PROJECT REPORT

TO: ENVIRONMENTAL EVALUATION COMMITTEE **AGENDA DATE: August 12, 2021**

Informational Item Only
FROM: PLANNING & DEVELOPMENT SERVICES DEPT. AGENDA TIME 1:30 PM/No1.

PROJECT TYPE: GPA #21-0003, ZC #21-0003, & CUP #20-0030 & WSA
SUPERVISOR DISTRICT 4

LOCATION: 1 mile north of City of Brawley APN: 037-140-006, 020, 021, 022 and 023

Brawley, CA 92227 PARCEL SIZE: 227 acres

GENERAL PLAN (existing) Agriculture/Geothermal Overlay Zone GENERAL PLAN (proposed) RE

ZONE (existing) A-2 G ZONE (proposed) A-2 G- RE

GENERAL PLAN FINDINGS ☒ CONSISTENT ☐ INCONSISTENT ☐ MAY BE/FINDINGS

PLANNING COMMISSION DECISION: HEARING DATE:

☐ APPROVED ☐ DENIED ☐ OTHER

PLANNING DIRECTORS DECISION: HEARING DATE:

☐ APPROVED ☐ DENIED ☐ OTHER

ENVIROMENTAL EVALUATION COMMITTEE DECISION: HEARING DATE: 08/122021

INITIAL STUDY: **20-0004**

☐ NEGATIVE DECLARATION ☐ MITIGATED NEG. DECLARATION ☒ EIR

DEPARTMENTAL REPORTS / APPROVALS:

PUBLIC WORKS	☒ NONE	☐ ATTACHED
AG / APCD	☒ NONE	☐ ATTACHED
E.H.S.	☒ NONE	☐ ATTACHED
FIRE / OES	☒ NONE	☐ ATTACHED
OTHER	(See Attached)	

REQUESTED ACTION:

SEE ATTACHED

Planning & Development Services Department
801 MAIN ST., EL CENTRO, CA, 92243 760-482-4236
(Jim Minnick, ICPDS Director)
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Initial Study and NOP

Brawley Solar Energy Facility Project

Imperial County, CA

July 2021

Reviewed by:	**Prepared by:**
County of Imperial	HDR Engineering, Inc.
Planning & Development Services Department	591 Camino de la Reina, Suite 300
801 Main Street	San Diego, CA 92108
El Centro, CA 92243	

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Contents

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Introduction

A. Purpose

This document is a ☐ policy-level; ☒ project-level Initial Study for evaluation of potential environmental impacts resulting with the proposed Brawley Solar Energy Facility Project.

B. CEQA Requirements and the Imperial County's Rules and Regulations for Implementing CEQA

As defined by Section 15063 of the State California Environmental Quality Act (CEQA) Guidelines and Section 7 of the County's Rules and Regulations for Implementing CEQA, an **Initial Study** is prepared primarily to provide the Lead Agency with information to use as the basis for determining whether an Environmental Impact Report (EIR), Negative Declaration, or Mitigated Negative Declaration would be appropriate for providing the necessary environmental documentation and clearance for any proposed project.

☒ According to Section 15065, an **EIR** is deemed appropriate for a particular proposal if the following conditions occur:

- The proposal has the potential to substantially degrade quality of the environment.
- The proposal has the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.
- The proposal has possible environmental effects that are individually limited but cumulatively considerable.
- The proposal could cause direct or indirect adverse effects on human beings.

☐ According to Section 15070(a), a **Negative Declaration** is deemed appropriate if the proposal would not result in any significant effect on the environment.

☐ According to Section 15070(b), a **Mitigated Negative Declaration** is deemed appropriate if it is determined that though a proposal could result in a significant effect, mitigation measures are available to reduce these significant effects to insignificant levels.

This Initial Study has determined that the proposed applications will result in potentially significant environmental impacts and therefore, an Environmental Impact Report is deemed as the appropriate document to provide necessary environmental evaluations and clearance for the proposed project.

This Initial Study and Notice of Preparation are prepared in conformance with the California Environmental Quality Act of 1970, as amended (Public Resources Code, Section 21000 et. seq.); the State CEQA Guidelines & County of Imperial's CEQA Regulations, Guidelines for the Implementation of CEQA; applicable requirements of the County of Imperial; and the regulations, requirements, and procedures of any other responsible public agency or an agency with jurisdiction by law.

Pursuant to the County of Imperial's CEQA Regulations, Guidelines for the Implementation of CEQA, depending on the project scope, the County of Imperial Board of Supervisors, Planning

Commission and/or Planning Director is designated the Lead Agency, in accordance with Section 15050 of the CEQA Guidelines. The Lead Agency is the public agency which has the principal responsibility for approving the necessary environmental clearances and analyses for any project in the County.

C. Intended Uses of Initial Study and Notice of Preparation

This Initial Study and Notice of Preparation are informational documents which are intended to inform County of Imperial decision makers, other responsible or interested agencies, and the general public of potential environmental effects of the proposed applications. The environmental review process has been established to enable public agencies to evaluate environmental consequences and to examine and implement methods of eliminating or reducing any potentially adverse impacts. While CEQA requires that consideration be given to avoiding environmental damage, the Lead Agency and other responsible public agencies must balance adverse environmental effects against other public objectives, including economic and social goals.

The Initial Study and Notice of Preparation, prepared for the project will be circulated for a period of no less than 35 days for public and agency review and comments.

D. Contents of Initial Study and Notice of Preparation

This Initial Study is organized to facilitate a basic understanding of the existing setting and environmental implications of the proposed applications.

SECTION 1

I. INTRODUCTION presents an introduction to the entire report. This section discusses the environmental process, scope of environmental review, and incorporation by reference documents.

SECTION 2

II. ENVIRONMENTAL CHECKLIST FORM contains the County's Environmental Checklist Form. The checklist form presents results of the environmental evaluation for the proposed applications and those issue areas that would have either a significant impact, potentially significant impact, or no impact.

PROJECT SUMMARY, LOCATION AND ENVIRONMENTAL SETTINGS describes the proposed project entitlements and required applications. A description of discretionary approvals and permits required for project implementation is also included. It also identifies the location of the project and a general description of the surrounding environmental settings.

ENVIRONMENTAL ANALYSIS evaluates each response provided in the environmental checklist form. Each response checked in the checklist form is discussed and supported with sufficient data and analysis as necessary. As appropriate, each response discussion describes and identifies specific impacts anticipated with project implementation.

SECTION 3

III. MANDATORY FINDINGS presents Mandatory Findings of Significance in accordance with Section 15065 of the CEQA Guidelines.

E. Scope of Environmental Analysis

For evaluation of environmental impacts, each question from the Environmental Checklist Form is summarized and responses are provided according to the analysis undertaken as part of the Initial Study. Impacts and effects will be evaluated and quantified, when appropriate. To each question, there are four possible responses, including:

1. No Impact: A "No Impact" response is adequately supported if the impact simply does not apply to the proposed applications.
2. Less Than Significant Impact: The proposed applications will have the potential to impact the environment. These impacts, however, will be less than significant; no additional analysis is required.
3. Less Than Significant With Mitigation Incorporated: This applies where incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact."
4. Potentially Significant Impact: The proposed applications could have impacts that are considered significant. Additional analyses and possibly an EIR could be required to identify mitigation measures that could reduce these impacts to less than significant levels.

F. Policy-Level or Project-Level Environmental Analysis

This Initial Study will be conducted under a ☐ policy-level, ☒project-level analysis.

Regarding mitigation measures, it is not the intent of this document to "overlap" or restate conditions of approval that are commonly established for future known projects or the proposed applications. Additionally, those other standard requirements and regulations that any development must comply with, that are outside the County's jurisdiction, are also not considered mitigation measures, and therefore, will not be identified in this document.

G. Tiered Documents and Incorporation by Reference

Information, findings, and conclusions contained in this document are based on incorporation by reference of tiered documentation, which are discussed in the following section.

1. **Tiered Documents**

   As permitted in Section 15152(a) of the CEQA Guidelines, information and discussions from other documents can be included into this document. Tiering is defined as follows:

   "Tiering refers to using the analysis of general matters contained in a broader EIR (such as the one prepared for a general plan or policy statement) with later EIRs and negative declarations on narrower projects; incorporating by reference the general discussions from the broader EIR; and concentrating the later EIR or negative declaration solely on the issues specific to the later project."

   Tiering also allows this document to comply with Section 15152(b) of the CEQA Guidelines, which discourages redundant analyses, as follows:

   "Agencies are encouraged to tier the environmental analyses which they prepare for separate but related projects including the general plans, zoning changes, and development

projects. This approach can eliminate repetitive discussion of the same issues and focus the later EIR or negative declaration on the actual issues ripe for decision at each level of environmental review. Tiering is appropriate when the sequence of analysis is from an EIR prepared for a general plan, policy or program to an EIR or negative declaration for another plan, policy, or program of lesser scope, or to a site-specific EIR or negative declaration."

Further, Section 15152(d) of the CEQA Guidelines states:

"Where an EIR has been prepared and certified for a program, plan, policy, or ordinance consistent with the requirements of this section, any lead agency for a later project pursuant to or consistent with the program, plan, policy, or ordinance should limit the EIR or negative declaration on the later project to effects which:

(1) Were not examined as significant effects on the environment in the prior EIR; or

(2) Are susceptible to substantial reduction or avoidance by the choice of specific revisions in the project, by the imposition of conditions, or other means."

2. **Incorporation by Reference**

Incorporation by reference is a procedure for reducing the size of EIRs/MND and is most appropriate for including long, descriptive, or technical materials that provide general background information, but do not contribute directly to the specific analysis of the project itself. This procedure is particularly useful when an EIR or Negative Declaration relies on a broadly-drafted EIR for its evaluation of cumulative impacts of related projects (*Las Virgenes Homeowners Federation v. County of Los Angeles* [1986, 177 Ca.3d 300]). If an EIR or Negative Declaration relies on information from a supporting study that is available to the public, the EIR or Negative Declaration cannot be deemed unsupported by evidence or analysis (*San Francisco Ecology Center v. City and County of San Francisco* [1975, 48 Ca.3d 584, 595]).

When an EIR or Negative Declaration incorporates a document by reference, the incorporation must comply with Section 15150 of the CEQA Guidelines as follows:

- The incorporated document must be available to the public or be a matter of public record (CEQA Guidelines Section 15150[a]). The General Plan EIR is available, along with this document, at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243 Ph. (442) 265-1736.
- This document must be available for inspection by the public at an office of the lead agency (CEQA Guidelines Section 15150[b]). These documents are available at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243, Ph. (442) 265-1736.
- These documents must summarize the portion of the document being incorporated by reference or briefly describe information that cannot be summarized. Furthermore, these documents must describe the relationship between the incorporated information and the analysis in the tiered documents (CEQA Guidelines Section 15150[c]). As discussed above, the tiered EIRs address the entire project site and provide background and inventory information and data which apply to the project site. Incorporated information and/or data will be cited in the appropriate sections.

- These documents must include the State identification number of the incorporated documents (CEQA Guidelines Section 15150[d]). The State Clearinghouse Number for the 'County of Imperial General Plan EIR is SCH #93011023.

The material to be incorporated in this document will include general background information (CEQA Guidelines Section 15150[f]).

Environmental Checklist Form

1. **Project Title:** Brawley Solar Energy Facility Project
2. **Lead Agency name and address:** Imperial County Planning & Development Services Department, 801 Main Street, El Centro, CA 92243
3. **Contact person and phone number:** David Black, Planner IV, 442-265-1746
4. **Project location:** The project site is located on approximately 227 acres of privately-owned land in the unincorporated area of Imperial County, CA. The site is approximately one mile north from the City of Brawley's jurisdictional limit. The project site is south of Baughman Road, west of Best Road, and north of Andre Road. The Union Pacific Railway transects the project site. The City of Brawley Wastewater Treatment Plant is located along the western edge of the project site.

   The gen-tie line would originate from the southern edge of the project site and then head west along Andre Road to interconnect to the Imperial Irrigation District's (IID) existing North Brawley Geothermal Power Plant substation, located at Hovley Road and Andre Road. The gen-tie line route would be approximately 1.8 miles.
5. **Project sponsor's name and address:** ORNI 30, LLC, 6140 Plumas Street, Reno, Nevada 89519
6. **General Plan Designation:** Agriculture
7. **Zoning:** A-2-G (General Agricultural with a Geothermal Overlay)
8. **Description of project:** The project applicant, ORNI 30, LLC, proposes to construct and operate a 40 megawatt (MW) photovoltaic (PV) solar facility with an integrated 40 MW battery storage system (BESS) (not to exceed 80 MW) on approximately 227 acres of privately-owned land. The proposed project would be comprised of bifacial solar PV arrays panels, an on-site substation, BESS, fiberoptic line or microwave tower, inverters, transformers, underground electrical cables and access roads. The proposed project would connect to the existing North Brawley Geothermal Power Plant substation located southwest of the project site via an approximately 1.8-mile long aboveground 92 kilovolt generation tie line.
9. **Surrounding land uses and setting: Briefly describe the project's surroundings:** The project site contains alfalfa fields within different levels of harvest. North and east of the project site is undeveloped agricultural land. South of the project site is a mixture of undeveloped agricultural land and dirt lots used for staging activities. The Del Rio Country Club golf course is located to the south of the site. The City of Brawley Wastewater Treatment Plant is located along the western edge of the project site.
10. **Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.):**
    - Department of Public Works – Ministerial permits (building, grading, encroachment)
    - Imperial County Air Pollution Control District – Fugitive dust control plan, Authority to construct

- California Regional Water Quality Control Board – Notice of Intent for General Construction Permit
- Imperial Irrigation District – Water supply agreement/permit for water use lease agreement

11. Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?

Yes, the Torrez Martinez Desert Cahuilla Indians and Quechan Indian Tribe. These tribes were sent an AB 52 consultation request letter on July 20, 2021.

Environmental Factors Potentially Affected

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

☒	Aesthetics	☒	Agriculture and Forestry Resources	☒	Air Quality
☒	Biological Resources	☒	Cultural Resources	☐	Energy
☒	Geology/Soils	☒	Greenhouse Gas Emissions	☒	Hazards & Hazardous Materials
☒	Hydrology / Water Quality	☒	Land Use/Planning	☐	Mineral Resources
☐	Noise	☐	Population/Housing	☒	Public Services
☐	Recreation	☒	Transportation	☒	Tribal Cultural Resources
☒	Utilities/Service Systems	☐	Wildfire	☒	Mandatory Findings of Significance

Environmental Evaluation Committee Determination

After Review of the Initial Study, the Environmental Evaluation Committee (EEC) has:

☐ Found that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ Found that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ Found that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ Found that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ Found that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

CALIFORNIA DEPARTMENT OF FISH AND GAME DE MINIMIS IMPACT FINDING:

☐Yes ☐No

EEC VOTES	YES	NO	ABSENT
PUBLIC WORKS	☐	☐	☐
ENVIRONMENTAL HEALTH	☐	☐	☐
OFFICE EMERGENCY SERVICES	☐	☐	☐
APCD	☐	☐	☐
AG	☐	☐	☐
SHERIFF DEPARTMENT	☐	☐	☐
ICPDS	☐	☐	☐

Jim Minnick, Director of Planning/EEC Chairman

Signature

Date:

Project Summary

Project Location

The project site is located on approximately 227 acres of privately-owned land in the unincorporated area of Imperial County, CA. The site is approximately one mile north from the City of Brawley's jurisdictional limit (Figure 1). As shown in Figure 2, the project site is south of Baughman Road, west of Best Road, and north of Andre Road. The Union Pacific Railway transects the project site. The City of Brawley Wastewater Treatment Plant is located along the western edge of the project site.

The gen-tie line would originate from the southern edge of the project site and then head west along Andre Road to interconnect to the Imperial Irrigation District's (IID) existing North Brawley Geothermal Power Plant substation, located at Hovley Road and Andre Road. The gen-tie line route would be approximately 1.8 miles.

Project Summary

The project applicant, ORNI 30, LLC, proposes to construct and operate a 40 megawatt (MW) photovoltaic (PV) solar facility with an integrated 40 MW battery storage system (BESS) (not to exceed 80 MW) on approximately 227 acres of privately-owned land. The proposed project would be comprised of bifacial solar PV arrays panels, an on-site substation, BESS building, fiberoptic line or microwave tower, inverters, transformers, underground electrical cables and access roads. The proposed project would connect to the existing North Brawley Geothermal Power Plant substation located southwest of the project site via an approximately 1.8-mile long aboveground 92 kilovolt generation tie line.

Environmental Setting

The project site contains alfalfa fields within different levels of harvest. North and east of the project site is undeveloped agricultural land. South of the project site is a mixture of undeveloped agricultural land and dirt lots used for staging activities. The Del Rio Country Club golf course is located to the south of the site. The City of Brawley Wastewater Treatment Plant is located along the western edge of the project site.

General Plan Consistency

The proposed project is located within an unincorporated area of the County. The existing General Plan land use designation is Agriculture. The project site is currently zoned A-2-G (General Agricultural with a Geothermal Overlay). Construction of a solar facility would be allowed within the existing zoning under a Conditional Use Permit.

The County Land Use Ordinance, Division 17, includes the Renewable Energy (RE) Overlay Zone, which authorizes the development and operation of renewable energy projects, with an approved CUP. CUP applications proposed for specific renewable energy project not located in the RE Overlay Zone would not be allowed without an amendment to the RE Overlay Zone. As shown in Figure 1, the northern portion of the project site (APNs 037-140-020 and 037-140-021) is located within the Geothermal Overlay Zone. However, the entire project site (APNs 037-140-020, 037-140-021, 037-140-022, 037-140-023, and 037-140-006) is located outside of the RE Overlay Zone. Therefore, the proposed project requires a General Plan Amendment and Zone Change to

include/classify all five project parcels into the RE Overlay Zone. No change in the underlying General Plan land use (Agriculture) is proposed.

Figure 1. Regional Location

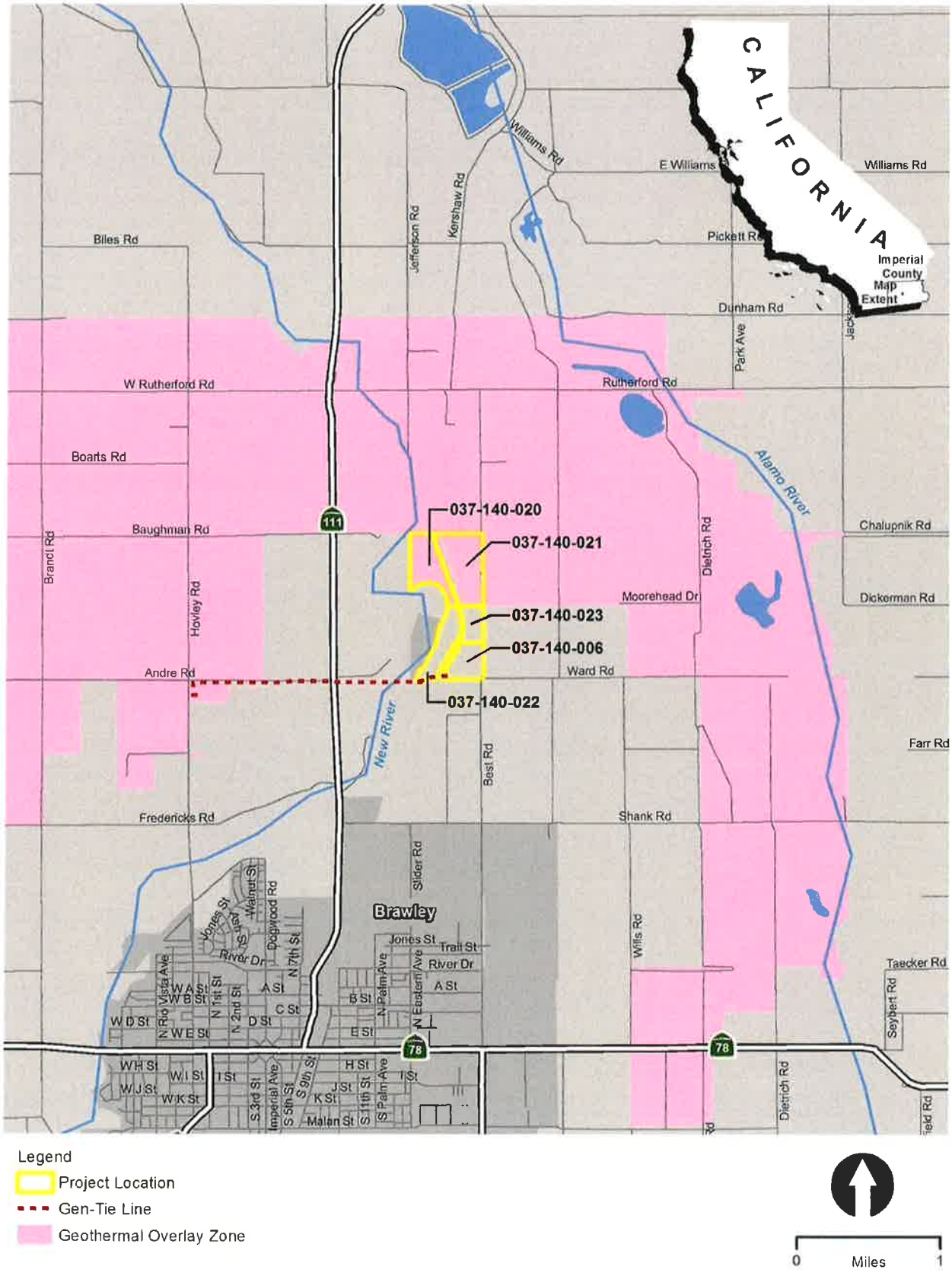

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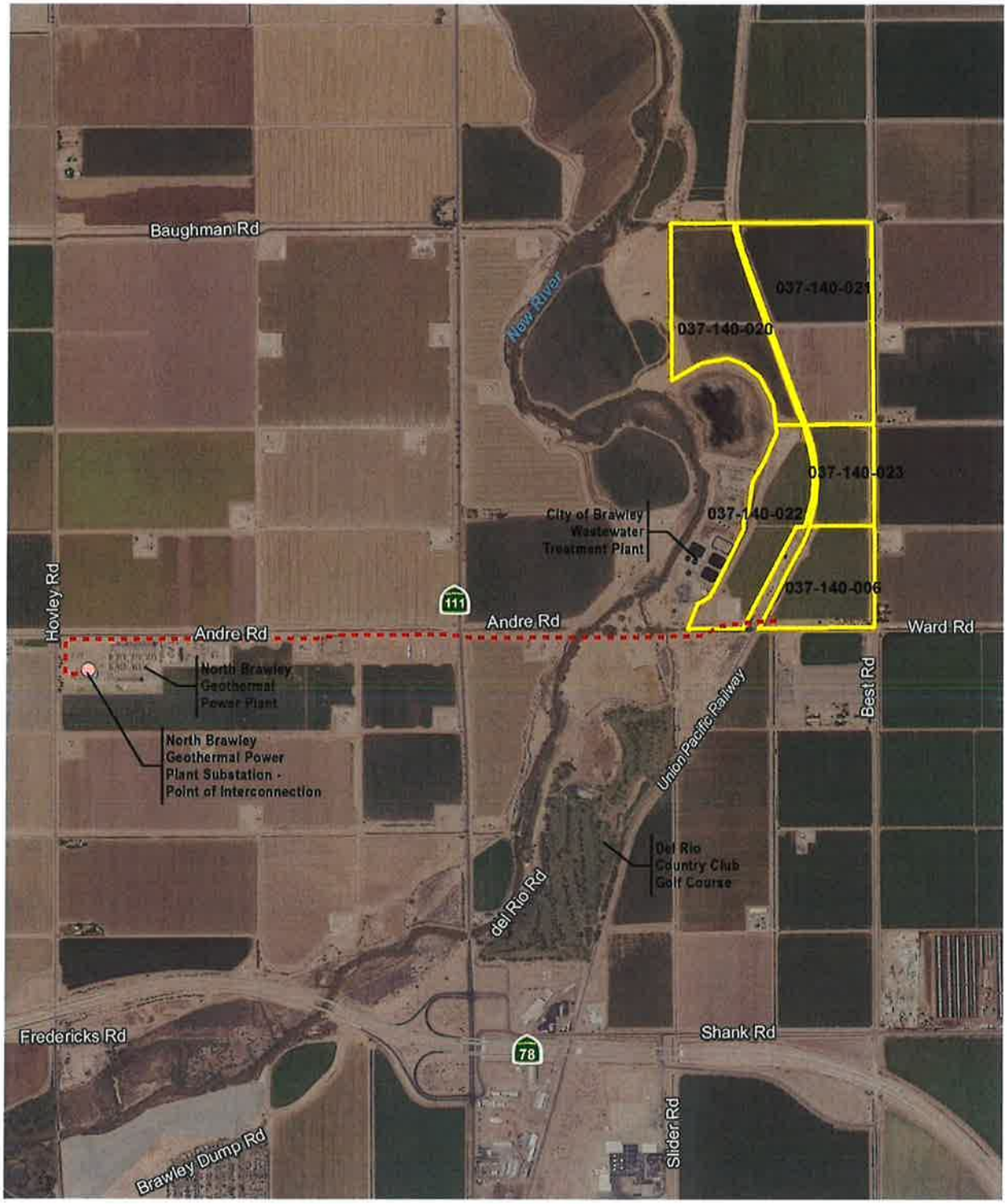
Figure 2. Project Site



Evaluation of Environmental Impacts

1. A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors, as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).
2. All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
3. Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.
4. "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from "Earlier Analyses," as described in (5) below, may be cross-referenced).
5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
    a. Earlier Analysis Used. Identify and state where they are available for review.
    b. Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
    c. Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6. Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.
7. Supporting Information Sources: A source list should be attached, and other sources used, or individuals contacted should be cited in the discussion.
8. This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.
9. The explanation of each issue should identify:
    a. The significance criteria or threshold, if any, used to evaluate each question; and
    b. The mitigation measure identified, if any, to reduce the impact to less than significance.

