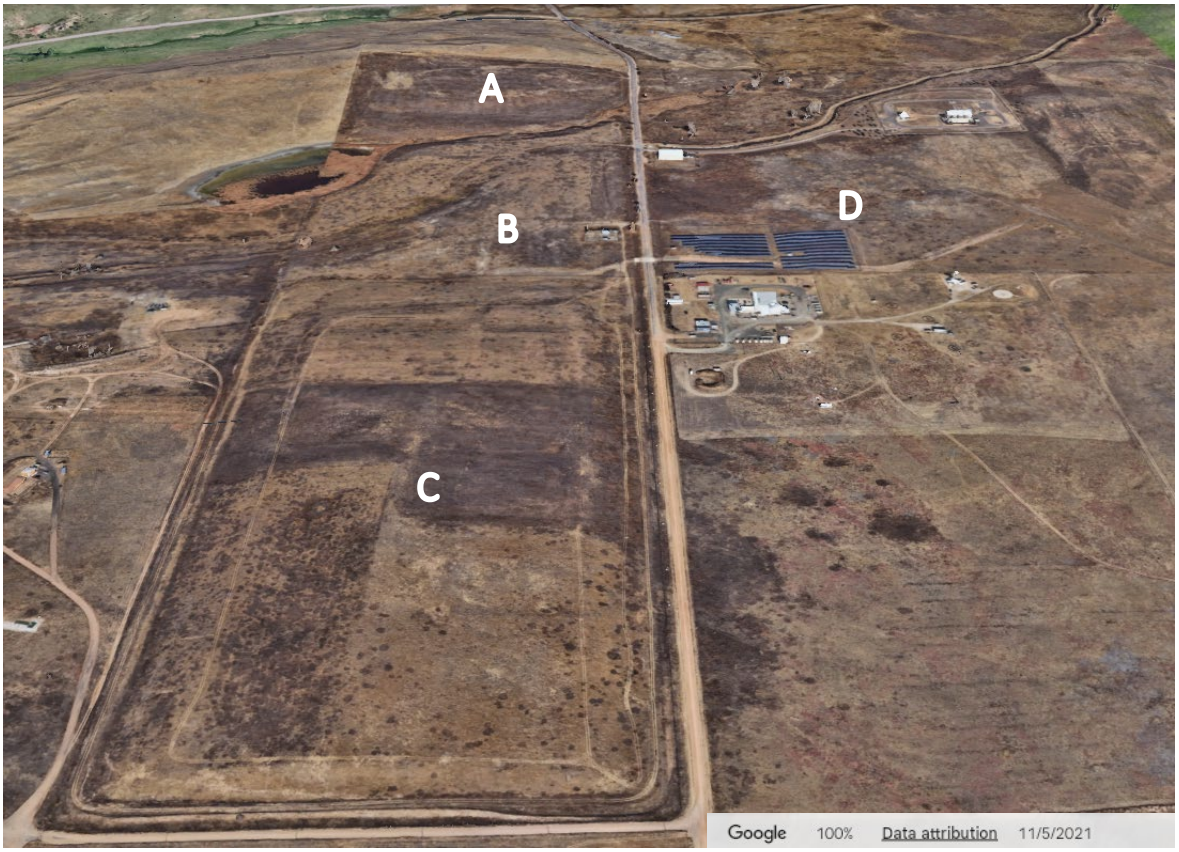


*Figure 5. Potential Solar Footprint Areas. Source: Google Earth.*

*Figure 6. Existing Community Solar Garden, East of South 66th Street*

## Local Land Use Permitting

Boulder County Planning & Zoning Department is the local government land use authority responsible for regulating land use and development codes. The County's code requires approval of a special use permit for solar projects of 2.5-10+ acres of disturbed area. The Special Use Review process takes about four to six months from application to review by the Board of County Commissioners. Hearings before both the Planning Commission and the Board of County Commissioners are required, and other meetings by advisory boards may be held.

The Site is located near several utility and public service uses, including natural gas provider Xcel Energy's compression station, a National Center for Atmospheric Research lab, City of Boulder Open Space to the north and east of the site, city of Louisville water utility operations, and a private conservation outdoor fishing club. Solar power generation is likely compatible with the local land use pattern of adjacent users spaced along a rural road in an open space area that is popular with cyclists.

