#2024-05
Ridgefield Road Solar Farm
Project Review for Planning and Zoning Commission

Meeting Date: March 6, 2024

Request:
1. Comprehensive Land Use Plan Amendment from Agriculture/Rural Residential to Industry.
2. Preliminary and Final Planned Unit Development and Special Use Permit for a Solar Farm.

Location: Ridgefield Road

Acreage: Approximately 46 acres (solar area) lot is approximately 78 acres

Zoning: M PUD Manufacturing

Surrounding Properties:
North: F Farming
South: O PUD Office
East: M PUD Manufacturing (The MAC soccer fields)
West: A-1 Agriculture (McHenry County)

Staff Contact: Elizabeth Maxwell (815.356.3615)

Background:

- The site is a vacant lot used for agriculture.
- The proposed solar company would be acquiring the back half of the property to install solar panels, battery storage and a fabric-wrapped fence.
- The site was annexed and zoned in 1989. This property was a planned Office-Industrial District. This PUD was never established as no development occurred.

Development Analysis:

General

- Requests:
    - Comprehensive Land Use Plan Amendment. This is a request to amend the Comprehensive Land Use Map from Agriculture / Rural Residential to Industry. The zoning of the property is M PUD Manufacturing so this is an appropriate land use category.

  - A Preliminary and Final Planned Unit Development and Special Use Permit for a Solar Farm.
- Zoning: The property is zoned M PUD Manufacturing, which is the appropriate zoning district for this use.

Site Layout

- The site would be accessed from Ridgefield Road, just west of the MAC and the kids soccer fields.
- A 10-foot paved drive is from Ridgefield Road. It runs throughout the site.
- The panels will be on a single track and not extend higher than 15' at the sharpest angle of tilt.
- There is a 100-foot setback from the Lilly Pond Marsh wetland to protect the integrity of the wetland.
- All equipment and improvements meet all required setbacks.

Landscape

- The landscape plan illustrates a staggered row of evergreen trees and shrubs and large deciduous shrubs surrounding the perimeter.
- A fabric-wrapped fence also screens the site from view.
- Within the site around the solar panels and perimeter are two pollinator seed mixes. These are plants that attract pollinators like bees, butterflies, and birds.

Preliminary/Final Planned Unit Development

The petitioner is requesting approval of a Preliminary and Final Planned Unit Development and a Special Use Permit to allow the construction of a Solar Farm. A Planned Unit Development is a Special Use and Special Uses require separate review because of their potential to impact surrounding properties and the orderly development of the City.

Section 2-400 B General Standards for all special uses in the Unified Ordinance establishes standards for all special uses in Crystal Lake. Briefly, the criteria are as follows:

1. The use is necessary or desirable, at the proposed location, to provide a service or facility which will further the public convenience and general welfare.
   ☐ *Meets* ☐ *Does not meet*
2. The use will not be detrimental to area property values.
   ☐ *Meets* ☐ *Does not meet*
3. The use will comply with the zoning districts regulations.
   ☐ *Meets* ☐ *Does not meet*
4. The use will not negatively impact traffic circulation.
   ☐ *Meets* ☐ *Does not meet*

5. The use will not negatively impact public utilities or municipal service delivery systems. If required, the use will contribute financially to the upgrading of public utilities and municipal service delivery systems.
   ☐ *Meets* ☐ *Does not meet*
6. The use will not negatively impact the environment or be unsightly.
   ☐ *Meets* ☐ *Does not meet*
7. The use, where possible will preserve existing mature vegetation, and provide landscaping and architecture, which is aesthetically pleasing, compatible or complementary to surrounding properties and acceptable by community standards.
   ☐ *Meets* ☐ *Does not meet*
8. The use will meet requirements of all regulating governmental agencies.
   ☐ *Meets* ☐ *Does not meet*
9. The use will conform to any conditions approved as part of the issued Special Use Permit.
   ☐ *Meets* ☐ *Does not meet*
10. The use will conform to the regulations established for specific special uses, where applicable.
    ☐ *Meets* ☐ *Does not meet*

In addition PUDs must also meet the standards in Section 4-500 C. Development Standards and 4-500 D. 1 Additional standards for Planned Unit Developments Commercial PUDs.

1. Implements the vision and land use policies of the Comprehensive Plan.
   ☐ Meets ☐ Does not meet
2. Shall not result in substantial adverse effect on adjacent property, natural resources, infrastructure, public sites or other matter of public health, safety and welfare.
   ☐ Meets ☐ Does not meet
3. PUDs must provide transitional uses to blend with adjacent development.
   ☐ Meets ☐ Does not meet
4. PUD phases must be logically sequenced.
   ☐ Meets ☐ Does not meet
5. The density and intensity of a PUD shall be in accordance with the Comprehensive Plan.
   ☐ Meets ☐ Does not meet
6. All dimensional standards shall be listed within the PUD plan if they do not meet the Ordinance minimum standards.
   ☐ Meets ☐ Does not meet
7. The responsible parties for all on-site and other required public improvements shall be established and a utility plan indicating all proposed easements shall be provided.
   ☐ Meets ☐ Does not meet
8. Any private infrastructure shall comply with the city standards.
   ☐ Meets ☐ Does not meet

9. The PUD plan shall establish the responsibility of the applicant/developer.
   ☐ Meets ☐ Does not meet

10. A bond or letter of credit shall be posted to cover required fees or public improvements.
    ☐ Meets ☐ Does not meet

SOLAR FARM
Solar Farms must comply with the following standards:

1. The entire project site shall be surrounded with landscape and a fabric-wrapped chain link fence, which would screen the property from any roadways or public driveways.
   ☐ *Meets* ☐ *Does not meet*

2. The grounds in and around the panels shall be repurposed for wildflowers or agriculture. A landscape plan is required.
   ☐ *Meets* ☐ *Does not meet*

3. One ten-foot-wide paved drive shall provide access around the entire site.
   ☐ *Meets* ☐ *Does not meet*

Comprehensive Land Use Plan 2030 Summary Review:
The Comprehensive Plan designates the subject property as Agriculture / Rural Residential. The petitioner is requesting an amendment to Industry. The Industrial land use allows for areas for jobs, industry and manufacturing. The following goal is applicable to this request:

Land Use – Industry
Goal: Support manufacturing uses within the community which contribute to the regional and local economy and Crystal Lake's live, work, play philosophy.

This can be accomplished with the following supporting actions:

Supporting Action: Expand and attract manufacturing users, which provide jobs, services, and products strengthening the City's economy.

Success Indicator: The number of properties zoned manufacturing as reviewed annually.

Supporting Action: Encourage businesses to adhere to regular maintenance of grounds and structure to maintain compliance with codes and ordinances.

Recommended Conditions:
If a motion to recommend approval of the petitioner's request is made, the following conditions are recommended:

1. Approved plans, reflecting staff and advisory board recommendations, as approved by the City Council:
   A. Application (Joseph Development LLC, received 01/29/24)

B. Site Plan (Kimley Horn, dated 11/06/23, received 01/29/24)
C. Landscape Plan (Kimley Horn, dated 11/03/23, received 01/29/24)
D. Narrative (Turning Point Energy, dated 01/11/24, received 01/29/24)
E. Wetland Delineation Report (Kimley Horn, dated November 2023, received

2. The petitioner shall maintain the interior plantings and exterior screening plantings and fabric for the life of the facility.

3. The petitioner must address all of the review comments and requirements of the Community Development, Fire Rescue, Police, and Public Works Departments and the City's Stormwater Consultant.

PIQ Map
Ridgefield Road



City of Crystal Lake
Development Application

Office Use Only
File # _____

Project Title: TPE IL MH405, LLC

Action Requested

- __ **Annexation**
- __ **Comprehensive Plan Amendment**
- __ **Conceptual PUD Review**
- __ **Final PUD**
- ☑ **Final PUD Amendment**
- __ **Final Plat of Subdivision**
- __ **Preliminary PUD**
- __ **Preliminary Plat of Subdivision**
- __ **Rezoning**
- ☑ **Special Use Permit**
- __ **Variation**
- __ **Other**

Petitioner Information

Name: Gloria Foxman, TPE

Address: 3720 S Dahlia St,

Denver, CO 80237

Phone: (646) 229-5041

Fax:

E-mail: gfoxman@tpoint-e.com

Owner Information (if different)

Name: EIGER LLC

Address: 1625 W Lake Shore Dr

Woodstock, IL, 60098

Phone: (815) 861-2339

Fax:

E-mail:

Property Information

Project Description: The development of a new 4.99-megawatt AC solar farm, access roads, and utilities.

Project Address/Location: Northeast of the intersection of Ridgefield Rd and US Highway 14, in Crystal Lake IL

PIN Number(s): 13-23-400-005

Development Team

Please include address, phone, fax and e-mail

Developer: TurningPoint Energy, (646) 229-5041, gfoxman@tpoint-e.com

Architect: N/A

Attorney: McGuireWoods LLP, Kyle Barry, (217) 527-1280, KBarry@mcguirewoods.com

Engineer: Kimley-Horn, Jason Cooper, jason.cooper@kimley-horn.com

Landscape Architect: Kimley-Horn, Chris Wilson, chris.wilson@kimley-horn.com

Planner: Kimley-Horn, Amy Henry, amy.henry@kimley-horn.com

Surveyor: LW Survey, (717) 826-9354, g.cunningham@lwsurvey.com

Other:

Signatures

PETITIONER: Print and Sign name (*if different from owner*) **Date**

As owner of the property in question, I hereby authorize the seeking of the above requested action.

OWNER: Print and Sign name **Date**

NOTE: If the property is held in trust, the trust officer must sign this petition as owner. In addition, the trust officer must provide a letter that names all beneficiaries of the trust.

City of Crystal Lake
Development Application
Ownership Sign-off Acknowledgement Form

The following information is related to a development application. As the owner of the property in question, I (we) acknowledge that the information provided in the submittal was reviewed and approved.

Owner Information

Name: EIGER LLC

Address: 1625 Lake Shore Dr

Woodstock IL 60098

Phone: (815) 861-2339

E-mail: craig@woolf1.net

Project Name & Description: IL TPE MH405, LLC: The development of a new 4.99 MW AC solar farm, access roads, and utilities.

Project Address/Location: NE of Ridgefield Rd and US Hwy 14

Signature

Stanley Craig Stoagell 12/4/23

Owner: Print and Sign name Date

NOTE: If the property is held in a trust, the trust officer must sign this petition as owner. In addition, the trust officer must provide a letter that names all beneficiaries of the trust.