I. Aesthetics

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Except as provided in Public Resources Code Section 21099, would the project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic building within a state scenic highway?	☐	☐	☐	☒
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage points). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☒	☐	☐	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☒	☐	☐	☐

Impact Analysis

a) **No Impact.** According to the Conservation and Open Space Element of the Imperial County General Plan, the project site is not located within an area that has been formally identified as a federal, state, or county scenic vista (County of Imperial 2016). No scenic vistas or areas with high visual quality would be disrupted. Thus, no impact is identified for this issue area and no further analysis is warranted.

b) **No Impact.** According to the California Department of Transportation (Caltrans) California Scenic Highway Mapping System (Caltrans 2018), the project site is not located within a state scenic highway corridor, nor are there any state scenic highways located in proximity to the project site. The proposed project would not substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic building within a state scenic highway. Therefore, no impact is identified for this issue area and no further analysis is warranted.

c) **Potentially Significant Impact.** Although the project site is not located near a scenic highway or designated scenic vista, the proposed project may result in a change to the look and rural character of the surrounding area. Therefore, a potentially significant impact is identified for this issue area. A visualization study will be prepared for the project and this issue will be addressed in the EIR.

d) **Potentially Significant Impact.** Minimal lighting is required for project operation and is limited to safety and security functions. All lighting will be directed away from any public right-

of-way; however, there are no heavily traveled public roadways in immediate proximity to the project site.

The solar panels will be constructed of low reflective materials; therefore, it is not anticipated that they would result in creating glare. Additionally, the proposed project is located in a rural undeveloped area of Imperial County. There are no established residential neighborhoods immediately adjacent to the project site. However, there are three residences located immediately east of the project site along Best Road. Although the proposed project is not expected to create a new source of substantial light or glare affecting day or nighttime views, a glare study will be prepared for the proposed project and this issue will be addressed in the EIR. Therefore, a potentially significant impact is identified for this issue area.

The Brawley Municipal Airport is located approximately 1.5 miles south of the project site. Although the solar panels will be constructed of low reflective materials, the potential for glare to impact aircraft will be analyzed further in the EIR.

II. Agriculture and Forestry Resources

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☒	☐	☐	☐
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☒	☐	☐	☐
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☒	☐	☐	☐

Impact Analysis

a) **Potentially Significant Impact.** According to the farmland maps prepared by the California Department of Conservation (DOC) (California DOC 2018), the majority of the project site is designated as Farmland of Statewide Importance, with a pocket of Prime Farmland located in the southern portion of the project site. Therefore, implementation of the proposed project

may result in a potentially significant impact associated with the conversion of Prime Farmland and Farmland of Statewide Importance to non-agricultural use.

b) **Potentially Significant Impact.** The project site is currently designated by the General Plan as "Agriculture" and is zoned A-2-G (General Agricultural with a Geothermal Overlay). Pursuant to Title 9, Division 5, Chapter 8 (County of Imperial 2019a), the following uses are permitted in the A-2 zone subject to approval of a CUP from Imperial County: solar energy electrical generator, battery storage facility, electrical substations, communication towers, and facilities for the transmission of electrical energy. Because the project site is located on lands designated for agricultural uses, this issue will be analyzed in further detail in the EIR.

According to the 2016/2017 Imperial County Williamson Act Map produced by the California Department of Conservation's Division of Land Resource Protection (California DOC 2016), the project site is not located on Williamson Act contracted land. Therefore, the proposed project would not conflict with a Williamson Act contract and no impact would occur.

c) **No Impact.** There are no existing forest lands, timberlands, or timberland zoned "Timberland Production" within or immediately adjacent to the project site that would conflict with existing zoning or cause rezoning. Therefore, no impact is identified for this issue area.

d) **No Impact.** There are no existing forest lands within or immediately adjacent to the project site. The proposed project would not result in the loss of forest land or conversion of forest land to non-forest use. Therefore, no impact is identified for this issue area.

e) **Potentially Significant Impact.** Refer to response II. a) above.

III. Air Quality

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Where available, the significance criteria established by the applicable air quality management district or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☒	☐	☐	☐
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?	☒	☐	☐	☐
c) Expose sensitive receptors to substantial pollutant concentrations?	☒	☐	☐	☐
d) Result in other emissions (such as those leading to odors adversely affecting a substantial number of people?	☐	☐	☐	☒

Impact Analysis

a) **Potentially Significant Impact.** The project site is located within the jurisdiction of Imperial County Air Pollution Control District (ICAPCD) in the Imperial County portion of the Salton Sea Air Basin. Construction of the proposed project would create temporary emissions of dust, fumes, equipment exhaust, and other air contaminants that may conflict with the ICAPCD's rules and regulations. No stationary source emissions are proposed from the proposed project; however, temporary construction emissions have the potential to result in a significant air quality impact. An air quality and greenhouse gas study will be prepared to analyze the proposed project's consistency with air quality plans, and will be included in the EIR analysis.

b) **Potentially Significant Impact.** Currently, the Salton Sea Air Basin is either in attainment or unclassified for all federal and state air pollutant standards, with the exception of the federal ozone (O_3), particulate matter less than 10 microns in diameter (PM_{10}) and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) standards, and state standards for O_3 and PM_{10}. Air pollutants transported into the Salton Sea Air Basin from the adjacent South Coast Air Basin (Los Angeles County, San Bernardino County, Orange County, and Riverside County) and Mexicali (Mexico) substantially contribute to the non-attainment conditions in the Salton Sea Air Basin. A potentially significant impact is identified for this issue area. An air quality and greenhouse gas study will be prepared to analyze the proposed project's potential air quality impacts and will be included in the EIR analysis.

c) **Potentially Significant Impact.** The project site is located in a rural agricultural area of Imperial County. The nearest sensitive receptor to the project site is a single-family home located as near as 40 feet to the north side of the project site (near the northwest corner of the project site). There are also homes located on the east side of Best Avenue that are as near as 120 feet east of the project site. This issue will be addressed in the air quality and greenhouse gas study and EIR analysis.

d) **No Impact**. Land uses commonly considered to be potential sources of odorous emissions include wastewater treatment plants, sanitary landfills, food processing facilities, chemical manufacturing plants, rendering plants, paint/coating operations, and concentrated agricultural feeding operations and dairies. The construction and operation of a solar facility is not an odor producer. Therefore, no impact is identified for this issue area.

IV. Biological Resources

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☒	☐	☐	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of wildlife nursery sites?	☒	☐	☐	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☒	☐	☐	☐
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Impact Analysis

a) **Potentially Significant Impact.** According to the Conservation and Open Space Element of the General Plan (County of Imperial 2016), numerous special-status species occur in the County, and of particular concern is the western burrowing owl which may have the potential to occur within the project site. Burrowing owls and burrows are commonly found along canals and drains. Although there are no Imperial Irrigation District (IID) canals located within

the project site, access roads, canals, and other drainages are located in the project vicinity, such as the Best Canal and Livesley Drain, which are immediately east and south of the project site, respectively. Thus, a potentially significant impact is identified for this issue area. A biological resources report that will address the proposed project's potential impacts on biological resources will be prepared and included in the EIR analysis.

b) **Potentially Significant Impact.** Refer to response IV. a) above.

c) **Potentially Significant Impact.** Currently, the project site contains alfalfa fields at different levels of harvest. The Best Canal and existing drain structure(s) would not be removed, relocated or impacted; and no washes are found within the project site.

The project site is adjacent to the New River and according to the United States Fish and Wildlife Service (USFWS) National Wetland Inventory, there are also several project adjacent freshwater ponds. There does not appear to be ponds within the project site; however, the project site has drainage channels that could potentially be considered jurisdictional waters by California Department of Fish and Wildlife (CDFW) and United States Army Corps of Engineers (USACE). Therefore, a potentially significant impact is identified for this issue area. A jurisdictional waters/wetlands delineation report will be prepared and included in the EIR analysis.

d) **Potentially Significant Impact.** Refer to response IV. a) above

e) **Potentially Significant Impact.** Refer to response IV. a) above

f) **No Impact.** The project site is not located in a Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan. No impact is identified for this issue area.

V. Cultural Resources

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource pursuant to §15064.5?	☒	☐	☐	☐
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☒	☐	☐	☐
c) Disturb any human remains, including those interred outside of dedicated cemeteries?	☒	☐	☐	☐

Impact Analysis

a) **Potentially Significant Impact.** Currently, the project site contains alfalfa fields at different levels of harvest. The disturbed nature of the site indicates that the presence of significant or undamaged cultural resources on the site is unlikely. Although the proposed project is not expected to cause a substantial adverse change in the significance of a historical resource or archaeological resource, a potentially significant impact could occur if an unanticipated find is discovered. A cultural resources report that will address the proposed project's potential impacts on historic and prehistoric resources will be prepared and this issue will be addressed in the EIR.

b) **Potentially Significant Impact.** Refer to response V. a) above.

c) **Potentially Significant Impact.** Although unlikely, there is a potential for unknown human remains to be unearthed during earthwork activities. This issue is potentially significant and will be addressed in the EIR.

VI. Energy

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☒	☐
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☒	☐

Impact Analysis

a) **Less than Significant Impact.** Information contained in this section is summarized from the *Air Quality, Energy, and Greenhouse Gas Emissions Impact Analysis* prepared for the project (Vista Environmental 2021a). The proposed project would impact energy resources during construction and operation. Energy resources that would be potentially impacted include electricity, and petroleum-based fuel supplies and distribution systems. The proposed project would not utilize any natural gas during either construction or operation of the proposed project, and no further analysis of natural gas is provided in this analysis.

The following discussion calculates the potential energy consumption associated with the construction and operation of the proposed project and analyzes if any energy utilized by the proposed project is wasteful, inefficient, or unnecessary consumption of energy resources.

Construction Energy

The construction activities for the proposed project are anticipated to include: 1) Site Preparation; 2) PV System Installation and Testing, and 3) Site Clean-up and Restoration. The proposed project would consume energy resources during construction in three (3) general forms:

1. Petroleum-based fuels used to power off-road construction vehicles and equipment on the project site, construction worker travel to and from the project site, as well as delivery and haul truck trips (e.g., hauling of construction waste material to off-site reuse and disposal facilities);
2. Electricity associated with the conveyance of water that would be used during project construction for dust control (supply and conveyance) and electricity to power any necessary lighting during construction, electronic equipment, or other construction activities necessitating electrical power; and,
3. Energy used in the production of construction materials, such as asphalt, steel, concrete, pipes, and manufactured or processed materials such as lumber and glass.

Construction-Related Electricity

During construction of the proposed project, electricity would be consumed to construct the new structures and infrastructure. Electricity would be supplied to the project site by IID and

would be obtained from the existing electrical lines in the vicinity of the project site. The use of electricity from existing power lines rather than temporary diesel or gasoline powered generators would minimize impacts on energy use. Electricity consumed during project construction would vary throughout the construction period based on the construction activities being performed. Various construction activities include electricity associated with the conveyance of water that would be used during project construction for dust control (supply and conveyance) and electricity to power any necessary lighting during construction, electronic equipment, or other construction activities necessitating electrical power. Such electricity demand would be temporary, nominal, and would cease upon the completion of construction. Overall, construction activities associated with the proposed project would require limited electricity consumption that would not be expected to have an adverse impact on available electricity supplies and infrastructure. Therefore, the use of electricity during project construction would not be wasteful, inefficient, or unnecessary.

The proposed project would include installation of an approximately 1.8 mile long overhead power line from the southwest corner of the project site to the North Brawley 1 Substation, which would provide adequate capacity to handle the power generated and utilized by the proposed project. Where feasible, the new service installations and connections would be scheduled and implemented in a manner that would not result in electrical service interruptions to other properties. Compliance with County and IID guidelines and requirements would ensure that the proposed project fulfills its responsibilities relative to infrastructure installation, coordinates any electrical infrastructure removals or relocations, and limits any impacts associated with construction of the project. Construction of the project's electrical infrastructure is not anticipated to adversely affect the electrical infrastructure serving the surrounding uses or utility system capacity.

Construction-Related Petroleum Fuel Use

Petroleum-based fuel usage represents the highest amount of transportation energy potentially consumed during construction, which would be utilized by both off-road equipment operating on the project site and on-road automobiles transporting workers to and from the project site and on-road trucks transporting equipment and supplies to the project site.

The off-road equipment utilized during construction of the proposed project would consume 84,890 gallons of fuel. The on-road trips generated from construction of the proposed project would consume 77,046 gallons of fuel. As such, the combined fuel used from off-road construction equipment and on-road construction trips for the proposed project would result in the consumption of 161,935 gallons of petroleum fuel. This equates to 0.17 percent of the gasoline and diesel consumed annually in Imperial County. As such, the construction-related petroleum use would be nominal, when compared to current county-wide petroleum usage rates.

Construction activities associated with the proposed project would be required to adhere to all State and SCAQMD regulations for off-road equipment and on-road trucks, which provide minimum fuel efficiency standards. As such, construction activities for the proposed project would not result in the wasteful, inefficient, and unnecessary consumption of energy resources. Impacts regarding transportation energy would be less than significant.

Operations-Related Electricity

Operation of the proposed project would result in consumption and production of electricity at the project site. The proposed PV solar panels will generate 97,333,333 kWh per year of electricity and operation of the project will use 1,946,667 kWh per year of electricity, which would result in the net generation of 95,386,667 kWh per year of electricity. This equates to 2.8 percent of the electricity consumed annually by IID. As such, the operations-related electricity use would provide a significant renewable resource for the IID and would help IID achieve the State' Renewable Portfolio Standards requirement for non-carbon sources of electricity. No impact would occur from electricity-related energy consumption from the proposed project.

Operations-Related Vehicular Petroleum Fuel Usage

Operation of the proposed project would result in increased consumption of petroleum-based fuels related to vehicular travel to and from the project site. The proposed project would consume 1,036 gallons of petroleum fuel per year from vehicle travel. This equates to 0.001 percent of the gasoline and diesel consumed in Imperial County annually. As such, the operations-related petroleum use would be nominal, when compared to current petroleum usage rates

It should be noted that, the proposed project would comply with all Federal, State, and County requirements related to the consumption of transportation energy and would provide a non-carbon source of electricity to power electric vehicles in Imperial County. Thus, impacts with regard transportation energy supply and infrastructure capacity would be less than significant and no mitigation measures would be required.

b) **Less than Significant Impact.** The proposed project would help California meet its Renewable Portfolio Standard of 60 percent of retail electricity sales from renewable sources by the end of 2030 and 100 percent by 2045. The electricity generation process associated with the project would utilize solar technology to convert sunlight directly into electricity. Solar PV technology is consistent with the definition of an "eligible renewable energy resource" in Section 399.12 of the California Public Utilities Code (CPUC) and the definition of "in-state renewable electricity generation facility" in Section 25741 of the CPUC. Therefore, the proposed project would not conflict with or obstruct a state or local plan for renewable energy of energy efficiency. This is considered a less than significant impact.

VII. Geology and Soils

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42?	☐	☐	☐	☒
ii. Strong seismic ground shaking?	☒	☐	☐	☐
iii. Seismic-related ground failure, including liquefaction?	☒	☐	☐	☐
iv. Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☒	☐	☐	☐
d) Be located on expansive soil, as defined in Table 18-1B of the Uniform Building Code (1994), creating substantial direct or indirect risk to life or property?	☒	☐	☐	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☒	☐	☐	☐

Impact Analysis

ai) **No Impact.** According to the California Earthquake Hazards Zone Application (California DOC 2019), the project site is not located within a State of California, Alquist-Priolo Earthquake Fault Zone. The nearest Alquist-Priolo Earthquake Fault Zone is located approximately 4.75 miles from the project site. Therefore, no impact is identified for this issue area.

aii) **Potentially Significant Impact.** The project site is located in the seismically-active Imperial Valley in Southern California and considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. The project site could be affected by the occurrence of seismic activity to some degree but no more than the surrounding properties. A potentially significant impact has been identified for this issue area. A geotechnical report that will address the proposed project's potential impacts on geology and soils will be prepared and this issue will be addressed in the EIR.

aiii) **Potentially Significant Impact.** Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as vibratory motion produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases, and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Four conditions are generally required for liquefaction to occur:

1) The soil must be saturated (relatively shallow groundwater).
2) The soil must be loosely packed (low to medium relative density).
3) The soil must be relatively cohesionless (not clayey).
4) Groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All these conditions may exist to some degree at the project site. Therefore, there is a potentially significant impact associated with liquefaction. A geotechnical report that will address the proposed project's potential impacts on geology and soils will be prepared and this issue will be addressed in the EIR.

aiv) **No Impact.** According to Figure 2: Landslide Activity in the Seismic and Public Safety Element of the General Plan (County of Imperial 1997), the project site is not located in an area that is prone to landslide hazards. Furthermore, the project site and surrounding area is relatively flat. Therefore, no impact is identified for this issue area.

b) **Less than Significant Impact.** According to Figure 3: Erosion Activity in the Soil the Seismic and Public Safety Element of the General Plan (County of Imperial 1997), the project site is within a generally flat area with low levels of natural erosion. However, soil erosion can result during construction as grading and construction can loosen surface soils and make soils susceptible to wind and water movement across the surface. Impacts are not considered significant because erosion would be controlled on-site in accordance with Imperial County standards including preparation, review, and approval of a grading plan by the Imperial County Engineer. Implementation of Imperial County standards would reduce the potential impacts to a less than significant level.

c) **Potentially Significant Impact.** Near surface soils within the project site will need to be identified to determine if the soils are unstable. Therefore, this issue is potentially significant and will be analyzed in the EIR.

d) **Potentially Significant Impact.** Near surface soils within the project site will need to be identified to determine if they consist of soils having expansion potential. Therefore, this issue is potentially significant and will be analyzed in the EIR.

e) **No Impact.** The proposed project would not require the installation of septic tanks or alternative wastewater disposal systems. The proposed solar facility would be remotely

operated, controlled and monitored and with no requirement for daily on-site employees. Therefore, no impact is identified for this issue area.

f) **Potentially Significant Impact.** Many paleontological fossil sites are recorded in Imperial County and have been discovered during construction activities. Paleontological resources are typically impacted when earthwork activities, such as mass excavation cut into geological deposits (formations) with buried fossils. It is not known if any paleontological resources are located on the project site. The proposed project's potential to impact paleontological resources will be addressed in the EIR.

VIII. Greenhouse Gas Emissions

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☒	☐	☐	☐
b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☒	☐	☐	☐

Impact Analysis

a) **Potentially Significant Impact.** In the long-term, the proposed project is expected to provide a benefit with respect to reduction of greenhouse gas emissions. However, the proposed project has the potential to generate greenhouse gas emissions during construction, in addition to construction worker trips to and from the project site. Thus, a potentially significant impact is identified for this issue area. An air quality and greenhouse gas study will be prepared for the proposed project, and this issue will be addressed in the EIR.

b) **Potentially Significant Impact.** Refer to response VIII. a) above.

IX. Hazards and Hazardous Materials

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the likely release of hazardous materials into the environment?	☐	☐	☒	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☒	☐	☐	☐
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?	☐	☐	☒	☐

Impact Analysis

a) **Less than Significant Impact.** Construction of the proposed project will involve the limited use of hazardous materials, such as fuels and greases to fuel and service construction equipment. No extremely hazardous substances are anticipated to be produced, used, stored, transported, or disposed of as a result of project construction. Operation of the proposed project will be conducted remotely. Therefore, no habitable structures (e.g. housing or operation and maintenance [O&M] building) are proposed on the project site.

Regular and routine maintenance of the proposed project may result in the potential to handle hazardous materials. However, the hazardous materials handled on-site would be limited to small amounts of everyday use cleaners and common chemicals used for maintenance. The applicant will be required to comply with State laws and County Ordinance restrictions, which regulate and control hazardous materials handled on-site. Such hazardous wastes would be transported off-site for disposal according to applicable State and County restrictions and laws governing the disposal of hazardous waste during construction and operation of the project. Therefore, this is considered a less than significant impact.

b) **Less than Significant Impact.** Refer to response IX. a) above.

c) **No Impact.** The project site is not located within 0.25 mile of an existing or proposed school. No impact is identified for this issue area.

d) **No Impact.** Based on a review of the Cortese List conducted in May 2021, the project site is not listed as a hazardous materials site. No impact is identified for this issue area.

e) **Potentially Significant Impact.** The project site is within 2 miles of a public airport. The nearest public airport is the Brawley Municipal Airport located approximately 1.5 miles south of the project site. However, the project site is outside of the airport compatibility zones of the Brawley Municipal Airport (County of Imperial 1996). Although the solar panels will be constructed of low reflective materials, the potential for glare to impact aircraft will be analyzed further in the EIR.

f) **Less than Significant Impact.** The proposed project is not expected to impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. The project applicant will be required, through the conditions of approval, to prepare a street improvement plan for the project that will include emergency access points and safe vehicular travel. In addition, local building codes would be followed to minimize flood, seismic, and fire hazard. Therefore, the proposed project would result in a less than significant impact associated with the possible impediment to emergency plans.

g) **Less than Significant Impact.** The project site is located in the unincorporated area of Imperial County. According to the Seismic and Public Safety Element of the General Plan (County of Imperial 1997), the potential for a major fire in the unincorporated areas of the County is generally low.