The Site is also within an environmental conservation area of the county. This designation means the area is generally unfragmented open space with high quality natural resources or habitats that provide ecological benefits or have significant potential for restoration. The Site's location offers views to the west of the Flatirons mountains and Eldorado Canyon State Park. These conservation areas are popular recreation areas for climbing and hiking. Future planning for a solar project would likely need to consider views from the higher elevation state forest and local recreation areas, and adjacent conservation/open space.

Research and stakeholder discussions highlighted that solar development has expanded rapidly in Boulder County, and the permitting process will likely require considerable local land use review and public consultation. More information about the County's special use permitting process is highlighted below.


*Figure 7 and 8. Photos of the land adjacent to Marshall Landfill*

Boulder County Special Use Permitting

- A Special Use is one that may be allowed if developed in a way that is located, designed and operated in harmony with neighboring development and the surrounding area.
- A use permitted by Special Use Review may be established in a zoning district only upon approval of the Board of County Commissioners, after review by the Planning Commission, and subject to the conditions set forth in an approval of the use by the Board of County Commissioners.
- During the review process, the County considers location, design, configuration, intensity and impacts by comparing the proposal to the code criteria, intergovernmental agreements, established hazard areas, parcel-specific conditions, site context and any other applicable regulations to ensure that the use can operate in a sustainable way with minimal danger or impact to the users, the natural environment, or the developed environment.

See more on the Boulder County Special Use Review Process

## Potential Solar Photovoltaic System Generation

The approximate area available for each solar footprint is shown in Figure 4. Based on the available acreage of four potential solar footprints, the site has the capacity to generate an estimated 31.6 megawatts (MW), with an additional 15.9 MW from footprint D that lies outside of the site boundary to the north of the existing community solar garden (Table 1).[2] This estimated system size and generation capacity range is summarized in Table 1 using low and high capcity estimates based on the following assumptions:

- Lower system capacity estimates assume an energy density of 2.8 acres/MW or 0.35 MW/acre.
- Higher system capacity estimates assume an energy density of 1.6 acres/MW or 0.63 MW/acre.

*Table 1. Estimated Solar Generation*

| | Size (acres) | Estimated Photovoltaic System Capacity (MW Direct Current) | |
|---|---|---|---|
| | | Low* | High** |
| **Area A** | 16 | 5.9 | 10.1 |
| **Area B** | 31 | 11.1 | 18.8 |
| **Area C** | 40 | 14.5 | 24.8 |
| **Area D** | 44 | 15.9 | 27.1 |
| **Total** | **131** | **47.5** | **80.8** |

***Estimate based on 2.8 acres/MW or 0.35 MW/acre**
****Estimate modeled using estimated footprint sizes and NREL PVWatts calculator, which assumes 1.6 acres/MW or 0.63 MW/acre**

[2]Solar output estimates were modeled NREL PVWatts Calculator. https://pvwatts.nrel.gov/pvwatts.php.

## Mounting Systems

Photovoltaic (PV) modules are held in place by mounting systems that are either directly anchored into the ground or ballasted above the surface. Mounting systems should be designed to withstand maximum local wind conditions. Depending on the region, snow and ice loads are also considered. For the Marshall and Boulder landfills, a ballasted system, or a driven-pile system could be used to support the PV project. Regardless of the anchoring approach, mounting system design will need to comply with CDPHE's required materials management plan, which is designed to allow for modification of the cap surface with proper soil handling and compliance monitoring. Throughout the site, there is about 6 inches or less of soil cover above the landfill material, that would require further engineering designs to account for any settlement.

*Figure 9. Driven-pile Anchoring System at the Reilly Tar Superfund Site, Indianapolis, Indiana. Source: EPA.*

## Ballasted Systems

Ballasted systems are the most common anchoring method for PV systems on landfills. They typically consist of a flat tray or large concrete block placed on the landfill cap, with the array support structure attached. Construction includes placing a gravel bedding layer to create a level compact surface to support concrete ballast blocks. In some cases, compaction and shallow excavations into the topsoil layer may be needed to accommodate ballast blocks.[3] Throughout the site, there is about 6 inches or less of soil cover above the landfill material, that would require further engineering designs to account for any settlement.