Development Team

Please include address, phone, fax and e-mail

Developer: TurningPoint Energy, (646) 229-5041, gfoxman@tpoint-e.com

Architect: N/A

Attorney: McGuireWoods LLP, Kyle Barry, (217) 527-1280, KBarry@mcguirewoods.com

Engineer: Kimley-Horn, Jason Cooper, jason.cooper@kimley-horn.com

Landscape Architect: Kimley-Horn, Chris Wilson, chris.wilson@kimley-horn.com

Planner: Kimley-Horn, Amy Henry, amy.henry@kimley-horn.com

Surveyor: LW Survey, (717) 826-9354, g.cunningham@lwsurvey.com

Other:

Signatures

Gloria Foxman — 12/12/23

PETITIONER: Print and Sign name (*if different from owner*) **Date**

As owner of the property in question, I hereby authorize the seeking of the above requested action.

Stacy Craig Steagall — 12/14/23

OWNER: Print and Sign name **Date**

NOTE: If the property is held in trust, the trust officer must sign this petition as owner. In addition, the trust officer must provide a letter that names all beneficiaries of the trust.

Northwest Herald

NORTHWEST HERALD

Publication Name:
Northwest Herald

Publication URL:
www.nwherald.com

Publication City and State:
Crystal Lake, IL

Publication County:
McHenry

Notice Popular Keyword Category:

Notice Keywords:
ridgefield

Notice Authentication Number:
202402231543482425184
213731298

Notice URL:

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Notice Publish Date:
Saturday, February 17, 2024

Notice Content

PUBLIC NOTICE BEFORE THE PLANNING AND ZONING COMMISSION OF THE CITY OF CRYSTAL LAKE, MCHENRY COUNTY, ILLINOIS IN THE MATTER OF THE PETITION OF Eiger LLC LEGAL NOTICE Notice is hereby given in compliance with the Unified Development Ordinance of the City of Crystal Lake, Illinois that a public hearing will be held before the Planning and Zoning Commission upon the application by IL TPE MH405 LLC, representing Eiger LLC property owner, for a Comprehensive Land Use Plan Amendment, Preliminary and Final Planned Unit Development and Special Use Permit for the property off Ridgefield Road in Crystal Lake, Illinois 60014. PIN: 13-23-400-005. This application is filed for the purpose of seeking a Comprehensive Land Use Plan Amendment to Industry, a Preliminary and Final Planned Unit Development Approval and Special Use Permit for a Solar Farm, pursuant to Article 2, Article 4, and Article 9. Plans for this project can be viewed at the City of Crystal Lake Planning and Economic Development Department at City Hall. A public hearing before the Planning and Zoning Commission for this request will be held at 7:00 p.m. on Wednesday, March 6, 2024, at the Crystal Lake City Hall, 100 West Woodstock Street, at which time and place any person determining to be heard may be present. Jeff Greenman, Chairperson Planning and Zoning Commission City of Crystal Lake (Northwest Herald Feb. 17, 2024) 2144505

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Proposed 4.99 Megawatt AC Ground-Mount Community Solar Facility

Crystal Lake, IL

TPE IL MH405, LLC
c/o TurningPoint Energy, LLC
3720 South Dahlia Street
Denver, CO 80237

Project Manager: Gloria Foxman
Phone: (646) 229-5041
Email: gfoxman@tpoint-e.com

January 11, 2024

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- G – SHPO Response Letter
- H – Ridgefield Road Solar Farm Staff Reports
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- N – Contaminant and Water Studies
- O – Property Value Impact Study
- P – FEMA FIRM Map
- Q – AIMA Submission

1.0 INTRODUCTION

1.1 Project Overview

TurningPoint Energy, LLC d/b/a TPE Development through its affiliated entity TPE IL MH405, LLC (Applicant) proposes the development of a 4.99-megawatt (MW) AC solar photovoltaic system on a parcel of land at Ridgefield Road in Crystal Lake, McHenry County, IL (Project). The Project will consist of a single axis tracking ground-mounted solar array, associated electrical equipment, an access driveway, required paved path surrounding the solar panels, landscape buffer and fence covering approximately 46 acres of the 77.56 acre host parcel (ID 13-23-400-005). The Project intends to participate in the Illinois Adjustable Block Community Solar Program and will power the equivalent of approximately 800-850[1] homes. Community Solar allows residents of Illinois to purchase credits for locally generated clean electricity at a discount to current electric rates without having to install panels on their roof.

The Project's host parcel is located in the M PUD (Manufacturing Planned Development) zoning district within the municipal boundaries of the City of Crystal Lake. The City of Crystal Lake's Zoning Ordinance (Ordinance) allows for the construction and operation of commercial solar energy facilities by special use permit (SUP) in the M PUD District. The development will also require a PUD Amendment. (The Applicant has submitted an Application for both the SUP and the PUD Amendment.) The Project is designed to comply with all setbacks prescribed in the Ordinance to ensure a sufficient buffer is maintained between the trackers and neighboring property lines and rights-of-way. The development will also comply with the Comprehensive Plan's goals for the Northwest Sub-Area, including watershed protection, encouraging development with minimal grading, and environmental preservation.

If approved, the Project would bring significant and consistent benefits to the City of Crystal Lake and the community surrounding the Project. The Project would create approximately 50-75 jobs during the projected 12 to 18-month development period and would generate property tax revenue in amounts estimated at more than $650,000 over 25 years and more than $1,000,000 over 40 years. Property tax revenue in Year 1 of the Project's operations is expected to be over 19 times the amount currently generated for local applicable taxing jurisdictions. Unlike nearly all other forms of development (residential, commercial, or industrial), the local community would benefit from the significant economic benefits mentioned above without straining community infrastructure – no new children in schools, no use of water and sewer systems, extremely limited use of roads, and little to no need for police or fire departments.

1.2 About Turning Point Energy

Formed in 2014, TPE is a privately held, independent company transforming our energy future by creating freedom to choose a smarter, cleaner, more flexible way forward through community solar. As a privately held and independent company, TPE customizes projects to the unique needs of each client. Its team has financed and/or built over 2 Gigawatts (GW) of the solar projects operating in the U.S. today. Since 2017, TPE has focused these services on the expanding community solar market in states including Illinois, Maine, Maryland, Delaware, Pennsylvania, Texas, and Rhode Island. TPE's development and investment

[1] Calculation based on data provided by the U.S. Energy Information Administration (EIA): https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php

portfolio now includes over 169MW community solar projects in construction or operation, with an additional 840MW in solar projects under development.

TPE is a "triple bottom line" company; we believe that our business should create financial, environmental, and community value in every project we create. Our intent is to be long-term members of the communities where our projects are developed. Upon successful permitting and utility interconnection, TPE donates to local charities and/or non-profits that support those in need.

2.0 SITE LOCATION & EXISTING CONDITIONS

TPE, in coordination with its engineering consultant, Kimley-Horn and Associates Inc (Kimley-Horn), has prepared and compiled information from many sources to form the basis of design for the proposed Project. A summary of existing conditions and the design elements that avoid and or minimize impact to the environment and surrounding community is presented in the following subsections.

2.1 Existing Conditions

If approved, the proposed Project would occupy approximately 46 acres of 77.56 acres of agricultural land (host parcel) in McHenry County within the municipal boundaries of the City of Crystal Lake. The site is located east of the intersection of IL-14 and Ridgefield Road and west of the Village of Ridgefield. The site is surrounded to the west by a church and agricultural field, to the north by a railway followed by an agricultural field, to the east by a sports complex, and to the south by Ridgefield Road followed by an agricultural field. Based on the results of a Level 2 Wetland delineation of the subject site, there is one freshwater emergent and open water wetland complex in the northern portion of the site. Per the Natural Resources Conservation Services (NRCS), the onsite soils consist of B rated loams.

2.2 Site Control

The landowner and TPE IL MH405, LLC entered into a Real Estate Lease Option Agreement on August 7, 2023.

2.3 Natural Resources and Consultations with State and Federal Authorities

2.3.1 Wetlands and Floodplain

The Project will be designed to avoid impacts to USACE jurisdictional waters. A Level 2 Wetland Delineation was completed, and no potential wetlands and waterways are impacted within the Project Area. Please see **Appendix D** for additional information.

Per FEMA FIRM Map Panels 17111C0200J and 17111C0215J, the entire limit of disturbance for the development is in Zone X, an Area of Minimal Flood Hazard. That is, the Project area is not within a FEMA flood zone. Refer to **Appendix P** for a copy of the FEMA FIRMETTE.

2.3.2 U.S. Fish & Wildlife Service ("USFWS")

The Project will be designed such that no federally listed species will be significantly impacted. Solar projects typically impose only minimal impacts on wildlife species. The Project's potential to impact federally protected species was evaluated as part of an Environmental Constraints Memorandum, which

is included as **Appendix E**. The assessment indicated that five federally listed species should be considered in an effects analysis for the Project, including the federally threatened northern long-eared bat (*Myotis septentrionalis*), the federally experimental population, non-essential whooping crane (*Grus americana*), the federally endangered rusty patched bumble bee (*Bombus affinis*), the federally threatened eastern prairie fringed orchid (*Platanthera leucophaea*), and the federal candidate monarch butterfly (*Danaus plexippus*). Due to the highly disturbed nature of the existing use (agricultural field), no impacts are anticipated to the five listed species. The Project will be designed to avoid impacts to all wetland and wooded areas; therefore, no impacts are anticipated to the listed species. Prior to the commencement of construction, and a USFWS "No Effect" determination is included as part of **Appendix F**.

2.3.3 Illinois Department of Natural Resources (IDNR) State Ecological Review

The Applicant is in consultation with IDNR for potential impacts to state threatened or endangered species. This consultation is conducted pursuant to IDNR's Ecological Compliance Assessment Tool (EcoCAT). The Applicant submitted an EcoCAT review request to IDNR in September 2023. The review concluded the following protected resources may be in the vicinity of the project location: Class 3 Groundwater (Gladstone Fen) and State Threatened or Endangered Species (Blanding's Turtle (*Emydoidea blandingii*) and Rusty-patched Bumble Bee (*Bombus affinis*)).

IDNR recommends the following to avoid and minimize impact to Gladstone Fen Class 3 Groundwater:

- use the lightest weight equipment possible to complete the job
- use balloon or large tires whenever possible to reduce compaction
- disc site upon completion to de-compact the surface after final soil is placed to ensure good infiltration
- naturalized permeable basins and swales in the design

To comply with the above recommendations, the Project will be designed to follow the above recommendations wherever possible.

IDNR concluded that adverse impacts to Blanding's Turtle (*Emydoidea blandingii*) and Rusty-patched Bumble Bee (*Bombus affinis*) are unlikely. Given the IDNR recommendations are adopted, the IDNR determined that adverse effects to state listed species or protected resources are unlikely. Consultation with IDNR is closed, given the recommendations are adopted.