Proposed project facilities would be designed, constructed, and operated in accordance with applicable fire protection and other environmental, health, and safety requirements (e.g., CPUC safety standards). Primary access to the project site would be located off Best Avenue. A secondary emergency access road would be located in the northwest portion of the project site. Access roads would also be constructed with an all-weather surface, to meet the County Fire Department's standards. Points of ingress/egress would be accessed via locked gates that can be opened by any emergency responders. Additionally, water for emergency fire suppression would likely be provided by water trucks during construction and the existing ground storage tank on-site which is filled by the Best Canal during operation. Based on these considerations, a less than significant impact is identified for this issue area.

X. Hydrology and Water Quality

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☒	☐	☐	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☒	☐
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:				
i. result in substantial erosion or siltation on- or off-site;	☐	☐	☒	☐
ii. substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;	☐	☐	☒	☐
iii. create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☒	☐
iv. impede or redirect flood flows?	☐	☐	☐	☒
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	☐	☐	☐	☒
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☐	☒

Impact Analysis

a) **Potentially Significant Impact.** The proposed project has the potential to create urban non-point source discharge (e.g., synthetic/organic chemicals). As runoff flows over developed surfaces, water can entrain a variety of potential pollutants including, but not limited to, oil

and grease, pesticides, trace metals, and nutrients. These pollutants can become suspended in runoff and carried to receiving waters. If they are not intercepted or are left uncontrolled, the polluted runoff would otherwise freely sheet flow from the project site to the IID Imperial Valley Drains and could result in the accumulation of these pollutants in the receiving waters. Potentially significant water quality impacts have been identified and will be addressed in the EIR.

b) **Less than Significant Impact.** During construction, potable water would be brought to the site for drinking and domestic needs. The approximate 20,000 to 30,000 gallons of water per day required during construction would be obtained from the existing ground storage tank on-site which is filled by the Best Canal. This water would be used for earthwork, soil conditioning, dust suppression, and compaction efforts. Because the solar panels will be pole-mounted above ground, they are not considered "hardscape", such as roads, building foundations, or parking areas, as they do not require a substantial amount of impervious material. Estimated annual water consumption for operation and maintenance of the proposed project, including periodic PV module washing, would be approximately 0.81-acre annually, which would be trucked to the project site as needed. Therefore, the panels and their mounting foundation would not impede groundwater recharge. A less than significant impact is identified for this issue area.

ci) **Less than Significant Impact.** The proposed project would not substantially alter the existing drainage pattern of the site. It is anticipated that the proposed drainage patterns would be similar to the existing site conditions. The project applicant would be required to implement on-site erosion control measures in accordance with Imperial County standards which require preparation, review, and approval of a grading plan by the Imperial County Engineer. Therefore, the proposed project would not result in substantial erosion or siltation on- or off-site. A less than significant impact is identified for this issue area.

cii) **Less than Significant Impact.** The proposed project is not anticipated to generate a significant increase in the amount of runoff water from water use involving solar panel washing. Water will continue to percolate through the ground, as a majority of the surface on the project site will remain pervious. Therefore, the proposed project would not substantially increase the rate of runoff in a manner which would result in flooding on- or off-site or exceed the capacity of existing or planned stormwater drainage systems and provide substantial additional sources of polluted runoff. A less than significant impact is identified for this issue area.

ciii) **Less than Significant Impact.** Refer to response X. cii) above.

civ) **No Impact.** According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (Panel 06025C1025C) (FEMA 2008), the project site is within Zone X, which is an area determined to be outside of the 0.2 percent annual chance of a flood. The proposed project does not propose the placement of structures within a 100-year flood hazard area. Therefore, the proposed project would not impede or redirect flood flows. No impact is identified for this issue area and no further analysis is warranted.

d) **No Impact.** The project site is within Zone X, which is an area determined to be outside of the 0.2 percent annual chance of a flood. The project site is not located near any large bodies of water. The Salton Sea is located approximately 12 miles northwest of the project site. Furthermore, the relatively flat project site is approximately 100 miles inland from the Pacific Ocean. Therefore, the proposed project would not risk release of pollutants due to inundation by flood, tsunami or seiche. No impact is identified for this issue area.

e) **No Impact.** The proposed project will not involve the use of groundwater nor require dewatering activities. Water to be used during project-related construction activities will obtained from the existing ground storage tank on-site which is filled by the IID Best Canal for earthwork, soil conditioning, dust suppression, and compaction efforts. Water provided by the IID Best Canal would be obtained in conformance with IID construction water acquisition requirements. Therefore, the proposed project will not conflict with or obstruct

implementation of a water quality control plan or sustainable groundwater management plan. No impact is identified for this issue area.

XI. Land Use and Planning

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☒	☐	☐	☐

Impact Analysis

a) **No Impact.** The proposed project is located in a sparsely populated, agriculturally zoned portion of unincorporated Imperial County. There are no established residential communities located within or in the vicinity of the project site. Therefore, implementation of the proposed project would not divide an established community. No impact is identified for this issue area.

b) **Potentially Significant Impact**. The project parcels are currently zoned as A-2-G (General Agricultural with a Geothermal Overlay). Pursuant to Title 9, Division 5, Chapter 8 (County of Imperial 2019a), the following uses are permitted in the A-2 zone subject to approval of a CUP from Imperial County: solar energy electrical generator, battery storage facility, electrical substations, communication towers, and facilities for the transmission of electrical energy.

The County Land Use Ordinance, Division 17, includes the Renewable Energy (RE) Overlay Zone, which authorizes the development and operation of renewable energy projects, with an approved CUP. CUP applications proposed for specific renewable energy project not located in the RE Overlay Zone would not be allowed without an amendment to the RE Overlay Zone. As shown in Figure 1, the northern portion of the project site (APNs 037-140-020 and 037-140-021) is located within the Geothermal Overlay Zone. However, the entire project site (APNs 037-140-020, 037-140-021, 037-140-022, 037-140-023, and 037-140-006) is located outside of the RE Overlay Zone.

Implementation of the project requires an amendment to the County's General Plan Renewable Energy and Transmission Element, Zone Change, and approval of a CUP, as described below:

- **General Plan Amendment:** The applicant is requesting a General Plan Amendment to include/classify all five project parcels (Assessor Parcel Nos. [APN] 037-140-006, -020, -021, -022, and -023) into the RE Overlay Zone. No change in the underlying General Plan land use (Agriculture) is proposed.
- **Zone Change:** The entire project site is currently zoned General Agricultural with a Geothermal Overlay (A-2-G). The applicant is requesting a Zone Change to include/classify all five project parcels into the Renewable Energy/Geothermal (REG) Overlay Zone (A-2-REG).
- **Conditional Use Permit:** Implementation of the project would require the approval of a CUP by the County to allow for the construction and operation of the proposed solar energy facility with an integrated BESS on land zoned General Agricultural with a REG Overlay Zone (A-2-REG).

The proposed General Plan Amendment and Zone Change may result in a conflict with an applicable land use plan, policy or regulation. A potentially significant impact has been identified for this issue, and this issue will be addressed in the EIR.

XII. Mineral Resources

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

Impact Analysis

a) **No Impact.** The project site is not used for mineral resource production. According to Figure 8: Imperial County Existing Mineral Resources of the Conservation and Open Space Element of the General Plan (County of Imperial 2016), no known mineral resources occur within the project site nor does the project site contain mapped mineral resources. Therefore, the proposed project would not result in the loss of availability of any known mineral resources that would be of value to the region and the residents of California nor would the proposed project result in the loss of availability of a locally important mineral resource.

b) **No Impact.** Refer to Response XIII. a) above.

XIII. Noise

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project result in:				
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐
b) Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

Impact Analysis

a) **Less than Significant Impact.** Information contained in this section is summarized from the Noise Impact Analysis prepared for the project (Vista Environmental 2021b). The following section analyzes the potential noise emissions associated with the temporary construction activities and long-term operations of the proposed project and compares the noise levels to the County standards.

Construction-Related Noise

The construction activities for the proposed project are anticipated to include: 1) Site Preparation; 2) PV System Installation and Testing, and 3) Site Clean-up and Restoration. Noise impacts from construction activities associated with the proposed project would be a function of the noise generated by construction equipment, equipment location, sensitivity of nearby land uses, and the timing and duration of the construction activities. The nearest sensitive receptors to the project site are single-family homes located as near as 40 feet to the north side of the project site (near the northwest corner of the project site). There are also homes located on the east side of Best Avenue that are as near as 120 feet east of the project site.

The General Plan Noise Element includes Construction Noise Standards that limits the noise created from construction equipment to 75 dB Leq, averaged over an eight (8) hour period at the nearest sensitive receptor. In addition, the Construction Noise Standards limit construction equipment operation to between the hours of 7 a.m. to 7 p.m., Monday through Friday, and 9 a.m. to 5 p.m. Saturday. No commercial construction operations are permitted on Sunday or holidays.

For each phase of construction, all construction equipment was analyzed based on being placed in the middle of the project site, which is based on the analysis methodology detailed in FTA Manual for a General Assessment. Since the County's construction noise standard is based on the noise level over an 8-hour period and in a typical day the proposed construction equipment would operate over the entire project site, the use of the methodology detailed in the FTA Manual for a General Assessment would provide a reasonable estimate of the construction-related noise levels created by the proposed project.

Table 1 shows that greatest construction noise impacts would be as high as 53 dBA Leq during the PV system installation and testing phase at the nearest homes to the northwest, northeast, and southeast of the project site. All calculated construction noise levels shown in Table 1 are within the County's construction noise standard of 75 dBA and would also be below the existing ambient daytime noise levels in the vicinity of the nearby homes. Therefore, through adherence to the limitation of allowable construction times provided in the General Plan Noise Element, construction-related noise levels would not exceed any standards established in the General Plan or Noise Ordinance nor would construction activities create a substantial temporary increase in ambient noise levels from construction of the proposed project. Impacts would be less than significant.

Table 1. Construction Noise Levels at the Nearby Homes

Construction Phase	Construction Noise Level (dBA Leq) at:		
	Home to Northwest[1]	Home to Northeast[2]	Home to Southeast[3]
Site Preparation	52	52	52
PV System Installation and Testing	53	53	53
Site Clean-Up and Restoration	52	52	52
Construction Noise Threshold[4]	**75**	**75**	**75**
Ambient Daytime Noise Level	66.5	60.2	62.0
Exceed Thresholds?	**No**	**No**	**No**

[1] The distance from the center of the project site to the home to the northwest was measured at 2,900 feet.
[2] The distance from the center of the project site to the homes to the northeast was measured at 2,900 feet.
[3] The distance from the center of the project site to the home to the southeast was measured at 2,850 feet.
[4] Construction Noise Threshold obtained from the General Plan Noise Element (County of Imperial, 2015).
Source: Vista Environmental 2021b

Operational-Related Noise

The proposed project would consist of the development of a solar facility with a BESS and a substation. Since the proposed project would be operated on an unstaffed basis and monitored remotely from the Brawley Geothermal Power Plant control room, operation of the proposed project would not typically generate any additional vehicle traffic on the nearby roadways. As such, potential noise impacts associated with the operations of the proposed project would be limited to onsite noise sources. The proposed PV solar panels do not create any operational noise, however the proposed BESS Enclosures (AC Unit noise), Power Conversion System (PCS), Power Distribution Center (PDC) that would be located at the BESS, and auxiliary transformers, and Battery Step Up Transformer that would be located at the proposed substation are known sources of noise that have been analyzed below.

Both the General Plan Noise Element and Section 90702.00 provide the same noise level limits at the property line of the nearby homes of 50 dBA Leq-1hour between 7 a.m. and 10 p.m. and 45 dBA Leq-1hour between 10 p.m. and 7 a.m. When the ambient noise level is equal to or exceeds the above noise standards, the proposed noise source shall not exceed the ambient plus 3 dB Leq.

In order to determine the noise impacts from the operation of onsite noise making equipment, noise specifications from previously prepared noise reports were obtained and are shown in Table 2. The noise levels from each source were calculated through use of standard geometric spreading of noise from a point source with a drop-off rate of 6 dB for each doubling of the distance between the source and receiver.

Table 2 shows that the proposed project's onsite operational noise from the anticipated onsite noise sources would not exceed the applicable noise standards at the nearby homes. Therefore, operational onsite noise impacts would be less than significant.

Table 2. Operational Noise Levels at the Nearby Homes

Noise Source	Home to Northwest		Home to Northeast		Home to Southeast	
	Distance - Source to Home (feet)	Noise Level[1] (dBA Leq)	Distance - Source to Home (feet)	Noise Level[1] (dBA Leq)	Distance - Source to Home (feet)	Noise Level[1] (dBA Leq)
BESS Enclosures[2]	5,050	25	5,100	25	850	40
Power Conversion System[3]	5,050	22	5,100	22	850	38
Power Distribution Center[4]	5,050	22	5,100	22	850	38
Auxiliary Transformers[5]	5,030	31	5,280	31	1,150	44
Battery Step up Transformer[6]	5,030	31	5,280	31	850	47
Combined Noise Levels		**35**		**35**		**50**
County Noise Standard[7] (day/night)		**69.5/67.9**		**63.2/58.6**		**65.0/59.2**
Exceed County Noise Standards?		**No/No**		**No/No**		**No/No**

Notes:
[1] The noise levels were calculated through use of standard geometric spreading of noise from a point source with a drop-off rate of 6 dB for each doubling of the distance between the source and receiver.
[2] BESS Enclosures is based on a reference noise measurement of 88.6 dBA at 1 meter.
[3] Power Conversion System is based on a reference noise measurement of 86.1 dBA at 1 meter.
[4] Power Distribution Center is based on a reference noise measurement of 86.1 dBA at 1 meter.
[5] Auxiliary Transformers are based on a reference noise measurement of 95.1 dBA at 1 meter.
[6] Battery Step up Transformer is based on a reference noise measurement of 95.1 dBA at 1 meter.
[7] County Noise Standard based on ambient noise level shown in **Error! Reference source not found.** plus 3 dB at the nearby homes.
Source: Vista Environmental 2021b

b) **Less than Significant Impact.** The following analyzes the potential vibration impacts associated with the construction and operations of the proposed project.

Construction-Related Vibration Impacts

Vibration impacts from construction activities associated with the proposed project would typically be created from the operation of heavy off-road equipment. The nearest sensitive receptor to the project site is a single-family home located as near as 40 feet to the north side of the project site (near the northwest corner of the project site).

Since neither the Municipal Code nor the General Plan provides any thresholds related to vibration, Caltrans guidance has been utilized, which defines the threshold of perception from transient sources at 0.25 inch per second PPV.

The primary source of vibration during construction would be from the operation of a bulldozer. A large bulldozer would create a vibration level of 0.089 inch per second PPV at 25 feet. Based on typical propagation rates, the vibration level at the nearest home (40 feet away) would be 0.06 inch per second PPV. The vibration level at the nearest home, would be below the 0.25 inch per second PPV threshold detailed above. Impacts would be less than significant.

Operations-Related Vibration Impacts

The proposed project would consist of the operation of a solar energy facility. The on-going operation of the proposed project would not include the operation of any known vibration sources. Therefore, a less than significant vibration impact is anticipated from the operation of the proposed project.

c) **No Impact.** The project site is located within 2 miles of a public airport. The nearest airport is the Brawley Municipal Airport located approximately 1.5 miles south of the project site. However, the project site is outside of the airport compatibility zones of the Brawley Municipal Airport (County of Imperial 1996). Therefore, the proposed project would not expose people residing or working in the project area to excess noise levels and no impact is identified for this issue area.

XIV. Population and Housing

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (e.g., by proposing new homes and businesses) or indirectly (e.g., through extension of roads or other infrastructure)?	☐	☐	☒	☐
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Impact Analysis

a) **Less than Significant Impact.** Development of housing is not proposed as part of the proposed project. No full-time employees are required to operate the proposed project since the project facility will be monitored remotely. However, it is anticipated that maintenance of the facility will require minimal site presence to perform periodic visual inspections and minor repairs. On intermittent occasions, the presence of additional workers may be required for repairs or replacement of equipment and panel cleaning; however, due to the nature of the facility, such actions will likely occur infrequently and would likely come from the existing local workforce. Therefore, the proposed project would not result in a substantial growth in the area, as the number of employees required to operate and maintain the facility is minimal. A less than significant impact is identified for this issue area.

b) **No Impact.** No housing exists within the project site. Therefore, the proposed project would not displace any existing people or housing, which would require the construction of replacement housing elsewhere. No impact is identified for this issue area.

XV. Public Services

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
i. Fire Protection?	☒	☐	☐	☐
ii. Police Protection?	☐	☒	☐	☐
iii. Schools?	☐	☐	☐	☒
iv. Parks?	☐	☐	☐	☒
v. Other public facilities?	☐	☐	☐	☒

Impact Analysis

ai) **Potentially Significant Impact.** Fire protection and emergency medical services in the project area are provided by the Imperial County Fire Department. The project site is located in the unincorporated area of Imperial County. According to the Seismic and Public Safety Element of the General Plan (County of Imperial 1997), the potential for a major fire in the unincorporated areas of the County is generally low. Primary access to the project site would be located off Best Avenue. A secondary emergency access road would be located in the northwest portion of the project site. All access roads and the area around the solar blocks (no greater than 500 by 500 feet) would be constructed with all-weather surface and meet the County Fire Department's standards. Points of ingress/egress would be accessed via locked gates that can be opened by any emergency responders. Although the proposed project would be designed, constructed, and operated in accordance with applicable fire protection and other environmental, health, and safety requirements (e.g., CPUC safety standards), the project applicant will be required to consult with the Fire Department to address any fire safety and service concerns (i.e, battery energy storage system) so that adequate service is maintained. The project's potentially significant impacts on fire services will be addressed in the EIR.

aii) **Less than Significant Impact.** Police protection services in the project area is provided by the Imperial County Sheriff's Department. Although the potential is low, the proposed project may attract vandals or other security risks and the increase in construction related traffic could increase demand on law enforcement services. Therefore, on-site security systems would be provided and access would be limited to the areas surrounding the project site during construction and operation, thereby minimizing the need for police surveillance. Six-foot high chain link fencing topped with barbed wire would be installed around the perimeter of the project site at the commencement of construction and site access would be limited to authorized site workers. Points of ingress/egress would be accessed via locked gates. In addition, a motion detection system and closed-circuit camera system may also be installed.

The site would be remotely monitored 24 hours per day, 7 days per week. In addition, routine unscheduled security rounds may be made by the security team monitoring the site security. Based on these considerations, the proposed project would not result in a need for police protection facility expansion and a less than significant impact is identified for this issue area.

aiii) **No Impact.** The proposed project does not include the development of residential land uses that would result in an increase in population or student generation. Additionally, construction of the proposed project would not result in an increase in student population within the Imperial County's School District since it is anticipated that construction workers would commute in during construction operations. Therefore, no impact is identified for this issue area and no further analysis is warranted.

aiv) **No Impact.** Although maintenance of the project facility will require minimal site presence to perform periodic visual inspections and minor repairs, no full-time employees are required to operate the proposed project because the project facility will be monitored remotely. Therefore, substantial permanent increases in population that would adversely affect local parks is not expected. No impact is identified for this issue area and no further analysis is warranted.

av) **No Impact.** Although maintenance of the project facility will require minimal site presence to perform periodic visual inspections and minor repairs, no full-time employees are required to operate the proposed project because the project facility will be monitored remotely. Therefore, substantial permanent increases in population that would adversely affect libraries and other public facilities (such as post offices) is not expected. The proposed project is not expected to have an impact on other public facilities such as post offices, and libraries. No impact is identified for this issue area and no further analysis is warranted.

XVI. Recreation

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment?	☐	☐	☐	☒

Impact Analysis

a) **No Impact.** The proposed project would not generate new employment on a long-term basis. As such, the proposed project would not significantly increase the use or accelerate the deterioration of regional parks or other recreational facilities. The temporary increase of population during construction that might be caused by an influx of workers would be minimal and not cause a detectable increase in the use of parks. Additionally, the proposed project would not include or require the expansion of recreational facilities. No impact is identified for this issue area and no further analysis is warranted.

b) **No Impact.** Refer to response XVI. a) above.

XVII. Transportation

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☒	☐	☐	☐
b) Conflict with or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?	☒	☐	☐	☐
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☒	☐
d) Result in inadequate emergency access?	☐	☐	☒	☐

Impact Analysis

a) **Potentially Significant Impact.** Operation and maintenance would be conducted remotely, with minimal trips to the project site for panel washing and other solar maintenance. Construction of the proposed project would result in a small increase of traffic to the area, which may result in a potentially significant impact. Therefore, a traffic study will be prepared and this issue area will be addressed in the EIR.

b) **Potentially Significant Impact.** Section 15064.3(b) of the CEQA Guidelines provides guidance on determining the significance of transportation impacts and focuses on the use of vehicle miles traveled (VMT), which is defined as the amount and distance of automobile travel associated with a project. Given the nature of the project, after construction, there would be a nominal amount of vehicle trips generated by the project. Once the proposed project is implemented, the proposed project would require intermittent maintenance requiring a negligible amount of traffic trips on an annual basis. However minimal, the proposed project would increase the number of vehicular trips related to construction and the need for intermittent maintenance on an annual basis. Therefore, this issue is potentially significant and will be addressed in the traffic study and EIR analysis.

c) **Less than Significant Impact.** To accommodate emergency access, PV panels would be spaced to maintain proper clearance. Proposed project facilities would be designed, constructed, and operated in accordance with applicable fire protection, CPUC safety standards, and other environmental, health, and safety requirements. Primary access to the project site would be located off Best Avenue. All access roads and the area around the solar blocks (no greater than 500 by 500 feet) would be constructed with all-weather surface and meet the County Fire Department's standards. Points of ingress/egress would be accessed via locked gates that can be opened by any emergency responders. Additionally, the project site is split vertically by the existing Union Pacific Railway and already contains an existing roadway off of Best Avenue that traverses across the railroad at-grade. This at-grade crossing would be maintained for access between the eastern and western portions of the project site. Therefore, the proposed project would not increase hazards because of incompatible uses or design features, and impacts are considered less than significant. A

haul truck route study will be required which will determine the appropriate construction route.

d) **Less than Significant Impact.** As previously stated, the PV panels would be spaced to maintain proper clearance. Proposed project facilities would be designed in accordance with applicable fire protection, CPUC safety standards, and other environmental, health, and safety requirements. Primary access to the project site would be located off Best Avenue. A secondary emergency access road would be located in the northwest portion of the project site. All access roads and the area around the solar blocks (no greater than 500 by 500 feet) would be constructed with all-weather surface and meet the County Fire Department's standards. Points of ingress/egress would be accessed via locked gates that can be opened by any emergency responders. Based on this context, impacts are considered less than significant.

XVIII. Tribal Cultural Resources

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project cause a substantial adverse change in the significance of a tribal cultural resource defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)?	☒	☐	☐	☐
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe?	☒	☐	☐	☐

Impact Analysis

a-b) **Potentially Significant Impact.** AB 52 was passed in 2014 and took effect July 1, 2015. It established a new category of environmental resources that must be considered under CEQA called tribal cultural resources (Public Resources Code 21074) and established a process for consulting with Native American tribes and groups regarding those resources. Assembly Bill 52 requires a lead agency to begin consultation with a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project.

In accordance with AB 52, Imperial County, as the CEQA lead agency, sent an AB 52 consultation request letter to the Torrez Martinez Desert Cahuilla Indians and Quechan Indian Tribe on July 20, 2021. This issue will be further analyzed in the EIR.