*Figure 10. Ballasted Solar System. Source: NREL.*

The weight of the ballast material prevents the PV system from shifting due to wind uplift and horizontal sliding. Ballasted systems typically require either shallow excavation in the topsoil layer to establish gravel-filled trenching or placement of gravel bedding on top of a vegetated cover. Shading from panels, gravel placement and trenching will likely alter vegetation management practices. Modified vegetated cover management, like the use of shade-tolerant grass species and soil stability inspections at the footings, will likely need to be considered.

## Stormwater Management

The PV project design should consider the interaction between the PV system components and the existing stormwater management system. The design of the stormwater management system, including the design storm, runoff and stage-storage calculations, should be understood before designing the solar project. The PV system will likely affect the operation of the existing stormwater management system because it will increase the area of impervious surface of the landfill and create changes in rainfall infiltration and runoff patterns. The PV system design should include necessary alterations to the stormwater management systems affected by the predicted

[3] Best Practices for Siting Solar on Landfills. NREL. 2022.

changes in rainfall infiltration and runoff patterns. Design considerations could include construction of drainage features, resizing detention ponds and upgrading stormwater treatment systems.[4]

## Hazard Vulnerability

The Site is within the 2021 Marshall Fire perimeter, so a PV project should consider hazard vulnerability of the Site.

*Fire:* Electrical grounding a standard consideration for all PV systems and protects the PV system from electrical surges and lightning strikes. The National Electrical Code gives safety standards for grounding electrical equipment (Article 250), and wiring and grounding of PV systems (Article 690). On landfills, PV systems should be grounded into the soil buffer zones or into the landfill cap material, if the cap material and thickness can appropriately dissipate the electrical charge. If grounded to the landfill cap, grounding rods should not penetrate the landfill cover and waste material. Codes and standards associated with PV system fire prevention and protection are addressed under the International Fire Code 35 and National Fire Protection Association.[5]

*Wind Speeds:* PV mounting systems should be designed to withstand maximum local winds. According to the American Society of Civil Engineers Hazard Tool and Boulder County, design wind speed for the Site ranges between 150 and 160 miles per hour.[6] For ballasted systems, wind loading impacts determination of the panel tilt angle. Designing a PV system to withstand local wind speed requires considerations related to array tilt angle, structural support and foundation systems. The weight of the ballast material keeps the PV system anchored down and protects it from wind uplift, shearing and severe weather situations. The selection of the proper weight of the ballast material is also a key factor in the system design. The design should also consider how alternatives for accommodating wind speed could impact landfill maintenance.[7]

*Figures 11 and 12. Photos of the topography at the Marshall Landfill Site*

[4] Best Practices for Siting Solar on Landfills. NREL. 2022.
[5] Best Practices for Siting Solar on Landfills. NREL. 2022.
[6] American Society of Civil Engineers Hazard Tool. https://asce7hazardtool.online/. 2023.
[7] Best Practices for Siting Solar on Landfills. NREL. 2022.

# Solar Development Considerations

Building on the solar suitability analysis discussed above, the following pages clarify key considerations for stakeholder roles, typical economic models for solar development, potential cost considerations, and incentives.

## Stakeholder Roles for a Potential Solar Reuse Process at the Site

Key stakeholders involved in property stewardship, environmental and land use regulations for the site include: the property owner Cowdery Company, potential solar developers, local land use authority Boulder County, as well as environmental agencies CDPHE and EPA.

*Cowdery Company:* Property owner representatives have indicated that Cowdery Company will entertain potential solar development proposals to lease either or both of the two 80-acre parcels encompassing the Marshall Landfill and Boulder Landfill. Potentially responsible parties (PRPs) City of Boulder and Republic Waste Services are responsible for site remedy operation and maintenance obligations outlined in the Long-term Site Management Plan.