Refer to **Appendix F** for a copy of the IDNR EcoCAT.

2.3.4 Illinois State Historic Preservation Office

Under the Illinois State Agency Historic Resources Protection Act, the State Historic Preservation Office (SHPO) division at IDNR is responsible for studying possible Project effects on archaeological and/or architectural (cultural) resources. Agencies requiring SHPO evaluation concurrent with their review include the Illinois Environmental Protection Agency (IEPA), IDNR, and the USACE. According to the Illinois SHPO database, no surveys, archeological sites, or historic buildings are listed on or within 0.5 miles of the site. The Applicant submitted a SHPO project review form for agency review. A response letter was received on October 24, 2023. According to SHPO's response letter, the Project is exempt pursuant to Section 6 of the Illinois State Agency Historic Resources Preservation Act and therefore an archaeological survey is not required under Illinois law. The response letter is included as **Appendix G**.

2.3.5 Illinois Department of Agriculture (IDOA)

The Renewable Energy Facilities Agricultural Impact Mitigation Act (505 ILCS 147/1, *et seq.*) requires the owner of a commercial solar energy facility to submit an Agricultural Impact Mitigation Agreement (AIMA) to the Illinois Department of Agriculture not less than 45 prior to the commencement of actual construction of the facility. In addition, at least 30 days prior to the commencement of construction for the facility, the owner of the facility must submit a copy of the fully-executed AIMA to the owner of the facility's host parcel. The intent of the AIMA is to preserve and/or restore the integrity of affected agricultural land during construction and decommissioning activities. On December 13, 2023, TPE submitted an AIMA request to the Department of Agriculture, which is included in this application submittal as **Appendix Q.**

2.4 Community Outreach & Benefits

TPE proactively engages the communities in which we work early in the process to determine what questions and concerns potential neighbors might have and give us adequate time to educate and address them prior to the public process.

We typically place calls, send letters and door knock on adjacent properties to our planned community solar site as well as meet with local officials.

Community solar projects such as TPE IL MH405, LLC enable residents to receive savings on their electricity bills from signing up to participate in a community scale solar project without installing solar on their rooftops.

In 2018, The State of Illinois enacted a statute that imposes a standardized, state assessment of fair cash value for solar energy projects designed to cover both the improvements (Project equipment) and the land. As a result, once constructed and operational, this Project will pay property taxes of more than $650,000 over 25 years split between the McHenry County, the City of Crystal Lake, and applicable school, fire, and other taxing authorities.

The Project would create approximately 50-75 jobs during the approximately 12 to 18 months prior to the start of Project operations. A regional operations and maintenance firm will service the facility over its working life cycle.

Unlike nearly all other forms of development (residential, commercial, or industrial), the community would benefit from the significant economic benefits mentioned above without stressing community infrastructure – no new children in schools, no use of water and sewer systems, limited use of roads, and little to no need for police or fire departments.

2.5 Existing Drain Tile Systems

The Applicant has retained Tom Huddleston with Huddleston McBride Professional Land Drainage Services (Drain Tile Consultant) to consult on drain tile issues. The Drain Tile Consultant will complete an existing drain tile survey prior to construction and work closely with the Applicant to ensure proper drainage and maintain and/or improve the existing surface and subsurface drainage to the extent practicable. Any drain tiles that are damaged during construction will be repaired in accordance with the AIMA.

3.0 PERFORMANCE STANDARDS

3.1 Project Description & Design Standards

The Project will consist of a 4.99 MW ground-mounted solar array. The solar array will consist of Tier 1 graded solar panels attached to single-axis trackers, which are installed on top of driven steel pier foundations or ground screw foundations, depending on the subsurface composition. An Illinois licensed engineer will certify the foundation and design of the solar racking system is suitable to meet local soil and climate conditions. At full tilt, the racking system with modules attached will not exceed fifteen feet (15') in height. In addition to the modules and racking, the Project will include the installation of string-inverters and two (2) medium voltage step-up transformers (600V:12.5KV). The point of interconnection for the Project will be located at Ridgefield Road. ComEd will install new utility-owned poles perpendicular to the existing infrastructure. Please refer to the site plan in **Appendix B** for additional clarification.

The potential equipment manufacturers include, but are not limited to, Silfab Solar, Heliene, AE Solar, or other Tier 1 module manufacturers.

The Project will be constructed by a licensed Engineering Procurement and Construction ("EPC") Contractor. The design and construction process will comply with all federal, state and local appliable building, electrical and fire codes, as well as the National Electrical Code ("NEC"). All modules, inverters, combiners, and disconnects will have Certificates of Compliance from Underwriters Laboratories ("UL") or an equivalent third party. The EPC Contractor shall also possess all professional and trade licenses required by the state and local authorities.

The EPC Contractor will create and maintain a health and safety manual in accordance with OSHA requirements which establishes appropriate rules and procedures concerning workplace safety.

All solid waste related to the construction, operation and maintenance of the Project shall be removed from the site promptly and disposed of in accordance with all federal, state and local regulations.

Any hazardous materials related to the construction, operation and maintenance of the Project will be handled, stored and transported, and disposed of in accordance with all applicable local and state laws. The Project will comply with the existing septic and well regulations required by the County Health Department and State of Illinois Department of Public Health. Noise from construction activities will be managed in accordance with all applicable local and state regulations.

There is no proposed lighting for this Project.

The inverter and transformers will be located on one or more concrete pads or piles. Utility poles at the point of interconnection will be above ground. The solar array will cover approximately 33 acres and the total project area will cover approximately 46 acres. The panels will be surrounded by a 7-foot-high fabric-wrapped chain link fence for safety and security purposes, as well as a landscape buffer to provide vegetative screening using native, pollinator-friendly plants. Entry into the fenced areas will be through gates with Knox Boxes for emergency access.

The Project design and planning has focused on minimizing any potential impacts to the surrounding neighborhood. The Project will produce electricity without requiring any combustion of materials. As a result, the community solar array will not cause or emit odors, dust, gas, smoke, or fumes. Further, the

Project will have very few moving parts and will generate electricity primarily in a passive manner – collecting the sun's rays and converting energy associated with the rays into electricity. There will be no vibrations generated by the solar panels or racking during the operating period of the Project. There may be de minimis vibrations produced by the inverter, and any such vibrations will not extend beyond the host parcel's property lines. The array was designed to meet all required setbacks from neighboring properties and rights of way in compliance with the Ordinance.

A warning sign shall be provided at the facility entrance and along the perimeter fence including the facility's 911 address and a 24-hour emergency contact number. No outdoor storage is planned for the Project at this time. In the event this were to change the Project would apply for the necessary approvals for the contemplated storage.

The scope of work includes but is not limited to:

- Preservation of existing topsoil onsite;
- Construction of a gravel access roads;
- Construction of project equipment pads;
- Construction of a temporary staging area(s); and
- Installation of solar panels and associated support equipment and structures.

3.2 Noise

The Project will operate in accordance with the applicable noise limits of the Illinois Pollution Control Board (IPCB). Solar panels themselves do not produce any noise. The only components in the array that generate noise are the inverters and transformers. The inverter pad location and design will ensure that any noise emitting components will be positioned at a sufficient distance and directed away from neighboring parcels. Kimley-Horn prepared a noise study that evaluated the projected sound levels generated by the string inverters that are likely to be deployed for the Project. The Noise Study is included as **Appendix L** in the Application materials. The Noise Study concludes that so long as the equipment pad for the Project, which will contain the string inverters, is located at least 40 feet from the Project's boundary, the Project will comply with the IPCB's noise limitation. The equipment pad for the Project is preliminarily proposed to be located at least 130 feet away from any property line. Accordingly, the Project, as designed, will more than comply with the ICPB's noise limits, and likewise the final placement for the equipment pad and system configuration will ensure continued compliance with the IPCB's noise limitations.

There will be no vibrations generated by the solar panels or racking during the operating period of the Project. There may be de minimis vibrations produced by the inverter, but any such vibrations will not extend beyond the host parcel's property lines. The Project's comprehensive maintenance plan includes routine inspections to assess and correct any malfunctioning equipment.

3.3 Environmental Impact

The Project will not emit any air pollution. It will, in fact, provide a net environmental carbon benefit. According to the EPA Clean Energy Equivalencies Calculator the Project will avoid the environmental equivalent of 7,991 metric tons of carbon annually, which is comparable to:

- Carbon sequestered by 9,529 acres of forest

- 899,142 gallons of gasoline consumed each year
- 1,778 passenger vehicles removed from our streets

A commitment to wildlife-sensitive construction and operation practices during and after construction will allow for increased local biodiversity. TPE proposes to use pollinator-friendly ground cover underneath the Project and native plantings around the perimeter. These include clover and grass species that promote the establishment and long-term health of bee populations. The Project will not use any pesticides for vegetation management.

3.4 Toxic substances

There are no toxic substances in the panels. The Project will incorporate Tier 1 monocrystalline photovoltaic solar modules, which have been analyzed as follows by North Carolina State University:

> Well over 80% (by weight) of the content of a PV panel is the tempered glass front and the aluminum frame, both of which are common building materials. Most of the remaining portion are common plastics, including polyethylene terephthalate in the back sheet, EVA encapsulation of the PV cells, polyphenyl ether in the junction box, and polyethylene insulation on the wire leads. The active, working components of the system are the silicon photovoltaic cells, the small electrical leads connecting them together, and to the wires coming out of the back of the panel. The electricity generating and conducting components make up less than 5% of the weight of most panels. The PV cell itself is nearly 100% silicon, and silicon is the second most common element in the Earth's crust. The silicon for PV cells is obtained by high-temperature processing of quartz sand (SiO2) that removes its oxygen molecules. The refined silicon is converted to a PV cell by adding extremely small amounts of boron and phosphorus, both of which are common and of very low toxicity.

Please see **Appendix N** for the full report.

3.5 Fire Safety

The solar panels and racking, which comprise the majority of the Project's equipment, are not flammable. Tempered glass offers protection from heat and the elements, and the panels are designed to absorb heat as solar energy. As concluded by the North Carolina State University:

> …Concern over solar fire hazards should be limited because only a small portion of materials in the panels are flammable, and those components cannot self-support a significant fire. Flammable components of PV panels include the thin layers of polymer encapsulates surrounding the PV cells, polymer backsheets (framed panels only), plastic junction boxes on rear of panel, and insulation on wiring. The rest of the panel is composed of non-flammable components, notably including one or two layers of protective glass that make up over three quarters of the panel's weight.

Please see **Appendix N** for the full report.