XIX. Utilities and Service Systems

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☒	☐	☐	☐
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?	☒	☐	☐	☐
c) Result in a determination by the wastewater treatment provider, which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☒	☐
d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☒	☐
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☒	☐

Impact Analysis

a) **Potentially Significant Impact.** Approximately 20,000 to 30,000 gallons of water per day would initially be required for grading, dropping to much less for the remainder of the project construction. Construction water needs would be limited to earthwork, soil conditioning, dust suppression, and compaction efforts. Water for construction and operation of the project would be obtained from an existing ground storage tank on-site which is filled by the Best Canal. The proposed project would not require the relocation, expansion, or construction of new storm drainage facilities because the proposed solar facility would not generate a significant increase in the amount of impervious surfaces that would increase runoff during storm events and exceed the capacity of existing or planned stormwater drainage systems. Water from solar panel washing would continue to percolate through the ground, as a majority of the surfaces within the project site would remain pervious.

The wastewater generated during construction would be contained within portable toilet facilities and disposed of at an approved site. The minimal volume of wastewater generated

during construction would not require the relocation expansion, or construction of wastewater treatment facilities.

Further, no habitable structures (e.g. housing or O&M buildings) are proposed on the project site. Therefore, the proposed project would not require or result in the relocation or construction of new or expanded electric power or natural gas.

New telecommunications equipment would be installed at the project substation within the unmanned Mechanical and Electrical Equipment Room. The proposed fiber optic telecommunications cable, once past the POI, would utilize existing transmission lines to connect to the North Brawley substation. The length of this proposed fiber optic telecommunications cable route would be approximately 1.8 miles. Alternatively, a microwave tower 40 to 100-feet tall could replace the need for a fiberoptic line to transmit data offsite. If selected, this microwave tower would be located within the project substation footprint. The project's potential impact on the construction of new telecommunication facilities will be addressed in the EIR.

Once fully constructed, estimated annual water consumption for operation and maintenance of the proposed project, including periodic PV module washing, would be approximately 0.81-acre feet annually (af/y), which would be trucked to the project site as needed. Although water for solar panel washing and fire protection during project operation is not anticipated to result in a significant increase in water demand/use, the proposed project's potential impacts on water supplies will be addressed in the water supply assessment and EIR analysis.

b) **Potentially Significant Impact.** Refer to response XIX. a) above.

c) **Less than Significant Impact.** The proposed project would generate a minimal volume of wastewater during construction. During construction activities, wastewater would be contained within portable toilet facilities and disposed of at an approved site. Further, no habitable structures (e.g. housing or O&M buildings) are proposed on the project site; therefore, there would be no wastewater generation from the proposed project during operation. The proposed project would not exceed wastewater treatment requirements of the RWQCB. Therefore, a less than significant impact is identified for this issue area.

d) **Less than Significant Impact.** Solid waste generation would be minor for the construction and operation of the proposed project. Solid waste will be disposed of using a locally-licensed waste hauling service, most likely Allied Waste. Trash would likely be hauled to the Imperial Landfill (13-AA-0019) located approximately 11 miles south of the proposed project in Imperial. The Imperial Landfill has approximately 12,384,000 cubic yards of remaining capacity and is estimated to remain in operation through 2040 (CalRecycle 2021). Therefore, there is ample landfill capacity in the County to receive the minor amount of solid waste generated by construction and operation of the proposed project.

Additionally, because the proposed project would generate solid waste during construction and operation, they will be required to comply with state and local requirements for waste reduction and recycling; including the 1989 California Integrated Waste Management Act and the 1991 California Solid Waste Reuse and Recycling Access Act of 1991. Also, conditions of the conditional use permit will contain provisions for recycling and diversion of Imperial County construction waste policies. Therefore, a less than significant impact is identified for this issue area.

e) **Less than Significant Impact.** Refer to response XIX. d) above.

XX. Wildfire

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:				
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☐	☐	☐	☒
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☐	☐	☒	☐
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☐	☐	☐	☒

Impact Analysis

a) **No Impact.** According to the Fire Hazard Severity Zone Viewer provided by the California Department of Forestry and Fire Protection, the proposed project is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2020). Therefore, the proposed project would not substantially impair an adopted emergency response plan or emergency evacuation plan. No impact is identified for this issue area.

b) **No Impact.** The proposed project is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2020). Therefore, the proposed project would not exacerbate wildfire risks. No impact is identified for this issue area.

c) **Less than Significant Impact.** Fire protection and emergency medical services in the area are provided by the Imperial County Fire Department. The proposed project is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2020). Further, the proposed project is located in an unincorporated area of Imperial County, which has a generally low potential for a major fire (County of Imperial 2016).

The project involves the installation of solar PV panels, an on-site substation, BESS, inverters, transformers, and a 1.8-mile-long aboveground 92 kV gen-tie line. To accommodate emergency access, PV panels would be spaced to maintain proper clearance.

Proposed project facilities would be designed, constructed, and operated in accordance with applicable fire protection, CPUC safety standards, and other environmental, health, and safety requirements. Primary access roads would be located off Best Avenue from the east and would be constructed with an all-weather surface, to meet the County Fire Department's standards. Points of ingress/egress would be accessed via locked gates that can be opened by any emergency responders. The existing east to west roadway that traverses over the existing railroad and connects the two halves of the project site would be maintained. This would serve as a secondary emergency access road. Further, water for emergency fire suppression would likely be provided by water trucks during construction and the existing ground storage tank on-site which is filled by the Best Canal during operation. Therefore, operation and maintenance would not affect the ability of fire personnel to respond to fires or exacerbate fire risk and would continue to be adequately supported by the existing fire protection services. A less than significant impact is identified for this issue area.

d) **No Impact.** The proposed project is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2020). Additionally, the proposed project would not expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes. No impact is identified for this issue area and no further analysis is warranted.

XXI. Mandatory Findings of Significance

Environmental Issue Area:	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐
b) Does the project have impacts that are individually limited, but cumulatively considerable ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☒	☐	☐	☐
c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?	☒	☐	☐	☐

Impact Analysis

a) **Potentially Significant Impact.** The proposed project has the potential to result in significant environmental effects on biological resources and cultural resources, which could directly or indirectly cause adverse effects on the environment. These issues will be further evaluated in the EIR.

b) **Potentially Significant Impact.** Implementation of the proposed project has the potential to result in impacts related to: aesthetics, agricultural resources, air quality, biological resources, cultural resources, geology/soils, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use/planning, public services, transportation, tribal cultural resources, and utilities/service systems. The proposed project has the potential to result in cumulative impacts with regards to the identified issue areas. Cumulative impacts will be discussed and further analyzed in the EIR.

c) **Potentially Significant Impact.** Implementation of the proposed project has the potential to result in impacts related to: air quality, geology/soils and GHG. These potential environmental effects could cause substantial adverse effects on human beings. These issues will be further evaluated in the EIR.

References

California Department of Conservation (DOC). 2016. Imperial County Williamson Act FY 2016/2017. Accessed May 2021.

——— 2018. *California Important Farmland Finder.* https://maps.conservation.ca.gov/DLRP/CIFF/. Accessed May 2021.

——— 2019. California Earthquake Hazards Zone Application. https://www.conservation.ca.gov/cgs/geohazards/eq-zapp. Accessed May 2021.

California Department of Forestry and Fire Protection. 2020. Fire Hazard Severity Zone Viewer. https://gis.data.ca.gov/datasets/789d5286736248f69c4515c04f58f414. Accessed May 2021.

California Department of Resources Recycling and Recovery (CalRecycle). 2021. Facility/Site Summary Details: Imperial Landfill (13-AA-0019). https://www2.calrecycle.ca.gov/SolidWaste/Site/Summary/603. Accessed May 2021.

California Department of Transportation (Caltrans). 2018. California Scenic Highway Mapping System. https://dot.ca.gov/programs/design/lap-landscape-architecture-and-community-livability/lap-liv-i-scenic-highways. Accessed May 2021.

County of Imperial. 1996. Airport Land Use Compatibility Plan. Amended June 19, 1996.

——— 1997. County of Imperial General Plan. Seismic and Public Safety Element. https://www.icpds.com/assets/planning/seismic-and-public-safety.pdf. Accessed March 2021. Accessed May 2021.

——— 2016. County of Imperial General Plan. Conservation and Open Space Element. https://www.icpds.com/planning/land-use-documents/general-plan/conservation-and-open-space-element. Accessed May 2021.

——— 2017. Imperial County Land Use Ordinance: Title 9, Division 7, Chapter 2, Section 90702.00 - Sound Level Limits. https://www.icpds.com/assets/planning/ordinances/title-9-div-7-2015.pdf. Accessed May 2021.

——— 2019a. Imperial County Land Use Ordinance: Title 9, Division 5, Chapter 8. https://www.icpds.com/assets/5-Zoning-Areas-Established-.pdf. Accessed May 2021.

——— 2019b. Imperial County Land Use Ordinance: Title 9, Division 17. https://www.icpds.com/assets/planning/ordinances/title-9-div-17-2017.pdf. Accessed May 2021.

Department of Toxic Substances Control. 2021. EnviroStor – Hazardous Waste and Substances Site List (Cortese). https://www.envirostor.dtsc.ca.gov/public/search?cmd=search&reporttype=CORTESE&site_type=CSITES,FUDS&status=ACT,BKLG,COM&reporttitle=HAZARDOUS+WASTE+AND+SUBSTANCES+SITE+LIST+%28CORTESE%29. Accessed May 2021.

Federal Emergency Management Agency (FEMA). 2008. Flood Insurance Rate Map (Panel 06025C0750C). https://msc.fema.gov/portal/search?AddressQuery=5003%20Best%20Ave%2C%20Brawley#searchresultsanchor. Accessed May 2021.

Vista Environmental. 2021a. Noise Impact Analysis – Brawley Solar Energy Facility Project. July 14, 2021.

——— 2021b. Air Quality, Energy, and Greenhouse Gas Emissions Impact Analysis - Brawley Solar Energy Facility Project. May 13, 2021.

List of Preparers

This Initial Study was prepared for the Imperial County Planning and Development Services Department by HDR at 591 Camino de la Reina, Suite 300, San Diego, CA 92108. The following professionals participated in its preparation:

Imperial County Planning and Development Services Department

Jim Minnick, Planning and Development Services Director

Michael Abraham, AICP, Assistant Planning and Development Services Director

David Black, Planner IV

HDR

Tim Gnibus, Principal

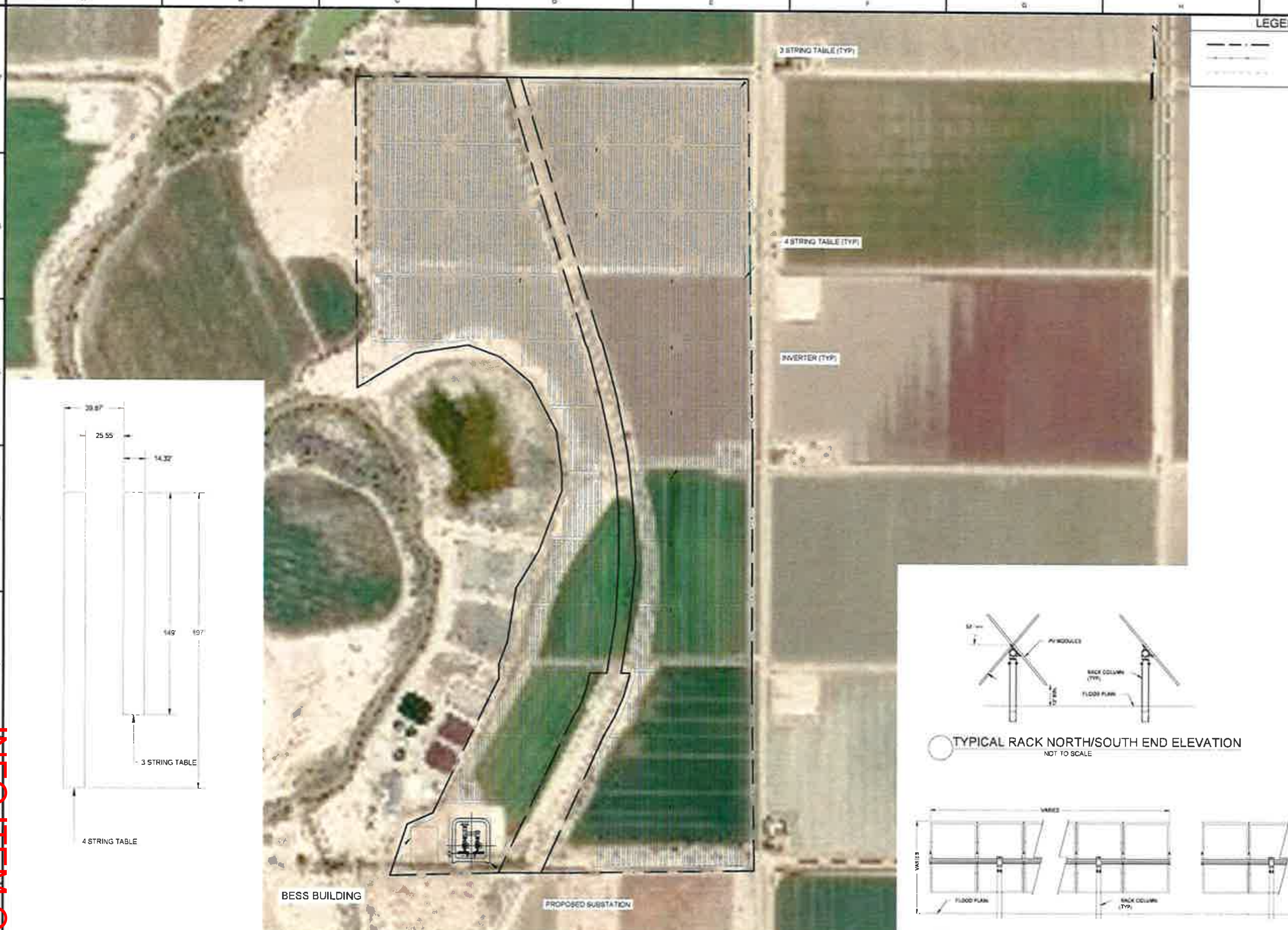
Sharyn Del Rosario, Project Manager

Elaine Lee, Environmental Planner

Ronell Santos, Biologist

Anders Burvall, Senior Geographic Information Systems Analyst

Renee Stueber, Document Production Administrator



PV SITE LAYOUT - PLAN VIEW

SCALE: 1" = 300'

PROPOSED TRACKER LAYOUT

TYPICAL RACK NORTH/SOUTH END ELEVATION

NOT TO SCALE

TYPICAL TRACKER RACK EAST/WEST SIDE ELEVATION

NOT TO SCALE

ARRAY SUMMARY	
SYSTEM SIZE GROSS (kW AC):	45,448
SYSTEM SIZE NET (kW AC): *	41,812
OVER BUILD %	13.6%
SYSTEM SIZE (kW DC):	46,394
POI VOLTAGE (kV AC):	138
SYSTEM VOLTAGE (VDC):	1,500
DC/AC RATIO:	1.16
INVERTER SPEC #:	SMA 4000 (3496 KVA @ 45°C)
INVERTER TOTAL QUANTITY:	13
MODULE TYPE:	CRYSTALLINE
MODULE SPEC:	CANADIAN SOLAR BIHIKU
MODULE WATTAGE (w):	415
MODULE TOTAL QUANTITY:	106,852
MODULES PER STRING:	28
TOTAL # OF STRINGS:	3,809
RACKING TYPE:	FTC
AZIMUTH (deg):	180
ROW SPACING (ft/m):	35.27/10.75
RACKING ROTATION (deg):	+/- 62
GROUND COVER RATIO: %	40.6%
SITE LATITUDE:	33.020034
SITE LONGITUDE:	-115.509479
SITE ACCESS GATES:	
ACREAGE (FENCE):	225
MV CABLE LENGTH (ft)	

* = .95PF, 3% AC LOSS. PLANT CONTROLLER LIMIT TO 40MW

GENERAL NOTES:

1. PROPOSED ROAD SHALL BE 20' WIDE WITH ENGINEERING APPROVED AGGREGATE
2. PROPOSED FENCE SHALL BE 6' TALL WITH 1' OF 3 STRAND BARBED WIRE
3. PROPOSED SITE CONSTRUCTION ENTRANCE SHALL BE 30' WIDE WITH PEDESTRIAN ENTRANCE

INFO USED TO PREPARE THIS DWG:

1. SITE BOUNDARY: ORNI Owned KMZ
2. TOPO SURVEY: EARTH POINT TOPO MAP (USGS QUADRANGLES)
3. WETLANDS: FWS WETLANDS AND RIPARIAN
4. FEMA: NATIONAL FLOOD HAZARD LAYER (FEMA)
5. AERIAL IMAGERY: VIA GOOGLE EARTH PRO

FastGrid

FastGrid, LLC
225 E Germann Road
Suite 101
Gilbert, AZ 85297

PRELIMINARY - NOT FOR CONSTRUCTION

PROJECT NAME
BRAWLEY
PV PLANT + BESS40MW/160MWh

PROJECT ADDRESS
NORTH BEST AVENUE
BRAWLEY, CA
92227

DATE: 09/18/2020
PROJECT #: 200016.05
DRAWN BY: ND
CHECKED BY: EH

SHEET NAME: OVERALL SITE PLAN

SHEET #: E-100

INFO ITEM ONLY

STATE OF CALIFORNIA Gavin Newsom, Governor

NATIVE AMERICAN HERITAGE COMMISSION

July 26, 2021

David Black, Planner IV
Imperial County Planning and Development Services Department
801 Main Street
El Centro, CA 92243

NAHC HEADQUARTERS
1550 Harbor Boulevard
Suite 100
West Sacramento,
California 95691
(916) 373-3710
nahc@nahc.ca.gov
NAHC.ca.gov

Re: 2021070424, GPA# 21-0003, ZC 21-0003, CUP #20-0030 & WSA (BRAWLEY SOLAR ENERGY PROJECT) ORNI 30 Project, Imperial County

Dear Mr. Black:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource, is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, §15064.5 (b) (CEQA Guidelines §15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) shall be prepared. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 5064 subd.(a)(1) (CEQA Guidelines §15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements.** If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a lead agency shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:

a. A brief description of the project.

b. The lead agency contact information.

c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).

d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A lead agency shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1(b)).

a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation if Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:

a. Alternatives to the project.

b. Recommended mitigation measures.

c. Significant effects. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:

a. Type of environmental review necessary.

b. Significance of the tribal cultural resources.

c. Significance of the project's impacts on tribal cultural resources.

d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code §6254 (r) and §6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:

a. Whether the proposed project has a significant impact on an identified tribal cultural resource.

b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:

a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or

b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:

a. Avoidance and preservation of the resources in place, including, but not limited to:

i. Planning and construction to avoid the resources and protect the cultural and natural context.

ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.

b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:

i. Protecting the cultural character and integrity of the resource.

ii. Protecting the traditional use of the resource.

iii. Protecting the confidentiality of the resource.

c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.

d. Protecting the resource. (Pub. Resource Code §21084.3 (b)).

e. Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code §815.3 (c)).

f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An Environmental Impact Report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:

a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §21080.3.2.

b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.

c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code §65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf.

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code §65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/.

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
    a. If part or all of the APE has been previously surveyed for cultural resources.
    b. If any known cultural resources have already been recorded on or adjacent to the APE.
    c. If the probability is low, moderate, or high that cultural resources are located in the APE.
    d. If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    a. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.

b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:

a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.

b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.

a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.

b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.

c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

If you have any questions or need additional information, please contact me at my email address: Andrew.Green@nahc.ca.gov.

Sincerely,

Andrew Green

Andrew Green
Cultural Resources Analyst

cc: State Clearinghouse

PUBLIC COMMENTS FOR THE ENVIRONMENTAL EVALAUATION COMMITTEE MEETING

ON AUGUST 12, 2021

FOR THE PROPOSED BRAWLEY SOLAR ENERGY FACILITY PROJECT

COMMENTS SUBMITTED BY CAROLYN ALLEN FOR MYSELF & ON BEHALF OF DONNA TISDALE, AND ON BEHALF OF BOTH OF US AS MEMBERS OF BACKCOUNTRY AGAINST DUMPS (BAD) AND ALSO ON BEHALF OF DONBEE FARMS.

These comments and references are for the record.

1) We strongly oppose this large scale industrial solar project the Brawley Solar Energy Facility Project proposed by ORNI 30 LLC.The Initial Study for this project showed 36 areas with "Potentially Significant Impacts".
All of these impacts need to fully considered and addressed .

2) Small point of use solar is a much better option than the large scale industrial solar projects like this one that wreck havoc on our farming communities.

3) We oppose the loss of farmland due to conversion to solar that this project and others like it cause. Our country's precious farm ground is finite and should be saved and protected for the future. These large solar projects cause the loss of long term agricultural jobs and create only short term temporary jobs. Large solar projects also harm the associated ag support businesses. Our Valley's Ag businesses contributes greatly to this county.This project would convert 227 acres of farmland to solar. See the article 10 Numbers That Show How Much Farmland We're Losing to Development
https://modernfarmer.com/2018/05/10-numbers-that-show-how-much-farmland -were-losing-to-development/
See Imperial County Agricultural Crop and Livestock Report
https://agcom.imperialcounty.org/wp-content/uploads/2021/08/2020-Crop-Report-v2.pdf
Also see Imperial County's Crop Report Plus for 2020

4) The project could potentially cause damage to the crops growing in the nearby fields. For example : heat island effect, excessive dust, spread of weeds ,etc.
This is just to name a few possibilities

5) There is the possibility of Soil, Crop and air contamination from the toxic chemicals and materials used for large solar projects. See Leaching Via Weak Spots in Photovoltaic Modules" https://res.mdpi.com/d_attachment/energies/energies-14-00692/article_deploy/energies-14-00692.pdf

6) Growing crops in fields provide habitat for wildlife. This proposed project will destroy that habitat. This loss needs to be taken into consideration.

7) The plants in a growing farm field help clean our air . They take in CO2 and release oxygen. Plants sequester carbon. This benefit will be lost for the 227 acres of farmland converted to industrial use by this project

8) Project poses a threat of danger to the nearby residents and to people who use the nearby golf course. For example EMF , Dirty Electricity, etc.

9) Issues of Glint and Glare problems possible for nearby airport

10) Extreme fire hazard from the lithium ion batteries used in Battery Energy Storage Systems See Battery 'Bombs': More Giant Renewable Energy Batteries Explode in Toxic Fireballs At stopthesethings.com

11) There is a growing awareness of the huge toxic trash problem that solar panels present .What is and will happen to all of the broken, damaged, expired solar panels. Will they pollute our land and water? Pile up in our landfills.?

12) All of the cumulative, direct and indirect impacts of this project need to be taken in to consideration and addressed. The total ramifications and consequences of not just this project but all of the large scale solar projects and other Battery Energy Storage Systems need to be looked at.