*Potential Solar Developers:* Solar developers interested in pursuing solar generation at the site would need to coordinate with the Cowdery Company to negotiate lease terms, and with Boulder County, CDPHE and EPA to secure appropriate development review and approvals. Proposals will need to comply with the site's remedy, LTMP, restrictive covenants, and materials management plan.

*Boulder County:* Boulder County Planning & Zoning Department is the local government land use authority responsible for regulating land use and development codes, and reviewing potential development impacts on environmental, wildlife and scenic viewsheds. Boulder County requires special use permit for solar development, which typically takes four to six months and requires a planning commission hearing.

*CDPHE:* State environmental agency CDPHE provides oversight of site long-term management plan and maintenance activities at the site and would require a materials management plan demonstrating how any disturbance to site remedy features will be addressed.

*EPA:* Federal agency EPA also provides oversight of the site's remedy and conducts periodic Five-Year Reviews to ensure the site's remedy is operational and protective of human health and the environment. EPA will require future site uses to maintain access to the site for inspection of site remedy features such as cap surface and monitoring wells. EPA can provide a site status letter, or comfort letter, outlining reasonable steps that need to be taken for maintaining the site's remedy, which can be helpful for developers. For additional information, see EPA contact information on page 14.

## Solar Development Approaches

Several typical solar development approaches are outlined below.

### Solar Land Lease Model

Solar land leasing consists of a long-term agreement between the landowner and project developer who is responsible for all aspects of project installation, development and maintenance.

- Low-cost method for building a solar project.
- Low-risk option. Payment is generally made to the site owner regardless of whether or how well a PV system operates.
- Ongoing site access is required for system operations and maintenance (O&M).
- Lease payments are generally made only once a purchase agreement with end user has been finalized.

Colorado State Community Solar Garden Law

The state's community solar garden legislation provides one path for development of a smaller sized solar project that would be designed and financed through a renewable energy subscription service. Project eligibility criteria are outlined below.

- Facility capacity of up to 5 MW alternating current or less.
- Colorado Public Utilities Commission can authorize up to 10 MW when sited in "preferred locations" or incorporating agrivoltaics.
    - "Preferred location" is a location on a rooftop, a parking lot, another impervious surface, a brownfield site, a body of water, a municipal property, a state property, or another previously disturbed location as established by the commission.
- Have at least 10 subscribers.
- Starting in 2026, investor-owned electric utility with more than 500,000 customers must make at least 50 MW of inclusive community solar capacity available, and a utility with 500,000 or fewer customers must make at least 3.5 MW of inclusive community solar available.
    - There are two investor-owned electric utility companies: Black Hills Energy and Public Service Company of Colorado (Xcel Energy). These utilities are regulated by the Colorado Public Utilities Commission.
- Interconnect to the electric distribution system of an investor-owned electric utility.
- Reserve at least 51% of its capacity for income-qualified subscribers.
- Not allocate more than 40% of the new facility's capacity to a single subscriber.
    - Subscribers: households, businesses or any other electricity customer.

## Community Solar Model

Community solar projects or purchasing programs provide power and financial benefits to multiple customers. They typically involve subscriptions to or ownership of a portion of the energy generated by a solar array. Projects generate electricity to the grid, subscribers pay for a share, the local utility pays the solar provider for the energy generated, and then subscribers receive credits that are applied to monthly electric bills.

Colorado was the first state to pass community solar legislation with the Community Solar Gardens Act in 2010, which established a framework allowing third-party developers to build solar projects that residents and organizations could subscribe to for clean energy access. In 2024, Colorado modernized its community solar laws through Senate Bill 24-207, which increased access, prioritized income-qualified subscribers, and enabled projects up to 10 MW on preferred sites. Brownfields and previously disturbed land are explicitly listed as preferred locations to qualify for approval of up to 10 MW.

The state of Colorado currently has 177 community solar projects with the capacity to produce 272.32 MW direct current, enough to power approximately 52,000 homes. The community solar garden adjacent to the Marshall Landfill site is operated by the Clean Energy Collective. This array services residential and commercial customers through Xcel Energy and produces 500 kW.

## Community Solar Gardens: Boulder County Case Studies

Several examples of community solar projects in Boulder County are included below to illustrate the local community solar approach.