3.6 Glare and Heat

As explained in Fire Safety **Section 3.6**, there is no heat generated by the Project.

A glare study was performed by TPE using ForgeSolar software to assess the possible effects of reflectivity created by the Project. ForgeSolar software incorporates GlareGauge, the leading solar glare analysis tool which meets Federal Aviation Administration ("FAA") standards and is used globally for glare analysis. It is based on the Solar Glare Hazard Analysis Tool licensed from Sandia National Laboratories.

A model of the Project was input into the software along with (2) Route Receptors along roadways in vicinity of the site. Height was assessed at 5' above ground to emulate passengers in cars. Further, (11) Observation Receptors were modeled at specific dwellings located around the perimeter of the solar array. Heights were modeled at 10' above ground to emulate residents on the 1st floor or doorsteps of dwellings and evaluate the glare impact.

A direct line of sight between the Project and the designated Route Receptors and Observation Receptors is required to produce any discernible glint/glare, so if there is existing or proposed vegetation between the receptor and the project, any glint/glare would be eliminated.

The model assumes the sun is shining 100% of the time it is above the horizon (during laylight hours). That is, it does not account for cloudy or overcast conditions when the sun is not shining. The results, therefore, would be the maximum expected glint and glare during any single year. Existing topography is taken into account in the simulation. Existing and planned vegetation are not considered in the simulation. The model assumed zero vegetation that may screen the Project, so this must be considered when interpreting the study results. Existing vegetation was modeled.

Based on the above inputs/assumptions, no potential for glint or glare was identified in the analysis at any of the Route Receptors or neighboring Observation Receptors. No additional mitigation measures are recommended since no glint or glare is anticipated based on the ForgeSolar GlareGauge results.

Please see **Appendix M** for a more detailed analysis of the Forge Solar results as well as a copy of the ForgeSolar Assessment.

3.7 Setback Compliance, Landscape & Buffering Plan

3.7.1 Setback Compliance

This proposed Project will meet the following setback requirements as set forth by the Ordinance:

- Per Section 3-200 Dimensional Standards for the Manufacturing zoning district, the minimum front setback is 30 feet, the minimum side setback is 15 feet, the minimum rear setback is 20 feet. The Project will also provide a 100-foot buffer around the wetland in the northern portion of the site.

3.7.2 Landscape and Buffering Plan

Appendix BB includes a Landscape Plan that complies with the following guidelines in the Ordinance:

- Per Section 2-400.C.74 regarding special use criteria for Solar Farms, the entire Project site shall be surrounded with landscape and a fabric-wrapped chain link fence, which would screen the property from any roadways or public driveways.
- The area underneath the solar array and buffer area will be seeded with a native pollinator-friendly seed mix. Pollinator seed mixes are intended to provide food and shelter for wildlife and should attract a variety of pollinators and songbirds. The wildflowers and grasses in the mix will provide an attractive display of color from spring to fall and will provide nectar and food for pollinators and their larvae. The Project will also maintain all areas within the lease area, including those outside the Project footprint and within the buffer areas, in accordance with the Ordinance.

3.8 FAA Filing

The Project filed using the Notice Criteria Tool with the Federal Aviation Administration (FAA) and the results indicated the Project did not exceed the Notice Criteria. As a result, no additional filings are required with the FAA. Please see **Appendix M** for a copy of the filing.

3.9 Safety and Security

The solar arrays will be enclosed by a 7-foot-high fabric-wrapped fence and locked gates, as required by the Ordinance and the National Electrical Code (NEC). Emergency access to the fenced areas will be through Knox-Boxes in order to provide the required 24-hour access. The paved driveway has been designed to allow emergency vehicle access, including fire trucks.

3.10 Interconnection

The proposed Project will interconnect to two existing 12.5 kV ComEd feeders. ComEd will install new poles for the line extensions along with multiple poles for metering and pole-top equipment.

3.11 Operations and Maintenance

The Operation and Maintenance Plan including a comprehensive vegetative management plan for the Project is included as **Appendix J**. Preventive maintenance will be conducted on a schedule based on manufacturer's recommendations and industry best practices and standards of care. Regular maintenance will include vegetation control, fence inspection and physical inspection of all system components. A mowing schedule will be followed based on the plant species in the seed mix that is properly timed to balance avoiding wildlife and native pollinator-friendly vegetation disturbance with preventing the establishment of weeds. Vegetation underneath and between the solar panels will be well maintained to keep vegetation below the low edge of the solar panels at maximum tilt angle. Mowing and weed trimming schedules will be adjusted as needed to allow for flexibility based on rainfall and vegetation growth. Chemical control will be applied in accordance with Illinois noxious weed regulations. The Project will be monitored continuously for system failures via a Supervisory Control and Data Acquisition (SCADA) system. Qualified and insured technicians will be dispatched to address any system failures, including inverter, transformer, or tracker motor malfunctions.

3.12 Decommissioning Plan

A Decommissioning Plan has been included as **Appendix C**. The Decommissioning Plan will meet all the standards specified in the AIMA as well as the Ordinance. The required Financial Assurance documentation to cover the estimated costs of decommissioning and site reclamation of the Project will be provided to Crystal Lake.

Decommissioning will include removal of all structures (including equipment, fencing and roads) and foundations and restoration of soil and vegetation. At the end of the operational life of the Project, the Project will be safely dismantled using conventional construction equipment. The Project consists of numerous materials that can be resold or recycled for significant scrap value, including steel, aluminum, glass, copper, and plastics. The solar panels are not considered hazardous waste. The panels used in the Project will contain silicon, glass, and aluminum, which have value for recycling. Often, current market salvage values of a Project exceed estimated decommissioning and site restoration expenses.

The site will be restored and reclaimed to approximately the pre-construction condition in conformance with the site lease agreement and the AIMA. It is assumed that the site will be returned to agricultural use after decommissioning and appropriate measures will be implemented to easily transition back to a use for agricultural purposes.

3.13 Avoidance and Mitigation of Damages to Public Infrastructure

Road: Roadways improved in preparation for and during the construction of the commercial solar energy facility will be repaired and restored as required by all applicable ordinances at the reasonable cost of the Project if the roadways have degraded or were damaged as a result of construction-related activities.

Drainage Systems: A drain tile survey will be completed as required by the AIMA. The Project will ensure no permanent adverse impact to existing mutual drains and drainage patterns. Within the footprints of the solar array, the Project will endeavor to maintain or improve drainage over that which currently exists on site by rerouting drainage networks within the project footprint around footprints where necessary and by repairing or replacing damaged drain tiles.

4.0 SPECIAL USE REVIEW CRITERIA

4.1 Special Use Required Findings of Facts (160.2.400, City Zoning Code)

a) *That the proposed use is necessary or desirable, at the location involved, to provide a service or facility which will further the public convenience and contribute to the general welfare of the neighborhood or community.*

The Project will provide a desirable service and facility which will further the public convenience and contribute to the general welfare of the neighborhood or community. The Project will enhance the local electric grid by serving as a new, direct source for electricity generation in the community. The Project will also promote the general welfare of City of Crystal Lake by supplying new jobs, new tax revenue and will be a source of generation of local, sustainable, clean, pollution-free renewable electricity. Also, the community would benefit from the significant economic benefit without stressing community infrastructure. The Project will also offer community members an opportunity to

subscribe to the delivery of electricity from the Project and potentially enjoy a discount for the purchase of that electricity.

b) That the proposed use will not be detrimental to the value of other properties or improvements in the vicinity.

The Project will not be detrimental to the value of other properties or improvements in the vicinity. As indicated by the property value impact study, **Appendix O**, the existence of the Project will have no negative impact on neighboring property values, and therefore will not substantially diminish or impair property values within the neighborhood of the Project. The CohnReznick General Impact Study Report indicates that solar facilities located in similar areas, with similar land uses, do not cause any negative impacts to adjacent real estate, based on a review of academic studies, CohnReznick's own paired sales data, and interviews with County Assessors and other Market Participants. The reports further detail how solar facilities are generally harmonious with surrounding uses.

c) That the proposed use will comply with the regulations of the zoning district in which it is located and this Ordinance generally, including, but not limited to, all applicable yard and bulk regulations, parking and loading regulations, sign control regulations, watershed, wetlands, and floodplain regulations, Building and Fire Codes and all other applicable City Ordinances.

The Project will fully comply with the Crystal Lake's zoning Ordinance, particularly those provisions found in amended Sections, 650-2-300 Permitted Uses Table, 650-2-400-74 Solar Farms and 650-3 Density and Dimensional Standards, and all regulations that are specifically applicable to a Solar Farm facility. The Project will also comply with all other City, County, State and Federal requirements.

d) *That the proposed use will not negatively impact the existing off-site traffic circulation; will adequately address on-site traffic circulation; will provide adequate on-site parking facilities; and, if required, will contribute financially, in proportion to its impact, to upgrading roadway and parking systems.*

The Project will be designed to include all roads and road entrances necessary to provide adequate ingress and egress to its facilities. Construction traffic will include approximately 25 work trucks per day. Considering the low number of work trucks visiting the Project site over the construction phase, traffic patterns in the vicinity of the Project will not be impacted.

The Project will have minimal traffic upon completion of construction. Landscape maintenance and maintenance to the Project components are anticipated to occur on an as-needed basis, consistent with the Maintenance and Operations Plan. Existing traffic patterns will not be impacted in the post-construction, operations phase. A Transportation and Access Plan is included as **Appendix K**.

e) That the proposed use will not negatively impact existing public utilities and municipal service delivery systems and, if required, will contribute financially, in proportion to its impact, to the upgrading of public utility systems and municipal service delivery systems.

The Project will have adequate utility interconnections. The System impact study by ComEd provides assurance that the electrical capacity is available to host the Project and the proposed point of interconnection is located at the first of the property and west of the site along IL-14. The Project does not require water, sewer or any other public utility facilities to operate. The Project will also build all roads and entrances necessary to access its facilities. A drain tile survey will be completed prior to construction and foundation design will work around or reroute any identified drain tiles to ensure proper drainage. The Project will also be designed in a manner that will not materially modify existing water drainage patterns around its facilities.

f) That the proposed use will not impact negatively on the environment by creating air, noise, or water pollution; ground contamination; or unsightly views.