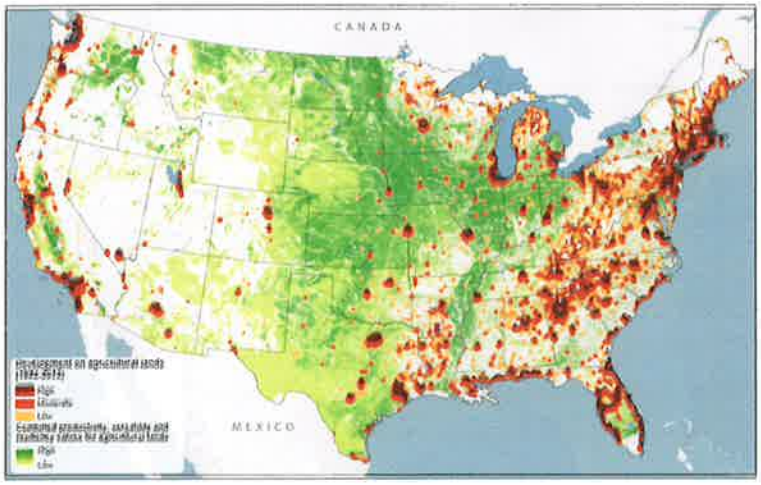
Submitted by: Carolyn Allen P.O. Box 301 Brawley, CA 92227

10 Numbers That Show How Much Farmland We're Losing to Development

MAY 22, 2018

Dan Nosowitz

"Farms Under Threat," a new report from the American Farmland Trust, shows the dire state of our nation's farmlands.



This image, courtesy of American Farmland Trust, shows the conversion of agricultural land to urban and low-density residential development between 1992 and 2012.

Photography AFT, Farms Under Threat

The organization's findings, which they are calling "the most comprehensive ever undertaken of America's agricultural lands," aren't hugely shocking, at least at the surface: American farmland is being vacuumed up by development. What's new, though, is the discovery that the development isn't coming only from urban areas expanding outwards = rural areas are also losing farmland rapidly. "The fact is that we have this sort of insidious development that no one's been paying attention to, and we really need to start paying attention," says Julia Freedgood, the assistant VP of programs at the AFT.

Why is this happening? There's no simple answer. One major reason, which has spiraling effects, is that farming is an incredibly difficult and not a very lucrative career path. The average age of the American farmer was nearly 60 in 2012 (the time of the last census); as those farmers retire or pass away, successive generations turn elsewhere for jobs, the land goes fallow and is sold off. Another reason: it's sometimes simply worth more to sell farmland rather than actually farm the land, especially if that farmland is near a city or town. "There's no one to take it over and it's worth more selling to developers, so why not?" That's also part of the reason it's obscenely difficult to find new land for new farmers; land access, according to the National Young Farmers Coalition, is one of the most difficult obstacles for beginning farmers.

This is concerning for a variety of reasons. The obvious one is that farmland produces food, so less farmland means the price of food may rise. The majority of American farmland is devoted to commodity crops = soy, corn, wheat = and many of the uses of those crops are not for direct eating.

POPULAR

7 Smokable Plants You Can Grow That Aren't Marijuana

Brian Barth

So, You Want to Be a Marijuana Farmer?

Dan Nosowitz

6 Differences Between Llamas and Alpacas

Andrew Amelinckx

Goat Sex: Everything You Wanted to Know But Were Afraid to Ask

Andrew Amelinckx

Raising Backyard Chickens for Dummies

Jason Price

Much of it, though, is used for animal feed, and if the price of animal feed goes up, so goes the price of meat. And, of course, some of the farmland being lost is for so-called "specialty" crops, like fruits and vegetables. But there are other reasons as well. Development on farmland can have negative effects, removing land that animals use as a habitat. Well-operated farms care for the soil, air, and water, and produce viable ecosystems. Economically, the agricultural industry employs millions in all sorts of fields, from machinery to inputs to researchers to retailers to packagers.

We put together a list of some of the AFT's findings that should help to add some (scary) context.

10% of the world's arable acres lie within the United States.

Agriculture contributes **$992 billion** to the American economy each year.

31 million acres of farmland lost to development, in total, between 1992 and 2012.

That's **175 acres per hour** of agricultural land

EXPLORE MODERN FARMER

ANIMALS
ENVIRONMENT
FOOD & DRINK
HOW-TO
LIFESTYLE
PLANTS
POLITICS
RECIPES
TECHNOLOGY

MEET THE MODERN FARMER

MILLION GARDENS MOVEMENT

lost to development = 3 acres per minute.

It probably comes as no surprise that the expansion of cities and suburbs are responsible for most of the loss in farmland. But **41% of the lost acres actually came from development in rural areas.**

The U.S. lost **11 million acres** of America's best agricultural land = land with superior soil conditions and weather for growing food = from 1992 to 2012.

Best agricultural land for intensive food and crop production in 2012. Source: AFT, Farms Under Threat.

0.43 PVR: PVR stands for Productivity, Versatility, and Resiliency, and it's a metric the American Farmland Trust uses to rate the quality of farmland. If farmland has a rating above that = say, 0.65 = that makes it great farmland. Below that, and it's subpar. Farmland with a high rating is being lost disproportionately quickly, which means suboptimal farmland will have to be used. And suboptimal farmland requires more water, more transportation, more energy, more fertilizers, and more pesticides to be productive, all of which are bad for the environment.

Just **17% of American land is ideal for farming.** We don't have that much to lose! The amount of the best land lost is about equal to California's entire Central Valley.

62% of development between 1992 and 2012 took place on agricultural land. The other 38% was primarily forest and simply unused space.

Some types of farmland are more at risk of being swallowed by development than others. **91% of the acreage devoted to fruit trees, tree nuts, and berries are directly in the path of development** as they're located in counties that qualify as either metropolitan areas or immediately adjacent to them.

This report is the first part of a multi-year project to better understand farmland use and loss state-by-state, and to better understand the effectiveness of state farmland protection policies. Make sure to read the full, eye-opening "Farms Under Threat" report, and you can also use that link to sign up for updates on the project from the AFT.

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Jeff Orrell 2 years ago

This is old news folks, the hour is later than we think. Read The Unsettling of America by Wendell Berry, 1976?
What can I do? I cry everytime I see a for sale sign go up on a piece of farmland because I know what's going to happen...more developing. If people could look at the land and stop to consider what they're looking at has been there since the dawn of man. Developments are no different to me than graffiti. We're taking what is timeless and putting a permanent stamp on it.
What can I do?

14 Reply

william f neal 1 year ago

The above data proves what is happening in our nation and needs to stop

3 Reply

John Hoadley 1 year ago

I come from a long history of agricultural family of farmers, my family started farming in the late 1800's, here in the treasure Valley of Boise Idaho, I myself have been in the seed industry since 1989, and have seen the turn over of prime farm ground in treasure Valley from dirt to concrete and asphalt and fields of fertil viable productive soil to homes and business. The treasure valley is very unique as we are considered the seed meca of the world as we have some of the best growers,the best soil, control of our irrigation and environment, and... Read more »

3 Reply

Gretchen Easterberg 1 year ago

Land must be purchased in large acreage masses, and donated to land trust organizations to prevent this development. It's my dream and goal to help to raise money to both donate to land trusts, and also, non-profit organizations must also be organized for farm

land and wilderness land preservation and restoration. Then, I will need help be with this, in terms of learning fundraising skills.

2 Reply View Replies (1)

Dixie Wong 2 years ago

Wonderful article. I am a realtor. What can we do?

1 Reply View Replies (3)

Roger Hoffecker 1 year ago

There will be no farmland preservation without farmer preservation.

1 Reply

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Leaching via Weak Spots in Photovoltaic Modules

Jessica Nover [1], Renate Zapf-Gottwick [1,*], Carolin Feifel [2], Michael Koch [2] and Juergen Heinz Werner [1]

[1] Institute for Photovoltaics and Research Center SCoPE, University of Stuttgart, 70569 Stuttgart, Germany; jessica.nover@ipv.uni-stuttgart.de (J.N.); juergen.werner@ipv.uni-stuttgart.de (J.H.W.)
[2] Institute for Sanitary Engineering, Water Quality, and Solid Waste Management, University of Stuttgart, 70569 Stuttgart, Germany; carolin.feifel@iswa.uni-stuttgart.de (C.F.); Michael.Koch@iswa.uni-stuttgart.de (M.K.)
* Correspondence: renate.zapf-gottwick@ipv.uni-stuttgart.de

Abstract: This study identifies unstable and soluble layers in commercial photovoltaic modules during 1.5 year long-term leaching. Our experiments cover modules from all major photovoltaic technologies containing solar cells from crystalline silicon (c-Si), amorphous silicon (a-Si), cadmium telluride (CdTe), and copper indium gallium diselenide (CIGS). These technologies cover more than 99.9% of the world market. We cut out module pieces of 5 × 5 cm^2 in size from these modules and leached them in water-based solutions with pH 4, pH 7, and pH 11, in order to simulate different environmental conditions. Unstable layers open penetration paths for water-based solutions; finally, the leaching results in delamination. In CdTe containing module pieces, the CdTe itself and the back contact are unstable and highly soluble. In CIGS containing module pieces, all of the module layers are more or less soluble. In the case of c-Si module pieces, the cells' aluminum back contact is unstable. Module pieces from a-Si technology also show a soluble back contact. Long-term leaching leads to delamination in all kinds of module pieces; delamination depends strongly on the pH value of the solutions. For low pH-values, the time dependent leaching is well described by an exponential saturation behavior and a leaching time constant. The time constant depends on the pH, as well as on accelerating conditions such as increased temperature and/or agitation. Our long-term experiments clearly demonstrate that it is possible to leach out all, or at least a large amount, of the (toxic) elements from the photovoltaic modules. It is therefore not sufficient to carry out experiments just over 24 h and to conclude on the stability and environmental impact of photovoltaic modules.

Keywords: leaching; long term; photovoltaic modules; delamination; solubility

Citation: Nover, J.; Zapf-Gottwick, R.; Feifel, C.; Koch, M.; Werner, J.H. Leaching via Weak Spots in Photovoltaic Modules. *Energies* **2021**, *14*, 692. https://doi.org/10.3390/en14030692

Academic Editor: Emmanuel Kymakis
Received: 19 November 2020
Accepted: 26 January 2021
Published: 29 January 2021

1. Introduction

Photovoltaic (PV) modules are not a niche product anymore. The market started with an installed capacity of 20 MW in the early 1990s and increased up to 635 GW of total installed PV modules worldwide at the end of 2019 [1]. By assuming an average lifetime of 30 years, we have to deal with an increasing amount of waste from PV modules of up to 1.7 million tonnes until 2030 [2].

In principle, photovoltaics are a green technology; however, some PV modules contain toxic elements such as lead in the solder ribbons and metalization pastes, or even worse, such as in CdTe technology, the toxic elements Cd and Te in the photoactive layer itself. Many modules using copper indium gallium diselenide (CIGS) also contain cadmium in the so-called CdS buffer layer of the CIGS cells. This situation is mainly possible because PV modules are still excluded from the EU Directive on the restriction of hazardous substances (ROHS 2) in electrical and electronic equipment. This exclusion will remain until the next review of the RoHS 2, which is planned for 2021 [3]. For all other electric and electronic equipment (EEE) on the EU market, the tolerated maximum concentrations by weight in homogeneous materials for lead (Pb) and cadmium (Cd) are 0.1% and 0.01%, respectively. Clearly, in the case of the compounds CdS or CdTe, with 50% of the mass being Cd,

the RoHS is not obeyed. However, also the technology of modules with crystalline Si cells has a problem with RoHS, although it could easily be overcome by using cell connectors without lead (usually, the solder contains about 40% lead) in the solder. The tiny amount of Pb in the metallization pastes could be kept below the RoHS limits. In 2019, the amount of lead-free metalization pastes in the case of silicon (Si) solar cells was only 30% [ ]. At the same time, the world market share of lead-containing solder for cell connectors was over 90% [ ].

Most probably, photovoltaic modules, which contain toxic substances, are safe for the users and the environment, at least as long as the modules are not damaged. Nevertheless, what happens if modules are damaged? What happens at the end of their use? Are they "donated" or "exported" like old cars, other old electronic equipment, and waste to countries outside the EU? In the worst case, finally, wherever it may be, the modules are crushed and/or discarded in landfills. What could happen with the toxic elements? In fact, it is no longer a question if these substances are released into in the environment: several studies proved they do and that the release depends on the pH-value of the leaching solvents, as well as on the redox conditions [–]. A literature review can be found in [ ].

Despite of all these studies [–], several questions are open: How are the toxic substances released? What are the weak spots in the modules? Does leaching only occur in the case of delaminated modules, i.e., in modules, that have lost the front glass? In this case, in particular for thin film modules, it would be understandable that the toxic substances are leached from, for example, the CdTe layers, which are no longer protected by the front glass. Does it work the other way around: Are the thin layers leached from the edges of the module (pieces) leading, finally, to delamination? Clearly, after delamination, the leaching would then be accelerated even more, because the leaching solution is now able to attack the thin layers not only from the edges, but also from the surface. Are there any potentially accelerating parameters, like agitation or temperature, regarding the leaching?

The present contribution gives answers to most of these questions via a long-term study. In contrast to previous work, our leaching tests are not only conducted over 24 h as requested by standard leaching tests [–], but for more than 1.5 year; some of our results are even taken after almost two years. Furthermore, we analyze not only eluted amounts of toxic substances like cadmium (Cd) and lead (Pb), but also other elements present in the module layers such as zinc (Zn), tellurium (Te), indium (In), gallium (Ga), selenium (Se), aluminum (Al), molybdenum (Mo), and copper (Cu), to identify soluble and, therefore, weak layers in PV modules. Parts of the experimental details were published earlier in German [ ]; some results about the leaching of Cd, Te, and Pb up to day 360 were published earlier by us [ ]. We find, that, finally, the modules delaminate because of the leaching from the edges of the module pieces. In all kinds of modules, at least one of the layers of the different cell types represents a weak path for the leaching. In the case of CdTe module pieces, the CdTe layer itself and the Mo contact are soluble. In the case of CIGS module pieces, the Zn front contact, the Mo back contact, and the Cd-containing buffer layer are susceptible to strong leaching. For crystalline silicon module pieces, the Al back contact is a weak spot; for amorphous silicon (a-Si) module pieces, also the back contact (Ni) and the intermediate layer containing Zn are identified as weak spots.

Section of the present contribution describes the sample preparation and the leaching conditions and shows how we determine the total amount of elements within each type of our investigated solar modules. Section presents our leaching results. We measured for more than 1.5 years, not only at room temperature, but also at increased temperature, as well as under accelerated leaching conditions. The leaching time constant depends on the module type, as well as on the leaching conditions. Section identifies the weak spots for each particular module type. Section , finally, concludes that the amount of leached out elements after 1.5 years in some cases exceeds the value after one day by more than two orders of magnitude. Thus, leaching experiments, which are just carried out over one day, are valuable. However, statements about the stability and environmental noxiousness of photovoltaic layers are highly questionable when based on such short-term measurements.

2. Materials and Methods

2.1. Sample Preparation and Experimental Conditions

For cutting the module pieces with well-defined sizes and edges, we applied water jet cutting to get samples from the four major commercial PV technologies: crystalline silicon (c-Si), amorphous silicon (a-Si), cadmium telluride (CdTe), and copper indium gallium diselenide (CIGS). The module pieces are cut in a way that all module pieces contained at least one solder ribbon, but no parts of the frame, module boxes, or cables. The sample size of the module pieces for the leaching experiments was 5×5 cm^2.

The leaching experiments were carried out under three different conditions, in order to identify potential accelerating conditions:

- Room temperature $T_{RT} = 25\,^{\circ}$C, no agitation;
- Room temperature $T_{RT} = 25\,^{\circ}$C, with agitation (orbital shaking with rotational speed $n = 100\,\mathrm{min}^{-1}$);
- Increased temperature $T_{IT} = 40\,^{\circ}$C, with agitation (orbital shaking with rotational speed $n = 100\,\mathrm{min}^{-1}$).

For all experiments, we used high-density polyethylene (HDPE) bottles supplied with the leaching solution with a 1000 mL volume and two pieces from the very same module; see also [ ]. The samples were not fixed in the bottles, and the bottles were lightproof. From earlier experiments (not presented here), we know that light accelerates leaching. However, light leads also to the production of alga, in particular for the long leaching times we are using. Alga production changes the experimental conditions and makes the leaching experiments less reproducible. Therefore, for the experiments presented here, we decided to use lightproof bottles. In order to increase the significance and validity of our experiments even more, each experiment was conducted in triplicate (this means three bottles, each one filled with two samples) for every condition. The leaching data, i.e., the concentration of a particular element in the solutions, are given as the mean value of the probes taken from the three bottles.

The leaching solutions with three different pHs covered the pH range of different environmental conditions that might occur in rain, groundwater, or waste disposal sites; their exact chemical composition and pH are shown in Table . All leaching solutions were base on deionized (DI) water. Over the whole 1.5 years of the experiments, the pH and the oxidation/reduction-potential E_H remained almost constant. Data for E_H, following DIN38404-6, stemmed from measurements with a platinum electrode against a silver/silver chloride reference (Ag/AgCl). The concentration of potassium chloride $c_{KCl} = 3$ mol/L was $T = 25\,^{\circ}$C; we converted the data to a potential against a standard hydrogen electrode [ ].

Throughout the leaching experiments, starting after 0.5 days, we periodically took 15 mL samples from the leaching solutions in the bottles and analyzed them for the leached out elements. After taking the probe, we pored in again fresh solution of 15 mL to keep the 1000 mL volume. All data were corrected for the amount of elements that were taken out from the solution due to sampling.

Table 1. Composition of leaching solutions with pH-values of 3, 7, and 11 used in the experiments and the measured reduction potential E_H ; the same conditions as in [ ]. (Copyright (2017) The Japan Society of Applied Physics, reproduced with permission).

pH	E_H (V)	Chemical Composition
3	0.62	15.4 g/L $C_6H_8O_7$, 2.8 g/L Na_2HPO_4, DI water
7	0.56	3.7 g/L KH_2PO_4, 5 g/L Na_2HPO_4, DI water
11	0.33	0.04 g/L NaOH, DI water

2.2. Heavy Metal Analysis and Determination of Initial Metal Content in Module Pieces

We characterized the samples that were taken from the leaching solutions with inductively coupled plasma mass spectrometry (ICP-MS) and give the data for the leached elements according to ISO 17294-2 [19]. This method is only able to measure dissolved substances; it cannot detect precipitations in the solution. Therefore, the elements in the precipitates were not counted as leached.

Here, we always give the amount of leached out elements as a percentage with respect to the total amount of elements that were in the original module pieces. Therefore, we had to measure the total mass of those elements in the module pieces before the experiment. For that purpose, similar module pieces as those for the experiments were milled to a powder. Then, the powder was digested by adding acid and oxidizing agents and, finally, using microwave irradiation. After that, the digested samples underwent the ICP-MS analysis, similar to our earlier experiment [20]. For each PV technology, and for all the elements analyzed, Table 2 shows their mass M_{total} that was contained in the original reference module pieces.

Table 2. Elemental mass M_{total} in the 5 × 5 cm^2 module pieces for crystalline silicon (c-Si), amorphous silicon (a-Si), cadmium telluride (CdTe), and copper indium gallium diselenide (CIGS). The data represent mean values and the standard deviation from three measurements.

Element	c-Si (mg)	a-Si (mg)	CdTe (mg)	CIGS (mg)
Zn		0.9 ± 0.4		16.1 ± 3.1
Cd			13.9 ± 0.9	0.2 ± 0.002
Te			15.6 ± 1.1	
In				14.1 ± 4.3
Ga				0.7 ± 0.1
Se				6.7 ± 1.3
Al	167 ± 40	196 ± 27	289 ± 63	280 ± 190
Mo			12.7 ± 1.7	5.0 ± 0.2
Cu	254 ± 15	130 ± 14	80 ± 11	146 ± 5.7
Ni		1.0 ± 0.1		
Pb	16.7 ± 0.8		2.4 ± 0.3	

2.3. Mass Balancing at the End of the Leaching Experiments

During the leaching experiments, the total mass:

$$M_{total} = M_{diss} + M_{MP} + M_{FR} \quad (1)$$

of a particular element is the sum of the following masses: the amount M_{diss} dissolved in the solution, the remaining mass M_{MP} within the module pieces, and the mass M_{FR} that precipitated in the bottles of the solution. Clearly, at the end of the leaching experiment, the total mass, determined by Equation (1) should equal the masses in Table 1. We measured the mass M_{FR} in the following way: First, the module pieces were removed from the bottles, and then, the solution was filtered using vacuum filtration with a cellulose nitrate membrane filter with a pore size of 0.45 µm. The mass M_{MP} was measured in the same way as the total mass of the elements in one module piece, as described previously. To measure the mass of the filter residue M_{FR}, we digested the filter residue together with the filter by applying a microwave enhanced oxidative digestion. Again, ICP-MS measured these samples, and the measurement of the cellulose nitrate membrane filter itself (blank value) ran in parallel. Subtracting the blank values for the filter, we calculated the amount of each element in the filter residue.

3. Results

3.1. Delamination of Module Pieces

One focus during long-term leaching in water-based solutions lies in the occurrence of delamination. In order to simulate field conditions, in a first series of experiments, we did not use any accelerating leaching parameters for the module pieces for analyzing the delamination (Figure 1a). Delamination, in this study, is defined as a separation between all kinds of module layers, not only between the encapsulation layer, often ethylene vinyl acetate (EVA) foil, and the glass. The delamination was determined by visual examination.

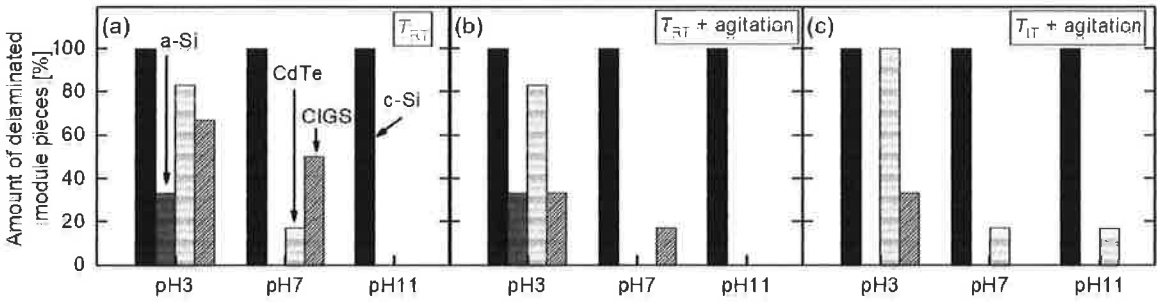

Figure 1. Amount of delaminated module pieces from crystalline silicon (c-Si), amorphous silicon (a-Si), cadmium telluride (CdTe), and copper indium gallium diselenide (CIGS) depending on the pH value of the water-based solution after 1.5 years for the three different experimental conditions: (**a**) $T_{RT} = 25\,^{\circ}C$, no agitation, (**b**) $T_{RT} = 25\,^{\circ}C$, with agitation, and (**c**) $T_{IT} = 40\,^{\circ}C$, with agitation.

After 1.5 years of leaching, we observed delamination in all kinds of PV module pieces: c-Si, a-Si, CdTe, and CIGS. The probability of delamination depends on the pH value of the solutions and the experimental conditions. In the case of c-Si module pieces, we always observed 100% delamination, independent of the pH-value, temperature, and agitation: in all aqueous solutions and for all module pieces, delamination occurred. However, in this case, delamination occurred via the EVA layer, and the type differed from the delamination type of thin film module pieces (via thin layers), as discussed later. Delamination of a-Si module pieces only happened in aqueous solutions with pH 3, and only 30% of the module pieces were affected. The agitation (Figure 1b) and also the temperature (Figure 1c) had no accelerating effect on the delamination. In fact, during the leaching experiments with $T_{IT} = 40\,^{\circ}C$ plus agitation, no delamination of a-Si module pieces was found. The highest amount of delamination in the case of CdTe module pieces occurred in acidic water-based solutions. For this type of module, the increased temperature weakly affected the delamination, as shown in Figure 1c. At room temperature, no delaminated CdTe module pieces were observed in the solutions with pH 11, whereas in neutral solutions, only 17% of the module pieces showed delamination. The pH dependence held also for the CIGS module pieces. In pH 3 solutions, the highest amount of delamination occurred with 67% of the module pieces. In pH 7 solutions, the amount of delaminated module pieces was still 50%. In alkaline solutions with pH 11, no delamination was observed with agitation or with increased temperature.