Jack's Solar Garden

Jack's Solar Garden is the largest commercial agrivoltaics research site in the United States. It combines solar energy production with agricultural use and community benefit. It is a project involving NREL, Colorado State University, and local nonprofits, serving over 300 homes and supporting low-income households with donated energy. The garden also functions as an educational center promoting sustainable agrivoltaics practices.

- 3,276 solar panels generate 1.2 MW, which is enough to power over 300 homes.

- Jack's Solar Garden is the largest commercially active agrivoltaics system researching crop and vegetation growth under photovoltaic solar panels in the United States.
- Multiple agrivoltaics activities including crop production, pollinator habitat, ecosystem services, and pasture grass for grazing are being researched across the site.

Boulder Housing Partners Triangle Solar Array

The Boulder Housing Partners Triangle Solar Array is a community solar project on degraded land. It has converted challenging terrain into productive solar generation capacity that supports local affordable housing. Despite site constraints like rocky soils and prairie dog burrows, the project successfully installed a solar array contributing to renewable energy and housing sustainability goals for the community. The project is one of the first solar arrays in Boulder that is solely dedicated to offsetting energy use for low-income residents. The array is a south-facing fixed array with the leading edge of the solar panels about two feet off the ground. Construction was completed in 2021, and the array will generate over 19 Gigawatt hours of solar energy in the next 10 years.

### Utility Scale Solar Opportunities

The size and potential solar generation of the Marshall Landfill site allows utility scale solar to also be a viable option for reuse. In the state, large-scale solar farms are typically 15 MW or larger and range from 75 acres to several thousand acres per project.

- Colorado has a total operating capacity of utility-scale solar of approximately 2,341 to 2,402 MW.
- The number of utility-scale solar farms in Colorado is around 166 projects.
- Colorado targets 9 GW of renewable energy capacity by 2030, with utility-scale solar being a major component requiring tens of thousands of acres for development.

An example of utility scale solar in Colorado is the 293 MW Sun Mountain solar project in Pueblo, Colorado. The project entered commercial operation in 2022. Lightsource BP owns and operates the facility, delivering the solar energy generated to Xcel Energy under a long-term power purchase agreement. The power purchase agreement supports Xcel's current Colorado Energy Plan to provide electricity from approximately 80% renewable sources and reduce carbon emissions 85% by 2030.

## Potential Solar PV System Costs

Potential cost estimates associated with the solar PV footprints discussed are outlined in Table 3. The cost of solar PV development includes installation costs and annual costs of O&M. O&M includes inverter replacement, operations administration, module replacement, property tax and other factors.[8] Table 3 outlines the estimated costs for each solar footprint are generated from NREL's System Advisor Model (SAM).

*Table 3. Estimated Costs for Installation and O&M for Both Conservative and Higher Capacity Estimates*

| Solar Footprint | Size (acres) | Estimated Capacity (kW) Conservative | Installed Costs ($1.30/Wdc) | Installed Costs ($1.80/Wdc) | Annual O&M Costs | Estimated Capacity (kW) | Installed Costs ($1.30/Wdc) | Installed Costs ($1.80/Wdc) | Annual O&M Costs |
|---|---|---|---|---|---|---|---|---|---|
| Footprint A | 16 | 5,951 | $ 7,736,948 | $ 10,712,697 | $ 77,369 | 10,116 | $ 13,150,800 | $ 18,208,800 | $ 131,508 |
| Footprint B | 31 | 11,087 | $ 14,412,934 | $ 19,956,370 | $ 144,129 | 18,844 | $ 24,497,200 | $ 33,919,200 | $ 244,972 |
| Footprint C | 40 | 14,596 | $ 18,974,337 | $ 26,272,159 | $ 189,743 | 24,808 | $ 32,250,400 | $ 44,654,400 | $ 322,504 |
| Footprint D | 44 | 15,951 | $ 20,736,489 | $ 28,712,062 | $ 207,365 | 27,112 | $ 35,245,600 | $ 48,801,600 | $ 352,456 |
| Total | 131 | 47,585 | $ 61,860,708 | $ 85,653,288 | $ 618,607 | 80,880 | $ 105,144,000 | $ 145,584,000 | $ 1,051,440 |

***Solar output estimates were modeled using estimated footprint sizes and NREL's pvWatts calculator**
***Based on the System Advisor Model (SAM) https://sam.nrel.gov/**
***Assumes that the installed costs = 1.30-1.80$/Watts Direct Current (Wdc) (includes range for environmental materials management) and annual O&M cost =$13/kW-year**

[8] Best Practices for Siting Solar on Landfills. NREL. 2022.