The Project will not impact negatively on the environment by creating air, noise, or water pollution; ground contamination; or unsightly views. Numerous studies have shown that solar arrays and their components do not have a negative environmental impact. Please refer to **Appendix N** for a copy of these studies. The Project will not emit any air pollution of any kind and any sound generated by the Project's operations (which occur only during the day) will more than comply with the Illinois Pollution Control Board's limitations on noise. Also, please refer to IDNR's response to the Project's EcoCat submission. The Project will comply with all local, state, and federal regulations and will be operated in a safe manner at all times. Dust control and E&S measures will be put in place during construction to alleviate potential issues that may arise with construction, operation, and maintenance. A glare study was performed and showed no glare to nearby routes and residences. The development will also comply with the Comprehensive Plan's goals for the Northwest Sub-Area, including watershed protection, encouraging development with minimal grading, and environmental preservation.

According to the City of Crystal Lake #2023-177 Ridgefield Road Solar Farm staff report, dated September 6, 2023, "While the subject property is not located in the Crystal Lake Watershed, the 2030 Comprehensive Plan encourages development, which minimizes its impact to the Northwest Sub-Area. Development that minimizes grading is encouraged." The Project will include minimal grading for the access road and equipment pads; the remainder of the site within the solar field is generally flat and so minimal grading is anticipated throughout the site. The staff report is included as **Appendix H** in the Application materials. Likewise, the layout for the solar arrays will be a standard layout with panels that do not exceed 15 feet in height. Moreover, the entire Project site will be surrounded with landscape and a fabric-wrapped chain link fence, which will screen the Project from any roadways or public driveways. As a result, the Project will not create any unsightly views.

g) That the proposed use will maintain, where possible, existing mature vegetation; provide adequate screening to residential properties; provide landscaping in forms of ground covers, trees and shrubs; and provide architecture, which is aesthetically appealing, compatible or

complementary to surrounding properties and acceptable by community standards, as further detailed in Article 4, Development and Design Standards.

Adequate screening around the site will be provided to obscure the Project from view. As discussed above, the solar array will be surrounded by a fabric-wrapped chain link fence and a landscape buffer, which will screen the Project from neighboring properties. The replacement of row crops with a pollinator seed mix will be a net positive for stormwater. Please refer to the Landscape Plan provided in **Appendix BB**. Per the Minnesota Rural Water Association, solar installations with native pollinator-friendly ground cover achieve positive impacts similar to soil conservation projects, which reduce soil erosion, reduce soil quality degradation, and improve water quality. This report is included in **Appendix N**. The Project will be designed to account for all existing features, environmental features, and the City of Crystal Lake's Ordinance. Please refer to **Appendix B** for the Zoning Site Plan. TPE proposes to use pollinator friendly ground cover underneath the Project and native plantings around the perimeter. These include clover and grass species that promote the establishment and long-term health of bee populations.

h) *That the proposed use will meet standards and requirements established by jurisdictions other than the City such as federal, state or county statutes requiring licensing procedures or health/safety inspections, and submit written evidence thereof.*

The Project will comply with all local, state, and federal regulations and will be operated in a safe manner at all times. In addition, the Project will promote the general welfare of the City of Crystal Lake by supplying new jobs, new tax revenue and will be a source of generation of local, sustainable, clean, pollution-free renewable electricity. Also, the community will benefit from the significant economic benefit without stressing community infrastructure.

i) That the proposed use shall conform to any stipulations or conditions approved as part of a special use permit issued for such use.

The Project will conform to any stipulations or conditions approved as part of a special use permit issued. In addition, the Project has been designed to incorporate the comments received in the City of Crystal Lake #2023-177 Ridgefield Road Solar Farm staff report, dated September 6, 2023. These comments include providing a 100-foot buffer around the wetland in the northern portion of the site; providing a 20-foot paved path throughout the site; providing a fabric-wrapped fence; providing a landscape plan with the SUP/PUD submittal; and completing a wetland delineation. The Project has also been designed to incorporate the comments received from the City of Crystal Lake Fire Development Review dated September 5, 2023, to meet the applicable City Fire Code and IFC (2018) fire regulations. The staff report and department review comments are included as **Appendix H**.

j) That the proposed use shall conform to the standards established for specific special uses as provided in this section.

The Project will conform to the standards established for specific special uses as provided in Article 2 Section 2-400 C.74 Solar Farms.

Operations & Maintenance ("O&M") Plan TPE IL MH405 LLC

O&M Plan / O&M Practices and Services

The O&M plan is structured to both maximize system performance and meet all permitting requirements. Regional O&M staff and seasonal staff will be assigned to perform:

1. Preventative maintenance,
2. Corrective maintenance, and
3. Support of monitoring and asset management services.

A summary scope of work for each is as follows:

Preventative Maintenance

- Industry standard of care to ensure and maintain solar production levels
- Regular maintenance on project components per manufacturer recommendations and industry best practices and standards of care
- Module cleanings are not expected given the average monthly rainfall in the area. If cleaning is required, modules will be cleaned to ensure project performance.
- Vegetation abatement as required to ensure project performance
- Primary component inspection on an annual basis (panels, inverter, high voltage equipment)
    - Array & balance of system inspection
    - Module visual inspection
    - Data Acquisition System (DAS) & Meteorological (MET) station inspection
    - Inverter full inspection
    - High voltage equipment inspections
- Mechanical & electrical maintenance on an annual basis including inverter maintenance per manufacturer warranty requirements and standards of care
- Yearly inspection and maintenance as needed for roads, storm water, and other site civil features

Corrective Maintenance

- Remote problem diagnosis & qualification via the project DAS system
- On-site technician dispatch: Trained, qualified and insured service techs for rapid response
- Warranty submittal/claims notification, tracking of replacement parts' arrival/storage/ installation, etc.
- Maintenance ticket updates and closure identifying root cause/problem resolution reporting to owner

Monitoring

- Remote equipment monitoring (24x7x365) via DAS system
- Remote dispatch per customer/owner requirements

- Ticketing: Create and dispatch automated ticketing with issue resolution notifications and root cause reporting
- Problem tracking and ensured resolution reporting included within monthly report
- Identify potential and actual underperformance issues; recommend remedies
- Customized data analysis and alerts for customer:
    - Collection and hosting of system monitoring data
    - Owner access to online portal monitoring and production with weather data
    - Operator to host site communication and fees for monitoring

Monitoring and asset management services are provided by the late-stage development company's remote operation center and central services staff.

Plan and Timeline for Responding to Loss of Major Plant Components

O&M personnel will be notified of any loss of major plant component or related failures by the 7x24 remote operations center. This center will dispatch onsite technicians for system critical failures (inverter, transformer, or tracker motor failure). The plan for such losses is to:

- Remove and replace the failed equipment with spare parts, nearby parts in inventory or emergency delivery of parts from manufacturer as rapidly as possible.
- Diagnose reason for failure.
- Work with general contractor and/or manufacturers for any warranty or related claims.

Compliance with Prudent Utility Practices

"Prudent Utility Practices" are defined as the practices, methods and acts (including the generally accepted practices, methods and acts engaged in or approved by the operators of similar electric generating facilities) that, at the time of such practice, method or act is employed and in the exercise of reasonable judgment in light of the facts known at such time, would be expected to accomplish the desired result in a workmanlike manner, consistent with applicable laws and other governmental requirements and reliability, safety and environmental protection. However, Prudent Utility Practices shall not require the use of the optimum practice, method or act, but shall only require the use of acceptable practices, methods or acts generally accepted in the United States in performing obligations in accordance with Prudent Utility Practices.

All O&M practices follow Prudent Utility Practices with the utmost focus on safety. As a part of all O&M contracts with vendors, contractors, and sub-contractors, our team will ensure that these companies are responsible for the safe performance of work and for the safety of its, and it's subcontractors', employees, representatives, agents and invitees of contractor or its subcontractors at and around the project site, or any other person who enters the project site for any purpose. To facilitate this, all contractors must provide a safety plan whereby contractor maintains responsibility for maintaining all safety precautions and measures for areas on and around the project site. As part of this safety plan, contractor must provide a safe working environment at the project site during the performance of the work, and shall, among other requirements, seek to minimize the number of safety-related incidents during the performance of the work (with both TPE's and contractor's mutual objective of zero lost time accidents). Such safety plan shall include requirements for the safety prequalification of each

subcontractor and a drug and alcohol program (which shall include a drug testing policy). Furthermore, the safety plan shall meet the requirements of applicable laws and applicable standards.

After the commencement of work, TPE and contractor shall periodically review safety compliance, particularly in light of any injuries or near-miss incidents that may arise through the performance of the work, and cooperate jointly to develop necessary changes to the safety plan in light of such circumstances, if any.

The safety plan shall apply to all individuals accessing the project site and performing work on the project. As part of the safety plan, a safety representative will be identified with the necessary qualifications and experience to supervise the implementation of, and monitoring of compliance with, the safety plan. The safety representative shall make routine inspections of the project site and shall hold regular safety meetings with contractor's personnel, subcontractors and others.

Each staff member undergoes personal background checks, qualifies as possessing safety and related solar skills training required, or shall gain this training from an approved O&M training program prior to starting work on the job site.

The contractor shall make the site safety plan available to local authorities having jurisdiction/permitting authorities (AHJs) during the construction process, upon request. The safety plan should include provisions for the management of site access, traffic management, road maintenance, and site security.

Emergency Response

The site owner shall provide an emergency response plan to the AHJs prior to commercial operation of the facility, if required by the local AHJs. The site owner shall provide an education training session to county representatives and first responders prior to commercial operation of the facility, if required by the local AHJs. The site owner shall provide a means and procedure for site access in coordination with the local AHJs.

Equipment Manufacturer Recommendations

The O&M plan referenced above complies with or exceeds all standard utility-scale PV equipment manufacturer recommendations. We can provide copies of all major equipment O&M recommendations prior to formal procurement as needed.

Mowing and Weed Management

Vegetation should be well maintained in the defined lease area for the solar array. Management should comply with any local ordinances or conditions of approval. Mowing and weed whacking schedules will be developed and allow for flexibility based on rainfall and vegetation growth.

Buffer Management

Vegetative Buffers should be inspected during maintenance visits to ensure compliance with local ordinances or conditions of approval. Tree health and growth should be assessed and promoted to ensure compliance with local ordinances.

Warranties

All warranties are managed and handled at the project company level and are the responsibility of the late-stage development company that will operate and own the project over its useful life. Manufacturers of major equipment including modules, inverters, racking and transformers provide equipment warranties for the life of their products.