We classified all these delaminations into three different types: (i) Total separation: Here, the front side is clearly separated from the rear side. This delamination occurs in case of CdTe and a-Si module pieces. Figure 2a shows a scheme of this delamination type. (ii) Fractional separation: Here, only parts of the rear or front side are separated. The major part of the module compound is still intact. This type of delamination takes place for CIGS module pieces and for c-Si module pieces when leached in solutions with pH 11. The scheme is shown in Figure 2b. (iii) Blistering: Figure 2c shows this third type of delamination. Blistering occurs between either the front glass and the EVA foil, or between the EVA foil and the solar cell, but there is no complete separation. This type only occurs in c-Si module pieces.

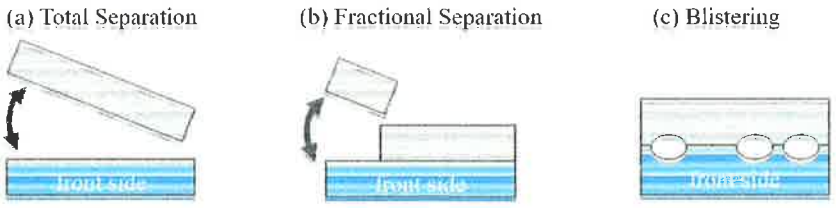

Figure 2. Different types of delamination during the leaching process: (**a**) Total separation (observed for CdTe and a-Si module pieces). The front side is completely separated from the rear side. (**b**) Fractional separation (observed for CIGS and c-Si module pieces). Only small parts of the rear side are separated; the major part of the module structure is still intact. (**c**) Blistering (only observed for c-Si module pieces). Bubble formation emerges locally on the front side of c-Si module pieces, either between glass and EVA or between EVA and solar cell depending on the pH. In this case, no separation occurs between the front and the rear side.

Total separation: Figure 3a–d shows photographs of the front and the rear side of a 5 × 5 cm^2 CdTe module piece before and after 1.5 years of leaching. Before leaching the CdTe module piece, the integrated series connection of the cells is visible (see the horizontal lines) on the front side (Figure 3a) and also on the rear side (Figure 3b). On the rear side, one sees also the solder ribbon. Only the rear side glass of the module piece shows cracks caused by the water jet cutting. The breakage pattern of this glass indicates that heat-strengthened glass is used as the rear side glass. Figure 3c,d shows the front and the rear side of a CdTe module piece after the leaching process of 1.5 years in solutions with pH 3. Apart from a few parts, the module material disappeared completely. The solder ribbon is still attached to the rear side glass by an insulating tape. After this long-term leaching, the front and the rear side glasses are no longer connected to each other, but totally separated. For a-Si module pieces, the same type of delamination is observed.

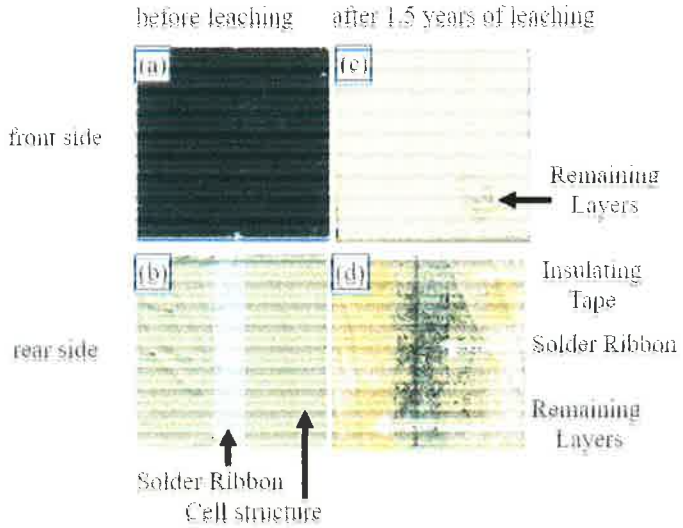

Figure 3. Photographs of (**a**) the front and (**b**) the rear side of a 5 × 5 cm^2 CdTe module piece before leaching. On the rear side, the solder ribbon and the interconnection of cells are visible. (**c**) Front side of the module piece after leaching over 1.5 years in solutions with pH 3. Apart from a few visible remaining parts, the module material disappeared. (**d**) Rear side of the module piece after the leaching. The solder ribbon with the insulating tape is visible and also some parts of remaining layers. After 1.5 years of leaching, the front and the rear side glasses are no longer attached to each other; total separation occurs.

Fractional separation: Figure 4a–d shows photographs of the front and the rear side of a 5 × 5 cm^2 CIGS module piece before and after 1.5 years of leaching: parts of the rear side are separated. Both glasses, the front and the rear side glass, show cracks due to the water jet cutting. Figure 4c shows a photograph of the front side after 1.5 years of leaching in solutions with pH 3. From the front side, a few transparent spots around the edges are visible. From a more detailed look at the back side of the module piece (Figure 4d), it becomes clear that at the transparent spots, parts of the rear side glass are missing, together with the back contact and the active module layers. Therefore, only the transparent front glass remains.

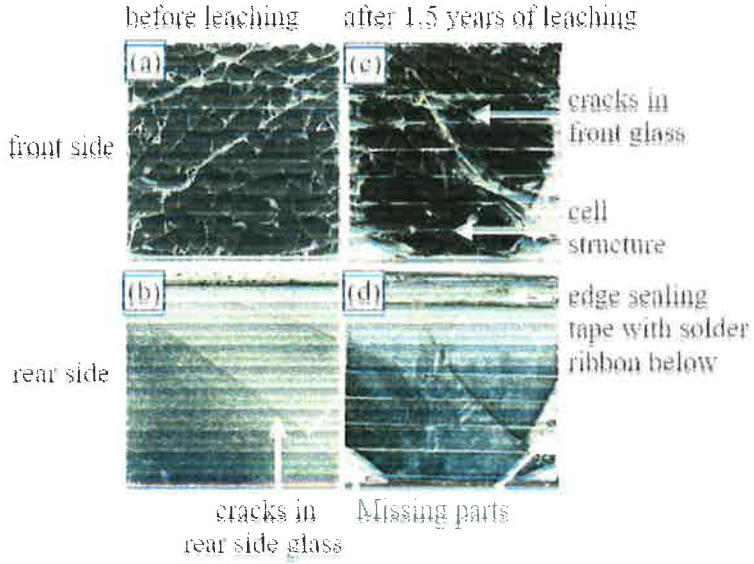

Figure 4. Photographs of (**a**) the front and (**b**) the rear side of a 5 × 5 cm^2 CIGS module piece before leaching. On the rear side, the edge sealing tape with the solder ribbon below is visible. In the front glass, as well as in the rear side glass, cracks are recognizable; they stem from the water jet cutting. (**c**) Front side after leaching for 1.5 years in pH 3 solution. (**d**) Rear side after leaching. Parts of the rear glass are missing, together with the back contact and the active layers. Only the transparent front glass remains.

Blistering: Figure 5a shows a photograph of a c-Si module piece of 5 × 5 cm^2 in size after 1.5 years of leaching in pH 3 solution. In this case, local bubble formation takes place between the solar cell and the EVA foil, especially around the solder ribbon, but no total separation is observed. In solutions with pH 11, delamination between the EVA foil and the front glass appears across extended areas (Figure 5b). A few parts of the glass are separated, and the exposed EVA foil with the solar cell below remains. Due to delamination, the textured structure of the front glass becomes visible. The breakage pattern of the glass matches the pattern known for tempered glass. The rear side of the c-Si module pieces (white backsheet) shows no changes caused by leaching. Only for this PV technology, the occurrence of delamination, i.e., blistering, does not depend on the pH value of the leaching solution. Module pieces leached in pH 7 solutions also show blistering. Blistering takes place at both locations: between the solar cell and the EVA foil, as well as between the EVA foil and the front glass.

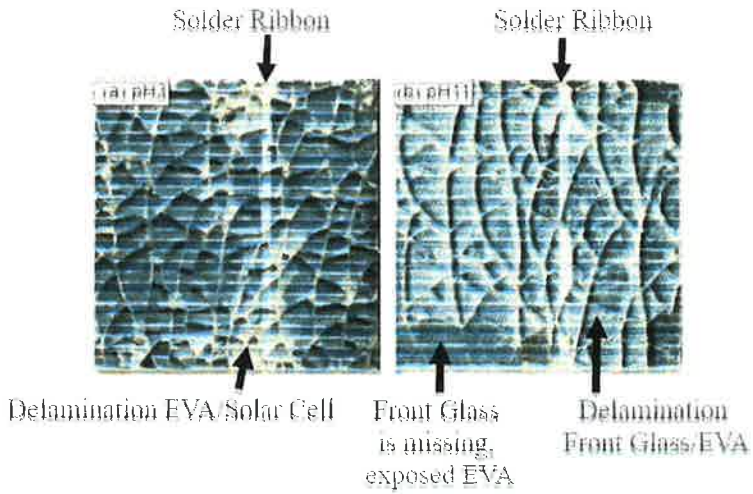

Figure 5. Photographs of c-Si module pieces with 5 × 5 cm^2 after 1.5 years of leaching in solutions with (**a**) pH 3 and (**b**) pH 11. In solutions with pH 3, a local bubble formation occurs between the solar cell and the EVA foil, preferably around the solder ribbon. In solutions with pH 11, a delamination between the EVA foil and the front glass appears across extended areas. A few parts of the glass are separated, and the exposed EVA foil with the solar cell below remains.

3.2. Leaching Results

The previous figures, as well as our previous experiments on milled module pieces [8] give the proof for severe leaching for all module technologies. In the following, we present detailed results on the elements that were leached out from module pieces of 5 × 5 cm^2 in size. In a first publication [10], we presented preliminary leaching data for Cd, Te, and Pb only and until Day 360, i.e., about one year. In contrast, here, we extend our study to 1.5 years and include many more other elements. This gives us the chance to identify possible weak spots and the leaching paths in the modules. In detail, we measure the amount of the following elements in our water-based solutions of Table 1 with different pH-values: Zn, Te, In, Ga, Se, Al, Mo, Cu, Cd, and Pb. The non-toxic element Si, which is contained in the modules' cells from crystalline, as well as from amorphous silicon, is not measured, simply because the module glass itself also contains high amounts of Si. Our measurement conducted by ICP-MS cannot distinguish between Si from the cells and from the glass of the modules.

3.2.1. CdTe Module Pieces

Figure 4a shows the common structure of a CdTe module including the front glass and front contact (usually tin oxide (SnO_2)), the buffer layer cadmium sulfide (CdS), the photoactive layer CdTe, the Mo back contact, the encapsulant EVA, and finally, the rear side glass. The typical thickness of each layer is also given [19–21]. CdTe modules are mostly fabricated in a superstrate configuration: the production process starts with the front glass, on which the transparent front contact SnO_2 is deposited. We used commercial CdTe-modules for the preparation of the module pieces and measured the amount of eluted elements with the above discussed ICP-MS method. Therefore, we are not able to distinguish between the Cd from the CdS buffer layer and the Cd from the photoactive CdTe film.

Figure 4b–d shows the time-dependent leaching of the elements Cd, Te, and Mo in water-based solutions with pH 3, pH 7, and pH 11; see also [10] for the leaching results of Cd and Te until Day 360. These results stemmed from experiments at T_{RT} = 25 °C without agitation. In all solutions, the amount of leached elements increases with time, but with different leaching rates for different pHs of the solutions. At the early beginning of leaching, Mo from the back contact leaches out with the highest amount, followed by Cd.

The leaching results in Figure 6b–d clearly demonstrate an enormous difference between the leaching concentrations after one day and after the 1.5 years. For example, the Cd-elution in pH 3 at the end of the experiment reaches almost 100%, whereas it is only about 1 % after one day. For pH 3 and pH 7, the eluted concentrations increase approximately linearly with time: a one order of magnitude increase (on the log-scale) of the time leads to a one order of magnitude higher concentration (on the log scale) of the concentration. For pH 11, the data approach a square root dependence with time: it needs a two orders of magnitude increase on the time scale for a one order of magnitude increase on the concentration scale.

Figure 7 shows the ratio $R_{Cd:Te}$ of dissolved Cd to dissolved Te from leaching CdTe module pieces in solutions with pH 3, pH 7, and pH 11. For leaching solutions with pH 3, the value of $R_{Cd:Te}$ is not constant over the leaching time. At the beginning of leaching, $R_{Cd:Te}$ is highest with 35:1, but with time, it approaches $R_{Cd:Te} \approx 1$. For neutral solutions with pH 7, $R_{Cd:Te} \approx 1$ and is almost constant over time. The same behavior applies for leaching in alkaline solutions, but with $R_{Cd:Te} \approx 0.1$. This means that more Te is dissolved in the solutions.

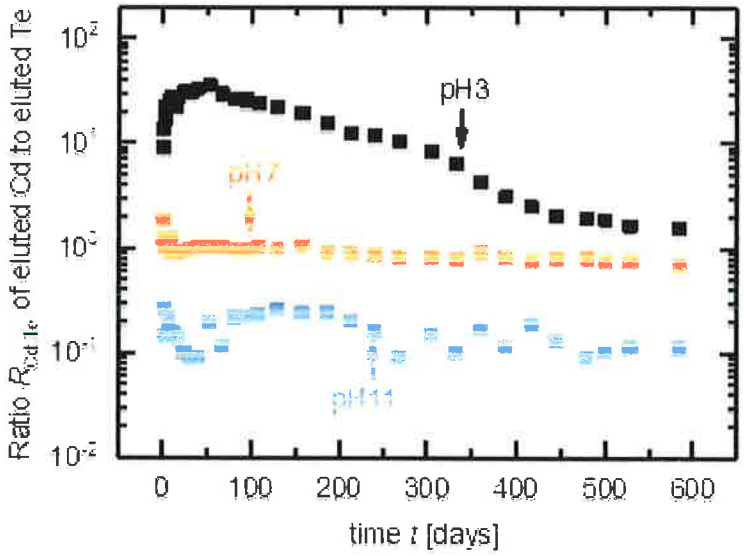

Figure 7. Ratio $R_{Cd:Te}$ of dissolved Cd to dissolved Te from leaching CdTe module pieces in solutions with pH 3, pH 7, and pH 11.

3.2.2. CIGS Module Pieces

Figure 8a shows a schematic cross-section through a CIGS module, composed of the front glass with EVA, the front contact (usually consisting of aluminum-doped zinc oxide, ZnO:Al), a buffer layer of CdS, the absorber layer Cu(In, Ga)Se_2, and a thin interfacial layer of $MoSe_2$ between the substrate glass and the CIGS. The $MoSe_2$ is formed by a reaction between the Mo and the Se atmosphere during the deposition of the Cu, In, and Ga [22]. CIGS modules are built in a substrate configuration. The fabrication starts with the deposition (sputtering or evaporation) of Mo on the rear glass. Then, the CIGS is deposited, mostly by co-sputtering or thermal evaporation of the constituent elements, Cu, In, and Ga in a Se atmosphere.

Figure 8b shows the leaching data for Zn, Cd, Mo, Cu, Ga, and In in pH 3 solutions. At the beginning of leaching, Zn from the front contact shows the highest amount with $c_{Zn} \approx 1\%$ already after one day; finally, we observe $c_{Zn} \approx 62\%$ after 1.5 years. Furthermore, already after one day, certain amounts of Mo from the back contact and In from the absorber layer are measurable in the solutions. Other elements, like Cd, Cu, and Ga, are detected later on. The leaching rates of each element differ in absolute values, but show a similar

time dependence. The leaching of the Mo from the CIGS module pieces differs from the data for Mo from CdTe module pieces (see Figure 7b). The Mo from CdTe module pieces seems to be more soluble, in particular for acidic solutions. The difference probably results from the formation of $MoSe_2$ at the back side of the CIGS films.

Figure 8c shows the leaching of Zn, Cd, Mo, Cu, Ga, and Se in pH 7 solutions. Indium is not detected in the solution with pH 7. The leaching of Zn for this pH is lower than that for pH 3, and so is the concentration after 1.5 years. In solutions with pH 11, we only find Mo, Ga, and Se with low concentrations in the solutions, as shown in Figure 8d. The leached Mo is lowest for pH 11 compared to the data from solutions with pH 3 and pH 7. In the case of CIGS module pieces, comparable to CdTe, the Mo back contact is a weak spot, but also the front contact Zn and the buffer layer Cd.

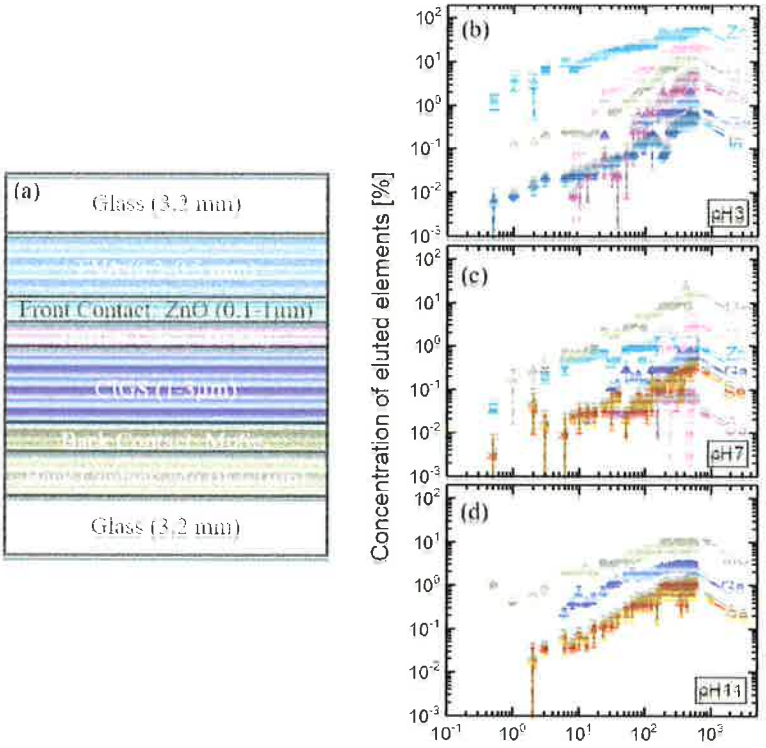

Figure 8. (**a**) Schematic structure of a typical CIGS module (not drawn to scale) and (**b**) time-dependent leaching results of the elements Zn, Cd, Mo, Cu, Ga, and In from CIGS module pieces in acidic aqueous solutions with pH 3 and (**c**) in solutions with pH 7 and (**d**) pH 11. In leaching solutions with pH 11, the concentrations of the elements Cd, Zn, Cu, and In are below the detection limit.

3.2.3. c-Si Module Pieces

Figure 9a shows a schematic cross-section through a classic c-Si module, consisting of a front glass with EVA, a silver front contact grid with contact fingers and busbars, and the silicon solar cell with a screen printed aluminum back contact and screen printed Ag contact pads (not drawn in the scheme). In contrast to thin film modules, instead of a rear glass, most c-Si modules have a backsheet and a second EVA sheet at the rear side. Figure 9b,c shows the leaching data for Al and Pb for pH 3 and pH 11 (see also [11] for the leaching results of Pb until Day 360). In the case of pH 7, the concentrations of Al and Pb are below the detection limit, which is 500 µg/L for Al and 20 µg/L for Pb. The eluted Pb stems either from the solder ribbon, which is not shown in the schematic cross-section, or from the screen printed metallization. For pH 3, the amount of leached Pb remains constant and below 0.1% until Day 241. After this time, the concentration increases dramatically up to $c_{Pb} \approx 3.7\%$ after 1.5 years. The concentration of Al reaches $c_{Al} \approx 27\%$ after 1.5 years in

the acidic solution. In contrast, for the alkaline solution with pH 11, the concentrations of Al and Pb are significantly lower, as shown in Figure 9c. In both cases, the leaching rates of Al are orders of magnitude higher than the ones for Pb. Thus, in the case of c-Si module pieces, the Al contact, which is screen printed and fired into the back side, makes up the weak spot and opens the path for leaching.

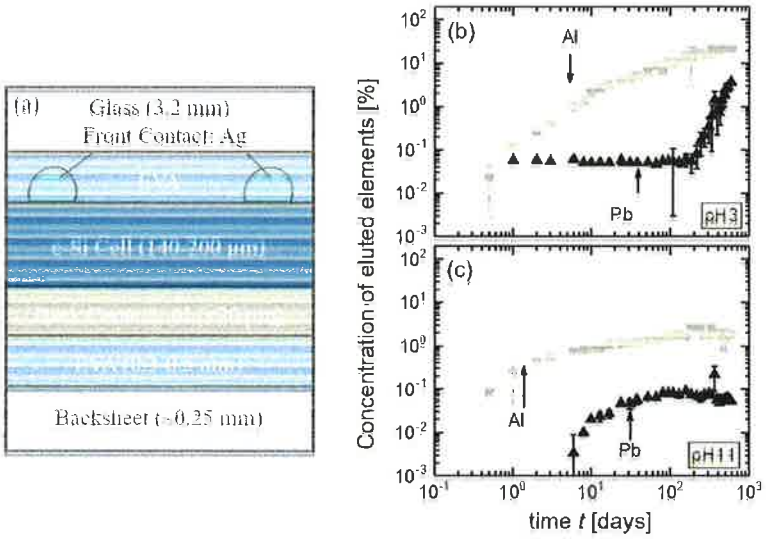

Figure 9. (**a**) Schematic structure of a typical c-Si module (not drawn to scale) and (**b**) time-dependent leaching results of Al and Pb from c-Si module pieces in acidic aqueous solutions with pH 3 and (**c**) in solutions with pH 11. In leaching solutions with pH 7, the concentrations of Al and Pb are below the detection limit.

3.2.4. a-Si Module Pieces

The common structure of an a-Si module is shown in Figure 10a. Amorphous silicon modules typically consist of a front glass with the front contact layer (SnO_2 is mostly used), the photoactive p-i-n layer from a-Si, followed by an intermediate layer consisting of ZnO and Ag, the back contact with a combination of Ni and Cu, and the encapsulant with the rear glass [23]. Similar to the production of CdTe modules, a-Si modules are built in a superstrate configuration, starting with the deposition of the front contact directly on the front glass. Figure 10b,c shows the concentrations of eluted Zn, Cu, and Ni in the solutions with pH 3 and pH 7. Unfortunately, we do not have any data about Ni before Day 388 of leaching. In leaching solutions with pH 11, the concentrations of Zn, Cu, and Ni are below the detection limits. For the other pH-values, we are able to present data: Zn, which stems from the intermediate layer, shows strong leaching with concentrations up to $c_{Zn} \approx 90\%$ after 1.5 years of leaching in the acidic pH 3 solution. The concentration of eluted Ni lies in the same range, whereas the concentration of Cu is $c_{Cu} \approx 7.5\%$. In aqueous solutions with pH 7, the elements Zn, Ni, and Cu leach only in minor amounts. The elements Zn, Cu, and Ni are leached out linearly with time, but with different rates depending on the element itself, as well as on the pH of the solution. In all cases, the leaching of the Zn is highest, and therefore, we identify the ZnO layer as a weak spot in a-Si module pieces.