## Incentives

### Federal Incentives

For commercial solar projects, the 30% investment tax credit remains available for systems that begin physical construction by July 4, 2026, or are placed in service by December 31, 2027.

### State and Local Incentives

The state of Colorado and public utilities offer a range of additional incentives that help to reduce installation, operating or land costs.

- Colorado State Property Tax and Sales/Use Tax Exemption – The state offers a sales and use tax exemption for components used in the production of alternating current electricity from a renewable energy source. This incentive eliminates a 2.9% state sales tax on the equipment. In addition the state offers a property tax exemption that limits property tax increases due to the value-added solar panel installations on commercial or community solar facilities.
- Xcel Solar Rewards – The electric utility Xcel offers per-kilowatt-hour cash incentives for utility customers who install solar. Commercial and industrial projects receive performance-based payments monthly based on energy generated.
- Xcel Net Energy Metering – Xcel also Offset electric consumption by selling back the excess electricity generated. Solar customers get credited for the excess energy their system produces by offsetting the electricity consumed from the grid.
- PACE Solar Rebate – Property Assessed Clean Energy (PACE) program provides financing for solar installations that is repaid through property tax assessments. This allows property owners to install solar without upfront costs, and repay over time through their property tax bill. This tool supports commercial and community solar projects. Rebate for the installation of solar PV systems for businesses, nonprofit organizations, and multifamily housing in Boulder County.

*Figure 13. Photo of the Marshall Landfill Site and adjacent view.*

## Conclusions and Recommendations

This project evaluated four potential areas at the Site for solar renewable energy generation. Preliminary costs are estimated for installation and ongoing O&M and can serve as a starting point for evaluating the project's feasibility. Within the landfill footprint, ballasted solar arrays could be sited on top of the cap and designed for compatibility with the Site's remedy features and institutional controls.

### Potential Next Steps

The Site would benefit from a more in-depth solar assessment. Additional solar reuse assessment recommendations are outlined below.

- *Potential Solar Generation Capacity:* The site offers three potential solar footprints at the Marshall Landfill and Boulder Landfill with potential to generate 31.6 MW. An additional solar footprint outside of the landfill areas to the north of the existing community solar garden offers potential to generate 15.9 MW from footprint D that lies outside of the site boundary.
- *Further Engineering Evaluations:* To refine the solar PV project siting, further engineering designs are warranted and would likely include evaluations for structural stability and potential for settlement, identifying additional stormwater runoff volumes and stormwater management features, wind shear and loading impacts, specific solar array layout and vegetation management modifications. These analyses will also need to consider local land use permitting requirements and the state's required materials management plan requirements.
- *Stakeholder Roles in Development Approval Process:* Solar development partners can to coordinate directly with the following entities: Property owner Cowdery Company regarding potential solar lease agreements; Boulder County to apply for a special use permit and initiate the land use permitting process; CDPHE regarding project compatibility with the site's Long-term Management Plan and a Materials Management Plan, and with EPA regarding overall compatibility with the site's remedy and available prospective lessee liability protections.
- *Development Approaches:* With significant acreage available for siting a potential solar array, project development models are likely to include a land lease for either community solar or utility scale solar PV project. Transmission infrastructure capacity, available financial incentives, permitting approvals are key factors that will help determine project size and development model.

The Marshall Landfill site has potential for a variety of solar development approaches and system sizes. Future development at the site would need to include close coordination with the property owner Cowdery Company, EPA, CDPHE and Boulder County. For additional information, please see the EPA contact listed below.

### Contact Information

**Marshall Landfill Site Profile:**
www.epa.gov/superfund/marshall-landfill

**EPA Region 8:**

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