Outage Schedules

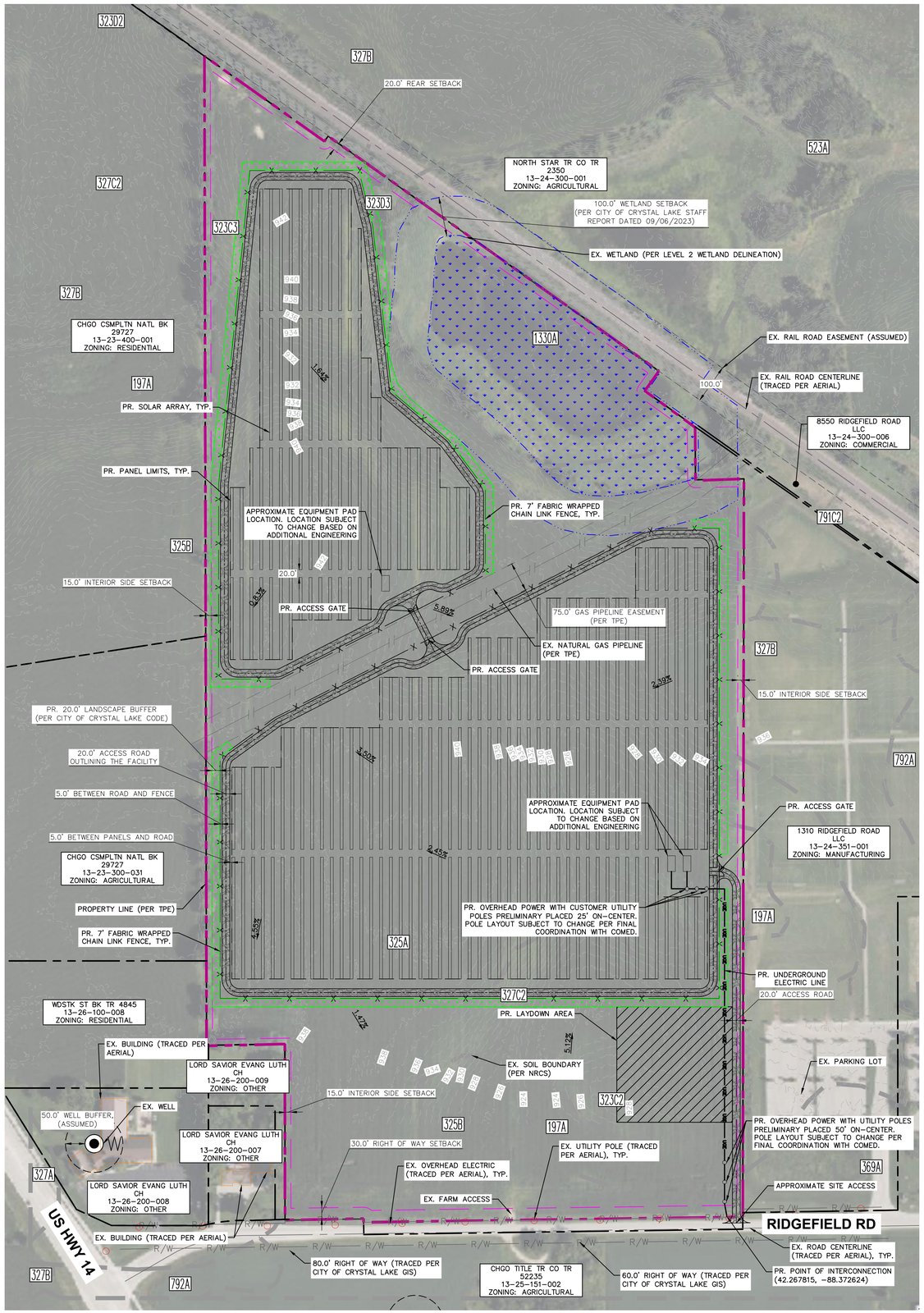
All planned shutdown of equipment for routine maintenance will be planned and coordinated with the local utility. When possible, these outages will occur in non-solar producing hours (nighttime). As such, no planned outages are scheduled.

Spare Parts

As part of the installation of the project, spare parts may be procured and stored with the O&M service provider for faster access to parts when necessary. This may include spare modules, inverters, parts, tracker components, fuses, wire and related inventory. Additionally, along with the warranty of the equipment, we expect to gain committed response intervals from manufacturers to address equipment replacement requirements. Spare parts will not be stored on site, rather, they will be stored off site in the O&M provider's facilities.

Start-up / Ramp-up Requirements / Times

The PV solar plant starts up as the sun rises in the morning and ramps down as the sun sets in the evening. We can provide specific historical times for the location of our solar array as a means of working to optimize this generation asset.

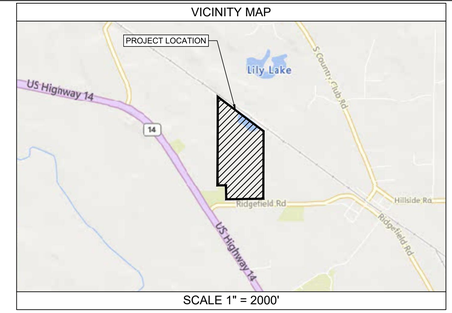


PRELIMINARY - NOT FOR CONSTRUCTION

NORTH

GRAPHIC SCALE IN FEET
0 75 150 300

VICINITY MAP



SCALE 1" = 2000'

LEGEND

ROAD NAME	**N 100 ST.**
PROPERTY LINE	
PROJECT BOUNDARY	
RIGHT OF WAY	R/W
SETBACK	
EX. OVERHEAD ELECTRIC	EX OHE
EX. ROAD CENTERLINE	
EX. EASEMENT	
EX. UTILITY POLE	
EX. RESIDENCE/STRUCTURE	
EX. WETLANDS	
WETLAND SETBACK	
EX. FLOW (DIRECTION AND SLOPE)	XX%
EX. NATURAL GAS PIPELINE	
EX. PIPELINE EASEMENT	
PR. SECURITY FENCE	X
PR. ACCESS GATE	
PR. LAYDOWN AREA	
PR. PANEL LIMITS	
PR. UNDERGROUND ELECTRIC	UGE
PR. OVERHEAD ELECTRIC	OHW
PR. ACCESS ROAD	
PR. UTILITY POLE	
PR. EQUIPMENT PAD	
PR. SOLAR ARRAY	
PR. LANDSCAPE BUFFER	
EX. WELL	W
WELL BUFFER	

SITE DATA TABLE

PIN #	13-23-40-005
PROPERTY OWNER	EIGER LLC 1625 W LAKE SHORE DR WOODSTOCK, IL 60098
SITE ADDRESS	RIDGEFIELD ROAD, CRYSTAL LAKE, IL 60098
LEGAL DESCRIPTION	DOC 2003R0085874 PT LT 15 SECS 23 & 24 LYING S OF RR /EX DOC 2012R0002480/ ASSRS PLAT
ZONING JURISDICTION	CITY OF CRYSTAL LAKE
ZONING	M PUD, MANUFACTURING PLANNED UNIT DEVELOPMENT
CURRENT LAND USE	AGRICULTURAL FIELD
PROPOSED USE	COMMERCIAL SOLAR FIELD
TOTAL PARCEL AREA	78 ± AC
PRELIMINARY DISTURBED AREA	46 ± AC
PRELIMINARY SOLAR AREA	33 ± AC
RIGHT OF WAY SETBACK	30 FT
PROPERTY LINE SETBACK	15 FT

*ZONING SITE PLAN IS BEING SUBMITTED FOR SPECIAL USE PERMIT AND PUD AMENDMENT TO CONSTRUCT/OPERATE A SOLAR FARM

NOTES

1. THE PURPOSE OF THIS PLAN IS FOR SPECIAL USE PERMIT AND PUD AMENDMENT REVIEW AND APPROVAL BY CITY OF CRYSTAL LAKE TO CONSTRUCT A SOLAR FARM.
2. THIS PLAN WAS PRODUCED UTILIZING GIS RESOURCES AND INFORMATION FROM MULTIPLE SOURCES, INCLUDING CITY OF CRYSTAL LAKE GIS, GOOGLE EARTH, AND USGS TOPOGRAPHIC INFORMATION.
3. SUBJECT PROPERTY DOES NOT LIE WITHIN A SPECIAL FLOOD HAZARD AS SHOWN ON THE FLOOD INSURANCE RATE MAP (COMMUNITY PANEL 17111C0200J AND 17111C0215J) PUBLISHED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA).
4. THE LOCATIONS OF PROPOSED IMPROVEMENTS, INCLUDING BUT NOT LIMITED TO: FENCING, SOLAR ARRAY RACKING, INVERTER/TRANSFORMER PADS, OVERHEAD POLES AND LINES, ETC., SHOWN ARE APPROXIMATE AND ARE SUBJECT TO MODIFICATION DUE TO SITE CONDITIONS, ADDITIONAL PERMITTING REQUIREMENTS, EQUIPMENT SPECIFICATIONS, AND/OR OTHER CONSTRAINTS DURING FINAL ENGINEERING.
5. PROJECT AREA, INCLUDING CONSTRUCTION STAGING AREAS, WILL BE CLEARED AND GRUBBED AS NECESSARY, RETAINING PRE-DEVELOPMENT DRAINAGE PATTERNS TO THE BEST EXTENT POSSIBLE. CONSTRUCTION STAGING AND AREAS SUBJECT TO RUTTING DURING CONSTRUCTION WILL BE TEMPORARILY STABILIZED WITH GRAVEL. SOIL CONDITIONS AND EQUIPMENT LOADS WILL DETERMINE FINAL DESIGN.
6. ALL DIMENSIONS SHOWN ARE AT 90 DEGREES UNLESS OTHERWISE NOTED.
7. CONTRACTOR SHALL CALL AT LEAST 72 HOURS PRIOR TO BEGINNING CONSTRUCTION OR EXCAVATION TO HAVE EXISTING UTILITIES LOCATED. ADDITIONALLY, CONTRACTOR SHALL CONTACT ANY LOCAL UTILITIES THAT PROVIDE THEIR OWN LOCATOR SERVICES.
8. CONTRACTOR SHALL MAINTAIN ACCESS AND UTILITY SERVICES TO ANY REMAINING BUILDING(S) OR ADJACENT BUILDING(S) THROUGHOUT THE DEMOLITION AND CONSTRUCTION PHASES. EXISTING IMPROVEMENTS DAMAGED DURING CONSTRUCTION SHALL BE REPLACED/RESTORED TO THE SATISFACTION OF THE OWNER BY THE CONTRACTOR RESPONSIBLE FOR THE DAMAGE.
9. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE TO PROVIDE SIGNS, BARRICADES, WARNING LIGHTS, GUARD RAILS, AND EMPLOY FLAGGERS AS NECESSARY WHEN CONSTRUCTION ENDANGERS EITHER VEHICULAR OR PEDESTRIAN TRAFFIC. THESE DEVICES SHALL REMAIN IN PLACE UNTIL THE TRAFFIC MAY PROCEED NORMALLY AGAIN.
10. SITE WILL HAVE NO DEDICATIONS FOR OPEN SPACE, NATURAL AREA, HISTORIC BUILDING(S)/STRUCTURE(S), OR STORMWATER MANAGEMENT FACILITIES.
11. SITE WILL NOT INCLUDE WATER SOURCE OR SEWAGE DISPOSAL. APPROXIMATE LOCATION OF EXISTING WATER WELL LOCATIONS SHOWN PER THE ILLINOIS WATER WELL INTERACTIVE MAP ONLINE.
12. STORMWATER MANAGEMENT FACILITIES TO BE PROVIDED AS REQUIRED BY CITY AND/OR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMITTING. REQUIREMENTS TO BE DETERMINED DURING FINAL ENGINEERING.
13. THE MAXIMUM HEIGHTS OF ANY SOLAR PANEL SHALL NOT EXCEED 25 FEET.
14. SOLAR PANELS WILL BE DESIGNED WITH ANTI-REFLECTIVE COATING TO MINIMIZE GLARE.
15. COLLECTION LINES WITHIN THE SOLAR FARM WILL BE LOCATED AND MAINTAINED UNDERGROUND.
16. THERE SHALL BE NO EXTERIOR LIGHTING.
17. SETBACKS SHOWN ON THIS PLAN ARE BASED ON CITY OF CRYSTAL LAKE CODE OF ORDINANCES, SECTION 3-200.
18. ALL NECESSARY PERMITS FOR SOIL EROSION CONTROL AND DRIVEWAY CONSTRUCTION WILL BE OBTAINED AS PART OF FINAL ENGINEERING AND PRIOR TO CONSTRUCTION
19. LANDSCAPE BUFFERS SHOWN ON THIS PLAN ARE BASED ON CITY OF CRYSTAL LAKE CODE OF ORDINANCES, SECTION 2-400C.
20. TO AVOID AND MINIMIZE IMPACT TO GLADSTONE FEN CLASS 3 GROUNDWATER, PER RECOMMENDATIONS FROM THE IDNR STATE ECOLOGICAL REVIEW, THE PROJECT WILL:
    - USE THE LIGHTEST WEIGHT EQUIPMENT POSSIBLE TO COMPLETE THE JOB.
    - USE BALLOON OR LARGE TIRES WHENEVER POSSIBLE TO REDUCE COMPACTION.
    - DISC SITE UPON COMPLETION TO DE-COMPACT THE SURFACE AFTER FINAL SOIL IS PLACED TO ENSURE GOOD INFILTRATION.
    - USE NATURALIZED PERMEABLE BASINS AND SWALES IN THE DESIGN.
21. SITE FENCE TO BE FABRIC WRAPPED PER CITY OF CRYSTAL LAKE SOLAR ORDINANCE.
22. SIGNAGE, ACCESS, GATES, AND SITE DESIGN SHALL BE IN ACCORDANCE WITH INTERNATIONAL FIRE CODE (IFC) 2018 EDITION WITH CITY OF CRYSTAL LAKE AMENDMENTS.