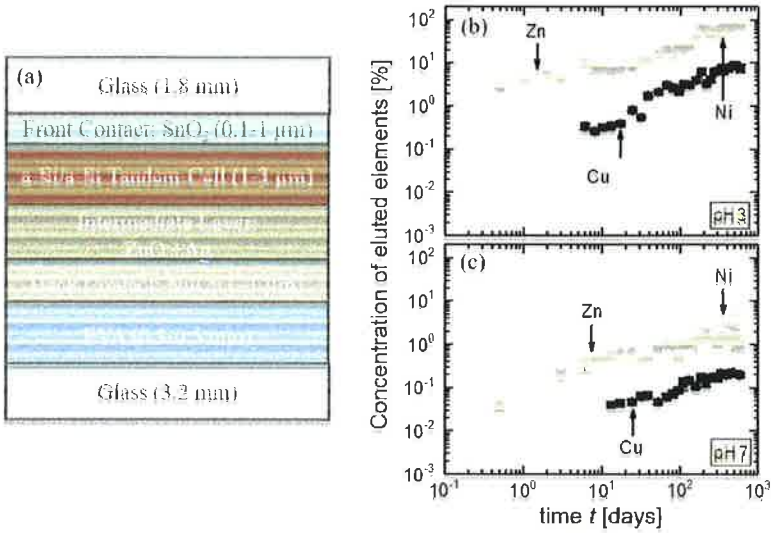

Figure 10. (**a**) Schematic structure of a typical a-Si module (not drawn to scale) and (**b**) time-dependent leaching results of Zn, Cu, and Ni from a-Si module pieces in acidic aqueous solutions with pH 3 and (**c**) in solutions with pH 7. In leaching solutions with pH 11, the concentrations of Zn, Cu, and Ni are not measurable according to the detection limit.

3.3. Accelerating Leaching Parameters for Cd from CdTe Module Pieces

All of the experiments considered so far were performed without any acceleration, for example, by elevated temperatures or stirring/agitation. Figure 11a,b compares the data for Cd, leached out from CdTe module pieces, for the three different pH-values and with/without agitation. Apart from the tests at $T_{RT} = 25\,^{\circ}\mathrm{C}$, we also used additional agitation and solutions at an elevated temperature $T_{IT} = 40\,^{\circ}\mathrm{C}$. All test series ran in parallel. Figure 11a shows the results after $t = 1$ day and Figure 11b after $t = 416$ days. The comparison of the two figures again underlines the dramatic difference in the leaching results after one day and after more than a year. Therefore, standard leaching experiments, which are only carried out over one day, are more or less meaningless, when one aims at judging the toxicity of CdTe modules. Furthermore, after just one day (see Figure 11a), additional agitation and/or elevated temperatures only slightly increase the amount of eluted Cd, even if for pH 3 solutions. In contrast, in particular for pH 7, increasing the temperature from $T_{RT} = 25\,^{\circ}\mathrm{C}$ to $T_{RI} = 40\,^{\circ}\mathrm{C}$ results in five times stronger leaching. Leaching in pH 11 solution triples the leaching of Cd for the same temperature increase. In contrast, in the case of agitation, we are not able to detect any Cd in the alkaline solutions after one day. In the case of pH 3, for all experimental conditions, after $t = 416$ days, the amount of eluted Cd in acidic solutions reaches almost 100%. In the case of the neutral pH 7 solutions, the final data all lie in the same range of $2\% < c_{Cd} < 4\%$. After 416 days, the eluted Cd reaches saturated values. Therefore, as shown in Figure 11b, there is almost no or only minor differences between the data with and without additional accelerating parameters.

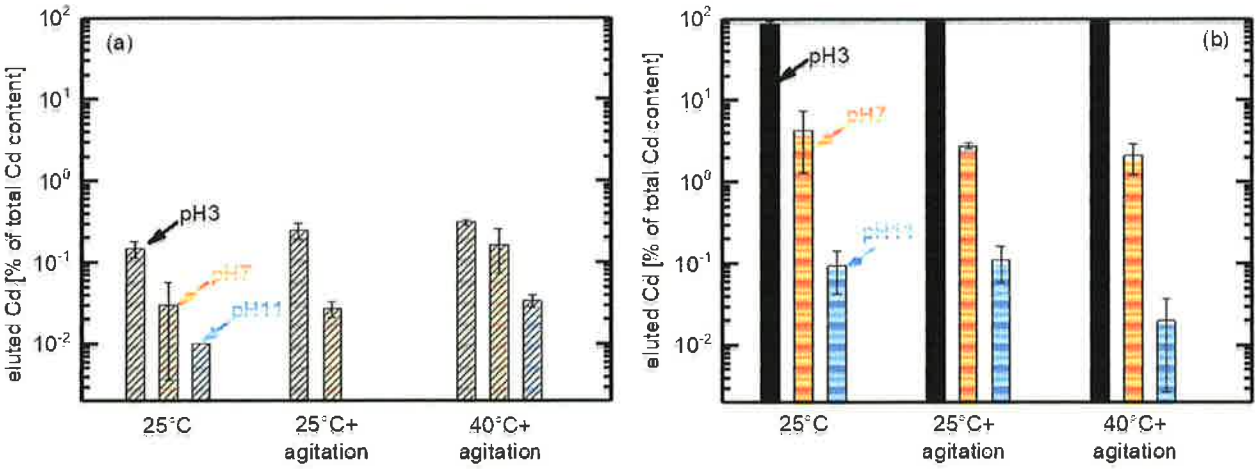

Figure 11. Dramatic difference between the leaching data after one day and more than a year of Cd out of CdTe module pieces. (**a**) Amount of eluted Cd from CdTe module pieces after $t = 1$ day in solutions of pH 3, 7, and 11 and different leaching conditions: with/without agitation and increased temperature $T_{IT} = 40\,^{\circ}\mathrm{C}$ plus agitation. For all conditions, after one day, the Cd concentration ranges below 1%. (**b**) Amount of eluted Cd from CdTe module pieces after $t = 416$ days. For pH 3, almost 100% of the Cd is leached out. For pH 7, still several percent are leached out. This finding raises the question of the meaningfulness of judging the toxicity of CdTe containing modules with tests that are carried out for one day only.

3.4. *Analysis of Time Dependence*

To get a better understanding of how the different leaching conditions affect the time-dependent leaching, we fit the measured concentration $C(t)$ at the time t to an exponential model according to:

$$C(t) = C_{max}(1 - e^{-\frac{t}{\tau}}), \tag{2}$$

where C_{max} is the maximum, final concentration dissolved in the solution and τ is the leaching time constant. The leaching time constant represents the time for the concentration to reach 63% of its final value as a measure of leaching velocity. For times $t \ll \tau$, the Taylor expansion of Equation (2) yields a linear behavior according to:

$$C(t) = C_{max}\frac{t}{\tau}. \tag{3}$$

Indeed, in almost all of our experiments, if not disturbed by delamination effects, we see the linear time dependence predicted by Equation (3) and the saturation predicted by Equation (2). Equation (3) is the direct consequence of the number of atoms (Cd)that are leached per unit time, being directly proportional to the number of atoms that are still available for etching. Such an approach always leads to an exponential function such as Equation (2). However, not only delamination (which is expected to accelerate the leaching), but also other effects such as the formation of surface layers (see our work [24]), diffusion limitations, and/or the formation of precipitates could result in deviations from a behavior following Equations (2) and (3). For a diffusion limited leaching on a thin layer, one would observe a square root dependence, as discussed in [24]. This might be the case for some of the data here, in particular for pH 11.

Most of experimental data, in particular for pH 3 and pH 7, show an excellent agreement with the linear behavior, predicted by Equation (3) for time $t \ll \tau$, as well as for the saturation behavior, Equation (2). As an example, Figure 12a–c shows the time-dependent leaching of Cd from CdTe module pieces in solutions with pH 3 for the three different leaching conditions. The data are excellently fit with coefficients of determination $R^2 \geq 0.96$. Figure 12d–f shows the leaching data of Cd in solutions with pH 7. The dotted lines

represent the calculated fit according to Equation (2). The dashed lines show the calculated maximum Cd concentration C_{max} in the solutions; the time constants τ are also given. Modifications to the leaching conditions lead to accelerated leaching with a shorter time constant τ: For example, increasing the temperature to $T_{IT} = 40\,^{\circ}C$, as shown in Figure 12c, leads to a time constant that is only a third of the value at $T_{RT} = 25\,^{\circ}C$. In contrast to the time constant, the C_{max}-value is almost independent of the leaching conditions in pH 3 solution; it holds $C_{max} \approx 100\%$. Figure 12d shows the leaching data for pH 7 at $T_{RT} = 25\,^{\circ}C$ without agitation; we find $\tau = 210$ days. After this time $t = \tau$, a value of 63% of the maximum Cd concentration is reached, which is estimated to be $C_{max} = 4.8\%$. Modified experiments slightly decrease the maximum concentration, which we explain by the large standard deviations at the end of leaching, caused by the delamination of module pieces. Additional agitation decreases the time constant to $\tau = 80$ days (Figure 12e); increased temperature yields $\tau = 20$ days (Figure 12f), i.e., four-times faster leaching.

The excellent fits of our leaching data for pH 3 and pH 7 to Equations (2) and (3) show also that in this case, the leaching is not limited by any diffusion processes, which might take place inside or on the surface of the CdTe layers (this statement holds also for the experiments on all other cell technologies). This behavior is in contrast to our results on the leaching of milled module pieces, which were reported in a separate publication [23]. There, the model for the small spherical CdTe particles, with sizes below one millimeter, predicts a power law, with leaching data following a dependence on time t according to $t^{0.43}$. Indeed, in [24] we observed this behavior for the small particles also experimentally. Due to the different size and geometry of the samples, the leaching from the flat plates of module pieces as presented here, at least for pH 3 and pH 7, follows a different time dependence, which, for short times compared to the leaching time constant, is $t^{1.0}$, as, for example, shown in Figure 6b,c.

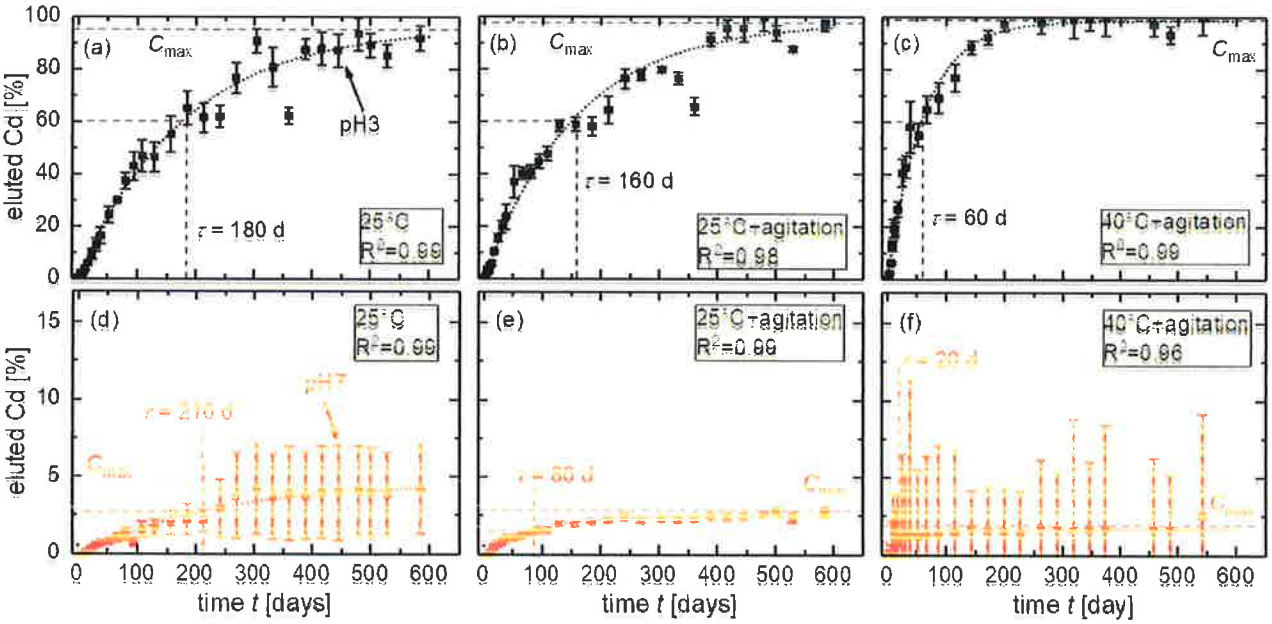

Figure 12. Leaching of Cd from CdTe module pieces in solutions with pH 3 at (**a**) $T_{RT} = 25\,^{\circ}C$, (**b**) at $T_{RT} = 25\,^{\circ}C$ with agitation, and (**c**) at $T_{IT} = 40\,^{\circ}C$ with agitation. Eluted Cd in solutions with pH 7 at (**d**) $T_{RT} = 25\,^{\circ}C$, (**e**) at $T_{RT} = 25\,^{\circ}C$ with agitation, and (**f**) at $T_{IT} = 40\,^{\circ}C$ with agitation. The dotted lines represent the calculated fit according to Equation (2) with high coefficients of determination R^2. The dashed lines show the calculated maximum concentration C_{max} in the solutions.

Figure 13a shows the leaching time constant τ for pH 3 and pH 7: A higher temperature results in faster leaching. In our study, $T_{IT} = 40\,^{\circ}C$ is used, which is a common temperature PV modules reach when exposed to sunlight; on hot summer days, the temperatures are

even higher. In solutions with pH 7, the change in the leaching time constant due to varied conditions is even stronger. In contrast to a different τ, Figure 13b shows that the maximum concentration C_{max} of eluted Cd remains nearly constant and independent of modifications to the leaching conditions. However, the value C_{max} highly depends on the pH of the leaching solution: it holds $C_{max} \approx 100\%$ for pH 3 and $C_{max} \leq 4.8\%$ for pH 7. The lower C_{max} for pH 7 is explained by the formation of cadmium hydroxide in neutral solutions. This compound is not soluble and therefore not detected by our measurement method ICP-MS.

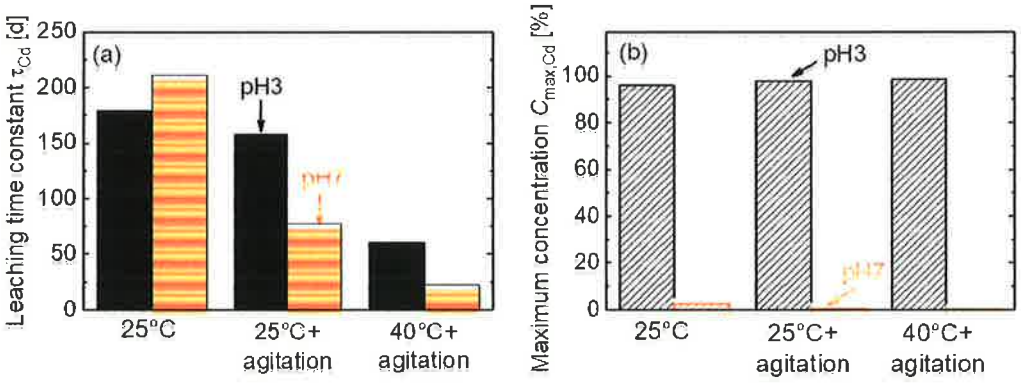

Figure 13. Calculated fit parameters for the leaching of Cd from CdTe module pieces under different conditions. **(a)** Leaching time constant τ_{Cd} for solutions with pH 3 and pH 7. **(b)** Maximum concentration C_{max} for the same conditions as in **(a)**.

3.5. Mass Balance for CdTe Module Pieces

Figure 14 shows the distribution of the mass fractions for the elements Cd, Te, and Mo from CdTe module pieces leached for 700 days at $T_{RT} = 25\,^{\circ}C$ without agitation: the dissolved amount in the solution M_{diss}, the remaining mass in the module piece M_{MP} after the leaching process, and the mass of the filter residue M_{FR} with particles bigger than 0.45 mm. There are strong differences between the leaching behavior for pH 3 and pH 11:

pH 3: Almost all Cd, Te, and Mo from the module pieces is found in the mass M_{diss} of dissolved elements. In particular, for Cd, almost nothing remains in the module piece (mass M_{MP}) or is found in the mass M_{FR} of precipitates.

pH 11: Almost all Cd and Te still remain in the module pieces and are represented by the mass M_{MP}. Only in the case of Mo, a part of the Mo is measured in the solution as M_{diss}.

Mass loss for Te and Mo: The sum of the masses in the solution, filter, and module pieces measured after the leaching should reach 100% of the value before the leaching. However, for Te and Mo, the sum of the measured values after leaching is below 100%. The relatively small amount of missing mass is termed M_{Rest} in Figure 14. We explain the difference by the milling process for the determination of the remaining mass M_{MP} in the module piece. For a few samples, the milling process did not completely crush the encapsulation. The Mo back contact has a strong adhesion to the encapsulant. Therefore, it seems possible that not all Mo material was digested. There might also be a material loss during the filtration process, either when drying the filter afterwards, or due to particles remaining in the HDPE bottles despite carefully repeated rinsing.

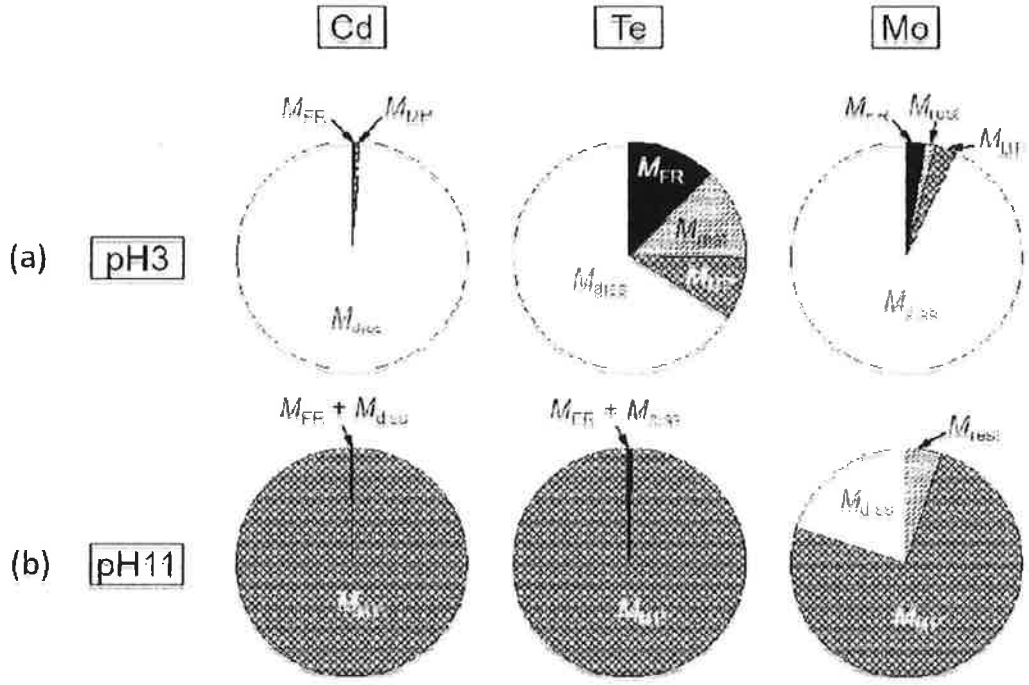

Figure 14. Mass balance of the CdTe module piece after 700 days in leaching solutions with (**a**) pH 3 and (**b**) pH 11 at $T_{RT} = 25\,°C$ without agitation. In solutions with pH 3, the largest fraction of Cd, Te, and Mo is dissolved and found as M_{diss}; only a small fraction M_{MP} remains in the module pieces. No Cd-particles (mass M_{FR}) are measured within the filter residue, whereas for Te and Mo, a small part is found in the residue. In solutions with pH 11, the major part of the elements Cd and Te remains in the module piece and is not leached out. Molybdenum is also measured in the solution.

4. Discussion

The combination of leaching experiments and the observation of delamination yields the following major insight: In the case of thin film modules (CdTe, CIGS, and a-Si), the delamination is the consequence of the high solubility of one or more thin layers of the modules' cells. They form a path for the attack of the water-based solutions. In contrast, in the case of modules containing cells from crystalline silicon, the cell's Al back contact is highly soluble, but not responsible for delamination. Instead, blistering occurs: delamination of c-Si modules is not visible on the back side, but on the front side, either between the front glass and EVA or between the EVA and the Si cell, depending on the pH of the leaching solution. Delamination between the front EVA and solar cell preferentially occurs around the solder ribbon on the front side of the cell and is therefore correlated with the leaching of Pb out of the solder ribbon. The backsheet on the rear side of the c-Si module piece shows no changes after the leaching. Unfortunately, the backsheet is not transparent; therefore, we do not have information about the condition of the solder ribbon on the back side and how the leaching of the Al back contact affects the leaching of the solder ribbon on the back. In solutions with pH 3, a local delamination takes place between the solar cell and the EVA foil, whereas in pH 11 solutions, the delamination occurs between front glass and EVA. In pH 7 solutions, we observe both kinds of delamination. The solution probably attacks the coupling agent. Therefore, in this case, we assume adhesion problems to be the main reason for blistering.

In the case of CdTe module pieces, the photoactive CdTe, as well as the Mo back contact are highly soluble in acidic, aqueous solutions with pH 3. The severe leaching correlates with the frequent total separation, i.e., delamination of the module pieces. For this type of module and under acidic conditions, frequently, the front side is clearly separated from the rear. As a consequence, this delamination enhances the leaching, especially of Te, which is

observed in all leaching solutions, independent of pH. For short times, leaching for Cd, Te, and Mo increases linearly with time, but at different rates; the rates depend on the pH. The ratio $R_{Cd:Te}$ of eluted Cd to eluted Te Cd:Te also depends on the pH. This behavior is in accordance with the Pourbaix (potential-pH) diagram for CdTe in aqueous solutions showing the possible species of Cd and Te depending on the pH and the redox potential E_H [9]. In solutions with pH 3, the Te species have a lower solubility compared to the Cd species, which are present as Cd^{2+} ions. The solubility of predominant species of Cd and Te for pH 7 is the same, which explains the ratio $R_{Cd:Te} = 1$. In solutions with pH 11, probably, Te species form with a solubility that exceeds that of Cd. This assumption explains the estimated $R_{Cd:Te} \approx 0.1$. It is notable that only in solutions with pH 3, the ratio $R_{Cd:Te}$ is strongly time dependent, whereas it is almost constant for solutions with pH 7 and pH 11.

Increasing the temperature results in accelerated leaching of Cd from CdTe module pieces. The same behavior was earlier reported by Collins and Anctil [25] for the leaching of Cd from CIGS modules and Pb from c-Si modules, by increasing the leaching temperature to $T = 50\,°C$. All of our leaching data for Cd are well described by Equation (3) and the C_{max}-value for Cd, which decreases with increasing pH. This finding is in accordance with the data reported by Ramos-Ruiz [7] on leaching of Cd and Te out of CdTe modules in solutions with different pH values under simulated landfill conditions. This pH-dependent leaching is understood on the basis of known leaching patterns, not only for Cd, but for all measured elements in this study.

In contrast to CdTe modules, with total delamination, for CIGS module pieces, fractional separation occurs in solutions with pH 3, as well as with pH 7: only parts of the rear side are separated. Our leaching experiments point out all CIGS module layers to be more or less soluble in aqueous solutions. The highest solubility is found for Zn from the front contact in pH 3 solutions, and at this location, we observe the fractional separation. With the Zn eluted, there is no longer a stable bond between the front glass/EVA and the rear side consisting of the photoactive layers (CdS, CIGS) and the back contact on top of the rear glass.