SOILS DATA TABLE

MAP UNIT SYMBOL	MAP UNIT NAME	HYDROLOGIC SOIL GROUP
197A	TROXEL SILT LOAM, 0 TO 2 PERCENT SLOPES	B
323C2	CASCO LOAM, 4 TO 6 PERCENT SLOPES	B
323C3	CASCO CLAY LOAM, 4 TO 6 PERCENT SLOPES. SEVERELY ERODED	B
323D2	CASCO LOAM, 6 TO 12 PERCENT SLOPES, ERODED	B
323D3	CASCO CLAY LOAM, 6 TO 12 PERCENT SLOPES, SEVERELY ERODED	B
325A	DRESDEN SILT LOAM, 0 TO 2 PERCENT SLOPES	B
325B	DRESDEN SILT LOAM, 2 TO 4 PERCENT SLOPES	B
327A	FOX SILT LOAM, 0 TO 2 PERCENT SLOPES	B
327B	FOX SILT LOAM, 2 TO 4 PERCENT SLOPES	B
327C2	FOX SILT LOAM, 4 TO 6 PERCENT SLOPES, ERODED	B
369A	WAUPECAN SILT LOAM, 0 TO 2 PERCENT SLOPES	B
523A	DUNHAM SILTY CLAY LOAM, 0 TO 2 PERCENT SLOPES	B/D
791B	RUSH SILT LOAM, 2 TO 4 PERCENT SLOPES	B
791C2	RUSH SILT LOAM, 4 TO 6 PERCENT SLOPES, ERODED	B
792A	BOWES SILT LOAM, 0 TO 2 PERCENT SLOPES	B
1330A	PEOTONE SILTY CLAY LOAM, 0 TO 2 PERCENT SLOPES, UNDRAINED	C/D
4103A	HOUGHTON MUCK, PONDED, 0 TO 2 PERCENT SLOPES	A/D

No.	REVISIONS	DATE

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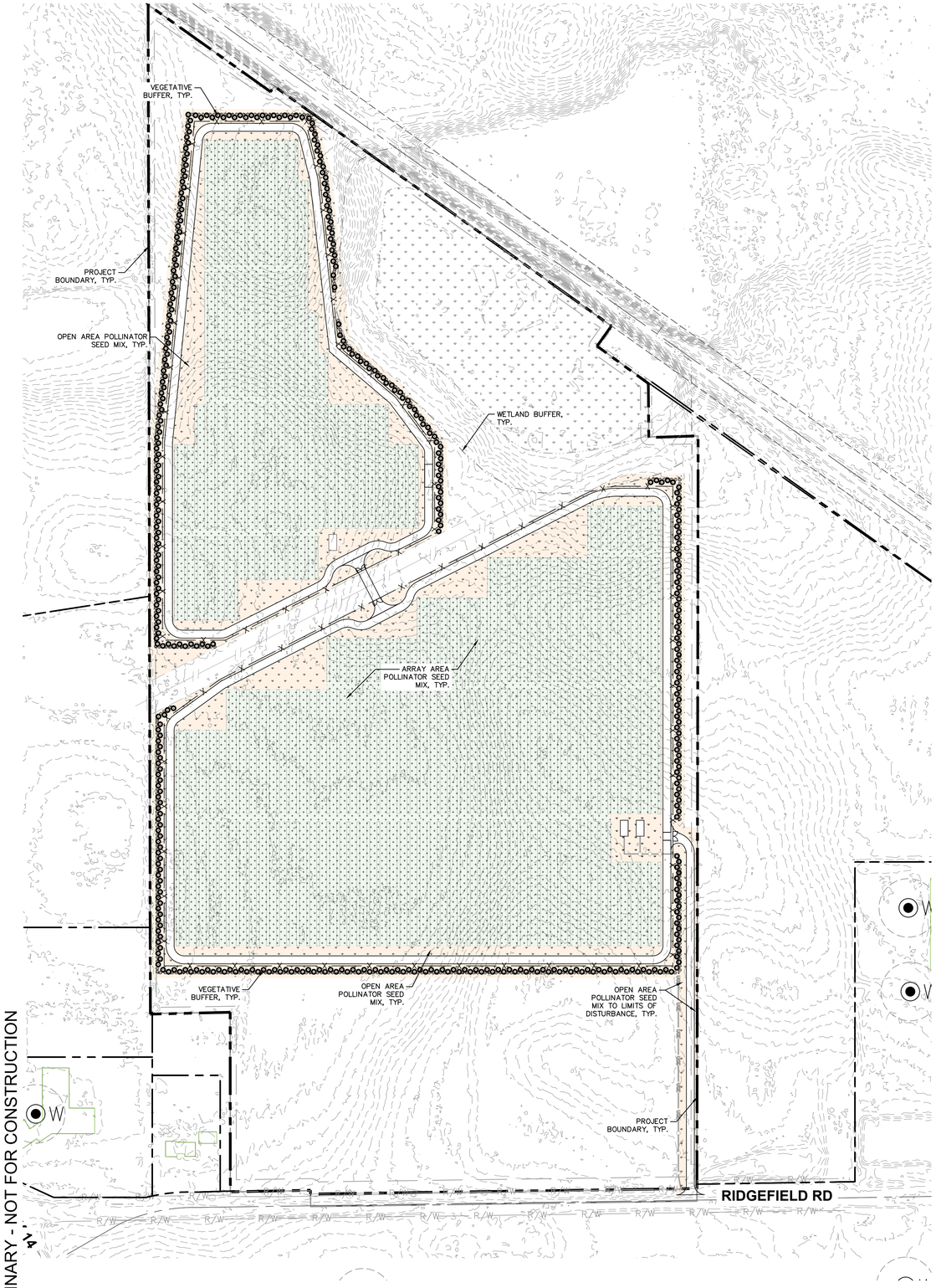
KHA PROJECT 26817304.3
DATE 11/06/2023
SCALE AS SHOWN
DESIGNED BY AH
DRAWN BY LAD
CHECKED BY APK

ZONING SITE PLAN

TPE IL MH405, LLC

CITY OF CRYSTAL LAKE,
MCHENRY COUNTY, IL

SHEET NUMBER
EX-1



PRELIMINARY - NOT FOR CONSTRUCTION

CONCEPT PLANT SCHEDULE

EVERGREEN TREE/SHRUB — 426
SAWARA CYPRESS `SOFT SERVE`
JUNIPERUS VIRGINIANA
JUNIPERUS CHINESIS `MOUNTBATTEN`
PICEA PUNGENS `FAT ALBERT`
TAXUS CUSPIDATA `CAPITATA`
TAXUS X MEDIA `HICKSII`
THUJA OCCIDENTALIS `WOODWARDI`

LARGE DECIDUOUS SHRUB — 439
ARONIA ARBUTIFOLIA
CORNUS SERICEA CARDINAL
EUONYMUS ALATUS `COMPACTUS`
ILEX VERTICILLATA
LINDERA BENZOIN
PHYSOCARPOS OPULIFOLIUS
SAMUCUS CANADENSIS
VIBURNUM DENTATUM
VIBURNUM LENTAGO `MOHICAN`
VIBURNUM PRUNIFOLIUM

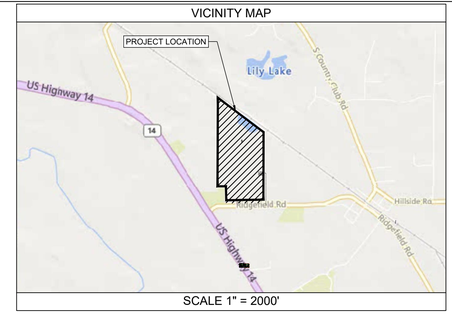
OPEN AREA POLLINATOR SEED MIX

ARRAY AREA POLLINATOR SEED MIX

NORTH

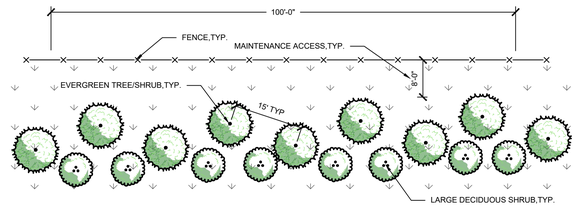
GRAPHIC SCALE IN FEET
0 75 150 300

VICINITY MAP



SCALE 1" = 2000'