The leaching concentrations of Cd out of CIGS module pieces are lower than from CdTe module pieces. This lower leaching of Cd indicates that CdS in the CIGS cells is more stable against the solutions than CdTe. The Mo back contact of CIGS module pieces also seems to be more stable than the Mo back contact of CdTe module pieces. Between these two module types, the amounts of leached Mo differ especially in solutions with pH 3 and pH 11: in these solutions, Mo from CIGS shows lower leaching than Mo from CdTe module pieces. This difference probably arises from the formation of the $MoSe_2$ layer during the deposition of the CIGS layer in module fabrication. Theelen et al. [26] proposed that $MoSe_2$ prevents the formation of molybdenum oxide, MoO_x, which is the main reason for the degradation of Mo when it comes in contact with water or moisture. Modules from CdTe do not contain a protecting $MoSe_2$ layer. Therefore, during leaching, MoO_x is probably formed. The formation of MoO_x results in a large volume expansion [26]. This could explain the observed delaminations for CdTe module pieces.

Amorphous silicon module pieces show also highly time-dependent leaching, in particular the front layer of ZnO in combination with the Ni/Cu back contact. After 1.5 years of leaching, the elements Zn and Ni reach almost 100% in solutions with pH 3. The time-dependent leaching behavior of Zn from a-Si module pieces is similar to the leaching behavior of Zn from CIGS module pieces in both solutions of pH 3 and pH 7. The leaching rates are also comparable. Therefore, in the case of a-Si modules, ZnO is a weak spot. This finding is in line with the experiments of Pern et al. [27]: These authors studied the stability of various transparent conducting oxides (TCO), including ZnO. In their experiments, ZnO showed the highest degradation rates (of all studied TCOs) when it comes in contact with moisture.

5. Conclusions

Our leaching experiments on PV modules pieces from CdTe, CIGS, c-Si, and a-Si in water-based solutions with pH 3, pH 7, and pH 11 simulate different environmental conditions. Due to the wide span of pH-values, it seems also possible to predict from our experiments the behavior for other pH-values. During the leaching over 1.5 years, we observe different types of delamination. In the case of thin film modules (CdTe, CIGS, a-Si), the thin film layers themselves or the contact materials (e.g., Mo, ZnO) are the weak spots. Finally, their leaching leads to delamination. In contrast, in the case of modules with c-Si, the Al back contact shows the strongest leaching. However, this leaching is not responsible for the delamination. Instead, problems with the EVA causes blistering, which leads to the delamination of the module pieces with c-Si.

The time-dependent leaching is well described by an exponential saturation behavior with a leaching time constant, at least for low pH-values. The leaching time constant differs from element-to-element and changes under agitation and/or a temperature increase. For times small compared to this time constant, the amount of leached out elements increases linearly with time. It is therefore understandable that, roughly speaking, the concentrations of many leached out elements after 500 days are also more than two orders of magnitude higher than after one day. However, we observe also ratios of the concentrations after one 500 days and after one day that are higher or lower than two orders of magnitude: Higher values are obtained, when delamination occurs during leaching. Lower values are obtained when, for example, the ratio of eluted to precipitating elements changes during the experiment.

In the case of Cd leaching from CdTe module pieces, increased temperature leads to substantially accelerated leaching. In contrast, the maximal concentration of leached Cd only depends on the pH of the solution. A mass balance method shows that Cd, which is not measured in the solutions as dissolved, remains in the module pieces themselves and is not, as expected, leached out and then precipitated in the solutions.

In any case and under all experimental conditions, it is possible to either leach out all or a substantial amount of most elements from the module pieces. Clearly, in the case of our module pieces, leaching starts from the unprotected edges of the pieces of 5×5 cm^2 in size, cut out from large area modules. During the manufacturing of commercial modules, they are provided with an edge sealing, which should prevent any leaching under normal operating conditions of the (undamaged) modules. However, if the edge sealing of the modules is not carefully done, or if it is damaged, or even worse, if the (front) module glass is broken, leaching is unavoidable. Rain water with pH values always below pH 7 will suffice to leach out the (toxic) elements. Even worse, if modules are cracked, crushed, or even milled and end up in landfills, the module constituents will also be leached out. Therefore, if toxic materials are not completely avoided in photovoltaic modules, it is of utmost importance to (i) replace damaged modules as fast as possible and to (ii) recollect and recycle them completely. In all other cases, in view of the huge amount of installed PV modules, most of them still containing Pb (mostly in the solder of the cell connectors) and/or Cd, they may impose a severe danger to the environment.

Compared to other, earlier studies, our experiments were carried out over more than a year. As one of the key results, we found huge differences between the amount of elements found in the solutions after one day and more than a year. In our opinion, tests for just one day are inappropriate to judge module technologies, in particular if conclusions and political decisions on the toxicity and environmental issues of photovoltaic module technologies are based on such short-term measurements.

Author Contributions: Conceptualization amd project administration, R.Z.-G. and J.H.W.; methodology, R.Z.-G., M.K., J.N.; validation and investigation, J.N., R.Z.-G., M.K., C.F.; analysis, writing, editing, and reviewing J.N., R.Z.-G., M.K., J.H.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by German Federal Ministry of Economics and Technology (BMWi), Project Number 0325718.

Acknowledgments: The authors thank Lara Busch for sample preparation and measurements.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; nor in the decision to publish the results.

References

1. Phillips, S.; Warmuth, W. *Photovoltaics Report*; Fraunhofer ISE: Freiburg, Germany, 2020.
2. Wade, A.; Heath, G.; Weckend, S.; Wambach, K.; Sinha, P.; Jia, Z.; Komoto, K.; Sander, K. *IRENA and IEA PVPS-End-of-Life Management: Solar Photovoltaic Panels*; National Renewable Energy Lab.: Golden, CO, USA, 2016.
3. Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Text with EEA Relevance. Available online: http://data.europa.eu/eli/dir/2011/65/oj (accessed on 29 January 2021).
4. ITRPV. International Technology Roadmap for Photovoltaic (ITRPV) 2019 Results. Available online: http://itrpv.vdma.org/en/ (accessed on 12 October 2020).
5. Ramos-Ruiz, A.; Wilkening, J.; Field, J.; Sierra-Alvarez, R. Leaching of Cadmium and Tellurium From Cadmium Telluride (CdTe) Thin-Film Solar Panels Under Simulated Landfill Conditions. *J. Hazard. Mater.* **2017**, *336*, 57. [CrossRef] [PubMed]
6. Zimmermann, Y.S.; Schäffer, A.; Corvini, P.F.X.; Lenz, M. Thin-film photovoltaic cells: Long-term metal (loid) leaching at their end-of-life. *Environ. Sci. Technol.* **2013**, *47*, 13151. [CrossRef] [PubMed]
7. Tammaro, M.; Salluzzi, A.; Rimauro, J.; Schiavo, S.; Manz, S. Experimental investigation to evaluate the potential environmental hazards of photovoltaic panels. *J. Hazard. Mater.* **2016**, *306*, 395. [CrossRef] [PubMed]
8. Zapf-Gottwick, R.; Koch, M.; Fischer, K.; Schwerdt, F.; Hamann, L.; Kranert, M.; Metzger, J.; Werner, J.H. Leaching Hazardous Substances out of Photovoltaic Modules. *Int. J. Adv. Appl. Phys. Res.* **2015**, *2*, 7. [CrossRef]
9. Zeng, C.; Ramos-Ruiz, A.; Field, J.A.; Sierra-Alvarez, R. Cadmium telluride (CdTe) and cadmium selenide (CdSe) leaching behavior and surface chemistry in response to pH and O_2. *J. Environ. Manag.* **2015**, *154*, 78. [CrossRef] [PubMed]
10. Nover, J.; Zapf-Gottwick, R.; Feifel, C.; Koch, M.; Metzger, J.; Werner, J.H. Long-term leaching of photovoltaic modules. *Jpn. J. Appl. Phys.* **2017**, *56*, 08MD02. [CrossRef]
11. Nain, P.; Kumar, A. Initial metal contents and leaching rate constants of metals leached from end-of-life solar photovoltaic waste: An integrative literature review and analysis. *Renew. Sustain. Energy Rev.* **2020**, *119*, 109592. [CrossRef]
12. EN 12457-4:2002. *Characterization of Waste-Leaching; Compliance Test for Leaching of Granular Waste Materials and Sludges–Part 4: One Stage Batch Test at a Liquid to Solid Ratio of 10 L/kg for Materials with Particle Size below 10 mm (without or with Limited Size Reduction)*; Swedish Institute for Standards: Stockholm, Sweden, 2002.
13. United States Environmental Protection Agency. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*; SW-846; United States Environmental Protection Agency: Washington, DC, USA, 1992.
14. CCR, California Code of Regulations. *Waste Extraction Test (WET) Procedures*; Title 22. Division 4.5, Chapter 11, Article 5, Appendix II. 1991.
15. Japanese Standards Association. *JIS K 0102:2016-Testing Methods for Industrial Wastewater*; Japanese Standards Association: Tokyo, Japan, 2016.
16. Nover, J.; Huber, S.; Zapf-Gottwick, R.; Werner, J.H.; Feifel, C.; Koch, M.; Metzger, J. *Schadstofffreisetzung aus Photovoltaik-Modulen Abschlussbericht: Laufzeit: 01.09.2014-31.08.2017*; Universität Stuttgart, Institut für Photovoltaik: Stuttgart, Germany, 2018.:1020510552. [CrossRef]
17. DIN 38404-6:1984-05. *German Standard Methods for the Examination of Water, Waste Water and Sludge; Physical and Physico-Chemical Parameters (Group C); Determination of the Oxidation Reduction (Redox) Potential (C 6)*; Swedish Institute for Standards: Stockholm, Sweden, 1984.
18. ISO 17294-2:2003. *Water Quality-Application of Inductively Coupled Plasma Mass Spectrometry (ICP-MS)-Part 2: Determination of 62 Elements*; ISO: Geneva, Switzerland, 2003.
19. Deb, S.K. Recent Advances and Future Opportunities for Thin-Film Solar Cells. In *Thin-Film Solar Cells: Next Generation Photovoltaics and Its Applications*; Hamakawa, Y., Ed.; Springer: Berlin/Heidelberg, Germany, 2004; p. 27.
20. Chopra, K.L.; Paulson, P.D.; Dutta, V. Thin-film solar cells: An overview. *Prog. Photovolt Res. Appl.* **2004**, *12*, 69. [CrossRef]
21. Fritsche, J.; Klein, A.; Jaegermann, W. Thin Film Solar Cells: Materials Science at Interfaces. *Adv. Eng. Mater.* **2005**, *7*, 914. [CrossRef]
22. Theelen, M.; Daume, F. Stability of Cu(In,Ga)Se2 solar cells: A literature review. *Sol. Energy* **2016**, *133*, 586. [CrossRef]
23. Gabriel, O.; Kirner, S.; Leendertz, C.; Gerhardt, M.; Heidelberg, A.; Bloeß, H.; Schlatmann, R.; Rech, B. Large area PECVD of a-Si:H/a-Si:H tandem solar cells. *Phys. Status Solidi C* **2011**, *8*, 2982. [CrossRef]
24. Zapf-Gottwick, R.; Zorn, M.; Nover, J.; Koch, M.; Feifel, C.; Werner, J.H. Solubility of Cadmium Telluride in Aqueous Solutions. *Energies* **2021**, *14*, 398. [CrossRef]

25. Collins, M.K.; Anctil, A. Implications for current regulatory waste toxicity characterisation methods from analysing metal and metalloid leaching from photovoltaic modules. *Int. J. Sustain. Energy* **2017**, *36*, 531. [CrossRef]
26. Theelen, M.; Polman, K.; Tomassini, M.; Barreau, N.; Steijvers, H.; Van Berkum, J.; Vroon, Z.; Zeman, M. Influence of deposition pressure and selenisation on damp heat degradation of the Cu(In,Ga)Se_2 back contact molybdenum. *Surf. Coat. Technol.* **2014**, *252*, 157. [CrossRef]
27. Pern, F.J.; Noufi, R.; Li, X.; DeHart, C.; To, B. Damp-heat induced degradation of transparent conducting oxides for thin-film solar cells. In Proceedings of the 33rd IEEE Photovoltaic Specialists Conference, San Diego, CA, USA, 11–16 May 2008.

Tellurium leaches the least. Thus, already from this observation, it becomes clear that the Mo layer is a weak spot in the case of the CdTe module. After approximately 300 days of leaching, the concentration of Te increases dramatically and approaches the eluted amount of Cd and Mo. Around this time of leaching, delaminations are observed. After 1.5 years, the concentrations of eluted Cd and Mo related to the total amount in the module piece in acidic solutions (pH 3) reach $c_{Cd} \approx 92\%$ and $c_{Mo} \approx 88\%$. The amount of eluted Te is $c_{Te} \approx 54\%$.

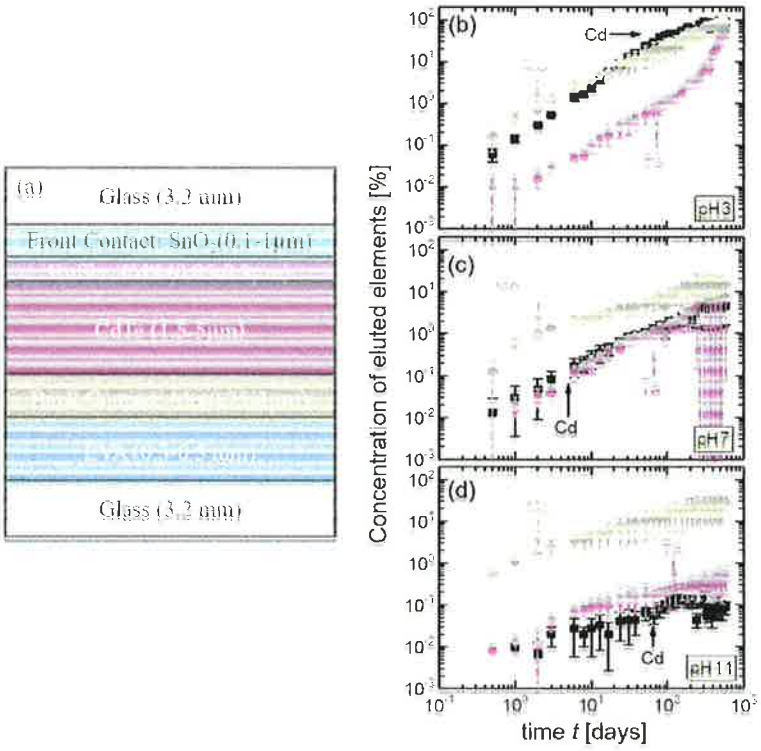

Figure 6. (**a**) Schematic structure of a typical CdTe module (not drawn to scale) and (**b**) time-dependent leaching results of the elements Cd, Te, and Mo from CdTe module pieces in acidic aqueous solutions with pH 3 and (**c**) in solutions with pH 7 and (**d**) pH 11.

Figure 6c shows the leaching in water-based solutions with pH 7. Here, the concentrations of eluted Cd, Mo, and Te, finally, after 1.5 years, reach $c_{Cd} \approx 4,5\%$, $c_{Mo} \approx 19\%$, and $c_{Te} \approx 7.8\%$, respectively. In this case, the leaching of Cd and Te shows the same time-dependent leaching behavior. The large standard deviations for Te appearing after approximately 300 days of leaching are due to the delamination of one module piece out of three experimental runs. Clearly, after delamination of this particular module piece, substantially higher amounts are leached out, because the leaching solution is able to directly attack the CdTe layers from the surface. Therefore, we observe substantially higher amounts of eluted Te and slightly higher amounts of Cd for this one out of the three experimental runs. The leaching of Mo is highest from the beginning to the end and comparable to the leaching amounts of Cd and Te.

Figure 6d presents the leaching data for pH 11. Here, at the end of the experiment, the amount of eluted Mo is still high with $c_{Mo} \approx 34\%$. The measured concentration of Te is below 1% after 1.5 years, and the amount of leached Cd is the lowest. In solutions with pH 11, the time-dependent leaching rates of Cd and Te are much lower compared to the leaching rates in solutions with pH 7 and pH 3. For all conditions, the leaching rate of Mo is always higher than the one of Cd and Te. This indicates again that, in the case of CdTe modules, the Mo back contact is a weak spot.

WORLD NEWS

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Battery 'Bombs': More Giant Renewable Energy Batteries Explode in Toxic Fireballs

July 31, 2021 by stopthesethings 8 Comments

'Bombs' are designed to store and quickly release copious amounts of energy, so are the mega-batteries said to save wind and solar from their hopeless intermittency.

The notion is that giant lithium-ion batteries will quell the power delivery chaos that comes with attempting to rely wholly weather-dependent wind power and wholly sunshine-dependent solar power; thereby bringing stability and security to plenty a power grid teetering on the brink of collapse, all the consequence of our "inevitable transition" away from reliable and dependable power generation sources, like coal and gas.

But there's nothing 'stable and secure' about lithium batteries.

As Samsung mobile phone owners are painfully aware, lithium batteries have a horrifying habit of spontaneous ignition. STT has fond memories of watching fellow airline passengers being berated for having a Samsung 7 in their pocket.

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And there have been plenty of incidents where the lithium batteries in **Tesla's electric cars have exploded in flames**.

Now, it's grid-scale explosions and conflagrations that we need to be concerned about, not just the odd exploding Telsa S and Samsung 7.

Here's a little saga from the land Downunder, where a giant Tesla decided to release a whole of 'wonderful green' energy in a furious hurry.

Crews battle Tesla battery fire at Moorabool, near Geelong
ABC
Leanne Wong
30 July 2021

A toxic blaze at the site of Australia's largest Tesla battery project is set to burn throughout the night.

The fire broke out during testing of a Tesla megapack at the Victorian Big Battery site near Geelong.

A 13-tonne lithium battery was engulfed in flames, which then spread to an adjacent battery bank.

More than 150 people from Fire Rescue Victoria and the Country Fire Authority responded to the blaze, which has been contained and will be closely monitored until it burns itself out.

"If we try and cool them down it just prolongs the process," the CFA's Assistant Chief Fire Officer Ian Beswicke said.

"But we could be here anywhere from 8 to 24 hours while we wait for it to burn down."

The Tesla battery is expected to become the **largest battery (or bomb) in the southern hemisphere** as part of a Victorian Government push to transition to renewable energy.

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Ambulance Victoria members are also on site monitoring the health of firefighters.

A toxic smoke warning has been issued near Geelong.

Residents have been warned to close windows, close fireplace flues and bring their pets inside in the Batesford, Bell Post Hill, Lovely Banks and Moorabool areas.

No-one was injured and the site has been evacuated.

Australian Energy Market Operator (AEMO) said the battery had been isolated and disconnected from the main electricity grid and "there are no implications" for supply.

The Tesla battery was paid for by renewable energy company Neoen.

Neoen Australia's Managing Director, Louis de Sambucy said Neoen and Tesla were working closely with emergency services on site to manage the situation.

Health Impacts of

Gary Weaven's Pac
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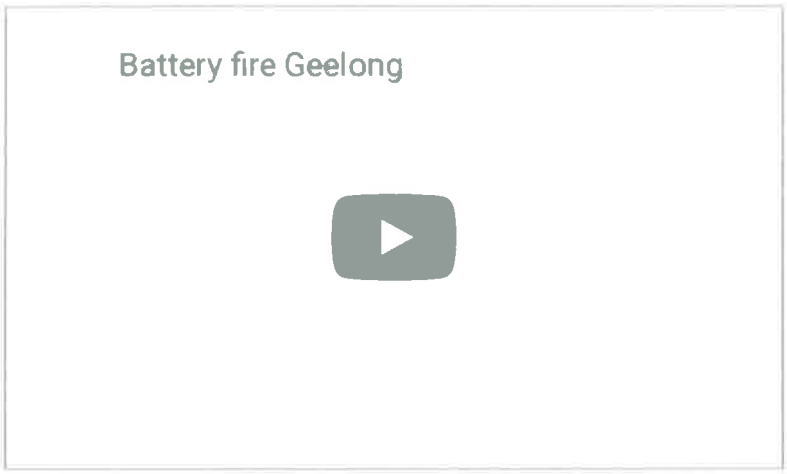

More Photos

Transcript

Ian Beswicke: Yeah, the plan is that we'll let the battery bank burn itself out. Now it's about 15 metres long by three metres high by three metres wide. There's another one right beside it that is currently burning as well. So we cannot put them out with water or anything else. The best way to deal with these things is to let them burn until they are burnt out. If we try and cool them down, it just prolongs the process. So by letting them burn, and this wind is helping us by keeping it burning fairly freely, but we could be here anywhere from eight to 24 hours whilst we wait for it to burn down.

ABC

So, there you have it – when one of these 'planet saving miracles' spontaneously bursts into a lethally toxic fireball, it's a case of burn, baby burn! No point attempting to extinguish the blaze, just keep clear of the toxic fumes and let it eventually burn itself out.

Oh, and if you think this is a rare and unusual occurrence, see our post here: **Giant Batteries Bomb: Renewable Energy Storage Systems Literally Setting The World On Fire**

And here are a couple more for your "Blazing RE Battery" scrapbook –

INFO ITEM ONLY

care of the team from Jo Nova.

Big batteries could be bigger bombs than Beirut Fertilizer
Jo Nova Blog
Jo Nova
13 July 2021

It turns out storing Megawatts of high density energy in a confined space is "like a bomb". Who could have seen that coming, apart from everyone who understands what a megawatt is?

Clean, green, noisy and explosive.

And they are "unregulated" in the UK.

GWPF

> UK's giant battery 'farms' spark fears of explosions that can reach temperatures of 660C
> Amy Oliver
> **Mail on Sunday**
>
> ...according to a troubling new report from leading physicists, these vast batteries amount to electrical bombs with the force of many hundreds of tons of TNT.
>
> With the potential for huge explosions, fires and clouds of toxic gas, they could devastate towns and villages nearby, says Wade Allison, emeritus professor of physics at Oxford University and co-author of the report.
>
> The batteries, designed as reservoirs of spare electricity for when the wind doesn't blow or the sun fails to shine, are spreading around the British countryside. And this, says Prof Allison and his fellow scientists, could spell catastrophe.
>
> It's like a potential bomb,' he says. 'When batteries catch fire, you can't just squirt water on them and put out the flames. It's evident from our research that nothing has been done to tackle this problem.'
>
> Given the size of the proposed plants, Prof Allison says this could, in theory, lead to an explosion several times bigger than the one that destroyed the harbour in Beirut last year.
>
> The threat of fire is not merely theoretical. South Korea saw 23 battery farm fires in just two years. A recent battery fire in Illinois burned for three days and thousands of residents were evacuated.
>
> Such blazes release highly toxic gases. One – hydrogen fluoride – is lethal if inhaled, and causes irreversible health effects after an

hour of exposure, according to Public Health England.

Meanwhile **3 – 4,000 people** were evacuated in Morris Illinois the week before last, as 100 tons of batteries burned. The fire burned for days. They could not use water or foam, and in the end, the **burning batteries were smothered with 28 tons of cement**.

These were run of the mill cell-phone and car batteries.

CBS Chicago
@cbschicago

State Declares Disaster For Morris After Battery Fire chicago.cbslocal.com/2021/07/05/mor...

6:00 PM · Jul 5, 2021

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Jo Nova Blog

One of South Korea's big batteries having a 'moment'

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