VEGETATIVE BUFFER



TYPICAL VEGETATIVE BUFFER PLAN



TYPICAL VEGETATIVE BUFFER ELEVATION

OPEN AREA POLLINATOR SEED MIX

25%	SCHIZACHYRIUM SCOPARIUM	LITTLE BLUESTEM
10%	BOUTELOUA CURTIPENDULA	SIDEOATS GRAMA
6%	SPOROBOLUS HETEROLEPIS	PRAIRIE DROPSEED
5.5%	ELYMUS CANADENSIS	CANADA WILDRYE
5.2%	ECHINACEA PURPUREA	PURPLE CONEFLOWER
5%	DALEA PURPUREA	PURPLE PRAIRIE CLOVER
4.3%	COREOPSIS LANCEOLATA	LANCELEAF COREOPSIS
3.5%	RUDBECKIA HIRTA	BLACKEYED SUSAN
3%	ALLIUM CERNUUM	NODDING WILD ONION
2.2%	SOLIDAGO NEMORALIS	GRAY GOLDENROD
2.1%	SPIRAEA ALBA DU ROI	MEADOWSWEET
2%	RATIBIDA PINNATA	YELLOW PRAIRIE CONEFLOWER
2%	ROSA SETIGERA MICHX	MICHIGAN ROSE
1.8%	SOLIDAGO SPECIOSA	SHOWY GOLDENROD
1.8%	SYMPHYOTRICHUM LAEVE	SMOOTH BLUE ASTER
1.6%	CEANOTHUS AMERICANUS	NEW JERSEY TEA
1.5%	GERANIUM MACULATUM	WILD GERANIUM
1.5%	LIATRIS ASPERA MICHX	ROUGH BLAZING STAR
1.4%	SOLIDAGO RIDDELLII	RIDDELL'S GOLDENROD
1.4%	SYMPHYOTRICHUM ERICOIDES	HEATH ASTER
1.3%	PENSTEMON HIRSUTUS	HAIRY BEARDTONGUE
1.2%	LOBELIA SIPHILITICA	BLUE LOBELIA
1.2%	ASCLEPAIS TUBEROSA	BUTTERFLY WEED
1.2%	ASCLEPIAS INCARNATA	SWAMP MILKWEED
1.2%	ZIZIA AUREA	GOLDEN ALEXANDERS
1.1%	PENSTEMON DIGITALIS	TALL WHITE BEARDTONGUE
1%	ANEMONE CANADENSIS	CANADA ANEMONE
1%	AQUILEGIA CANADENSIS	COLUMBINE
1%	BAPTISIA BRACTEATA VAR LEUCOPHAEA	WILD INDIGO
1%	LUPINUS PERENNIS V. OCCIDENTALIS	WILD LUPINE
1%	MONARDA FISTULOSA	WILD BERGAMOT
1%	MONARDA PUNCTATA	HORSE MINT

SEEDING RATE: 25 LB PER ACRE
SEED WITH COVER CROP OF OATS, JAPANESE MILLET, WINTER PEA, OR ANNUAL RYE DEPENDENT ON SEASON AT A RATE OF 30 LB PER ACRE.

SPECIFIED MIX SUBJECT TO AVAILABILITY DURING TIME OF CONSTRUCTION, OR APPROVED EQUAL.

ARRAY AREA POLLINATOR SEED MIX

26%	SCHIZACHYRIUM SCOPARIUM	LITTLE BLUESTEM
10%	BOUTELOUA CURTIPENDULA	SIDEOATS GRAMA
8%	SPOROBOLUS HETEROLEPIS	PRAIRIE DROPSEED
5%	CAREX BICKNELLII	COPPER-SHOULDERED OVAL SEDGE
5.2%	COREOPSIS LANCEOLATA	SAND COREOPSIS
4.8%	SYMPHYOTRICHUM LAEVE	SMOOTH BLUE ASTER
4%	SYMPHYOTRICHUM ERICOIDES	HEATH ASTER
3.5%	DALEA PURPUREA	PURPLE PRAIRIE CLOVER
3.5%	GERANIUM MACULATUM	WILD GERANIUM
3%	ALLIUM CERNUUM ROTH	NODDING WILD ONION
3%	VERONICASTRUM VIRGINICUM	CULVER'S ROOT
1.8%	DESMODIUM CANADENSES	SHOWY TICK TREFOIL
1.7%	SPIRAEA ALBA DU ROI	MEADOWSWEET
1.6%	ZIZIA AUREA	GOLDEN ALEXANDERS
1.5%	ECHINACEA PURPUREA	PURPLE CONEFLOWER
1.4%	SOLIDAGO SPECIOSA	SHOWY GOLDENROD
1.2%	PYCNANTHEMUM VIRGINIANUM	COMMON MOUNTAIN MINT
1.2%	EUPATORIUM PERFOLIATUM	BONESET
1.2%	OENOTHERA BIENNIS	EVENING PRIMROSE
1.2%	SILPHIUM PERFOLIATUM	CUP PLANT
1.2%	RUDBECKIA HIRTA	BLACKEYED SUSAN
1.1%	HERACLEUM MAXIMUM	COMMON COWPARSNIP
1.1%	LUPINUS PERENNIS V. OCCIDENTALIS	WILD LUPINE
1%	RATIBIDA PINNATA	YELLOW PRAIRIE CONEFLOWER
1%	LIATRIS ASPERA MICHX	ROUGH BLAZING STAR
0.9%	ANGELICA ATROPURPUREA	ANGELICA
0.8%	CACALIA ATRIPLICIFOLIUM	PALE INDIAN PLANTAIN
0.8%	LOBELIA SIPHILITICA	BLUE LOBELIA
0.8%	PENSTEMON HIRSUTUS	HAIRY BEARDTONGUE
0.8%	ASCLEPAIS TUBEROSA	BUTTERFLY WEED
0.7%	ANEMONE CANADENSIS	CANADA ANEMONE
0.6%	SOLIDAGO NEMORALIS	GRAY GOLDENROD
0.4%	CEANOTHUS AMERICANUS	NEW JERSEY TEA

SEEDING RATE: 25 LB PER ACRE
SEED WITH COVER CROP OF OATS, JAPANESE MILLET, WINTER PEA, OR ANNUAL RYE DEPENDENT ON SEASON AT A RATE OF 30 LB PER ACRE.

SPECIFIED MIX SUBJECT TO AVAILABILITY DURING TIME OF CONSTRUCTION, OR APPROVED EQUAL.

No.	REVISIONS	DATE

TurningPoint Energy

Kimley»Horn

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KHA PROJECT

DATE	11/03/2023
SCALE	AS SHOWN
DESIGNED BY	AH
DRAWN BY	LAD
CHECKED BY	AK

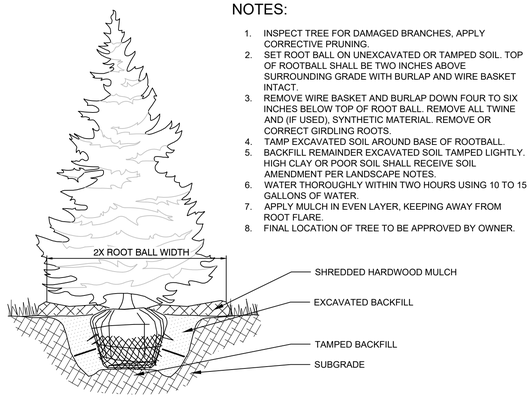
CONCEPT LANDSCAPE PLAN

TPE IL MH405, LLC

CITY OF CRYSTAL LAKE,
MCHENRY COUNTY, IL

SHEET NUMBER

LA-1

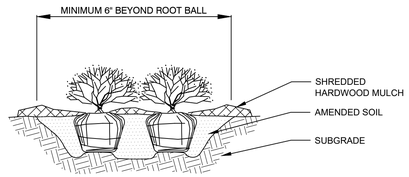


NOTES:

1. INSPECT TREE FOR DAMAGED BRANCHES, APPLY CORRECTIVE PRUNING.
2. SET ROOT BALL ON UNEXCAVATED OR TAMPED SOIL. TOP OF ROOTBALL SHALL BE TWO INCHES ABOVE SURROUNDING GRADE WITH BURLAP AND WIRE BASKET INTACT.
3. REMOVE WIRE BASKET AND BURLAP DOWN FOUR TO SIX INCHES BELOW TOP OF ROOT BALL. REMOVE ALL TWINE AND (IF USED), SYNTHETIC MATERIAL. REMOVE OR CORRECT GIRDLING ROOTS.
4. TAMP EXCAVATED SOIL AROUND BASE OF ROOTBALL.
5. BACKFILL REMAINDER EXCAVATED SOIL TAMPED LIGHTLY. HIGH CLAY OR POOR SOIL SHALL RECEIVE SOIL AMENDMENT PER LANDSCAPE NOTES.
6. WATER THOROUGHLY WITHIN TWO HOURS USING 10 TO 15 GALLONS OF WATER.
7. APPLY MULCH IN EVEN LAYER, KEEPING AWAY FROM ROOT FLARE.
8. FINAL LOCATION OF TREE TO BE APPROVED BY OWNER.

1 EVERGREEN TREE PLANTING

NTS



NOTES:

1. APPLY CORRECTIVE PRUNING.
2. SET ROOT BALL OR CONTAINER ON UNEXCAVATED OR TAMPED SOIL. TOP OF ROOTBALL (CONTAINER) SHALL BE ONE INCH ABOVE SURROUNDING GRADE. FOR LARGER SHRUBS WITHIN PLANTING BED DIG A DEEPER PIT ONLY FOR THOSE SHRUBS.
3. REMOVE BURLAP FROM TOP HALF THE LENGTH OF ROOTBALL. TWINE AND (IF USED) SYNTHETIC MATERIAL SHALL BE REMOVED FROM PLANTING BED. FOR CONTAINER GROWN SHRUBS, REMOVE CONTAINER AND LOOSEN ROOTS PRIOR TO INSTALLATION.
4. REMOVE OR CORRECT GIRDLING ROOTS.
5. PLUMB AND BACKFILL WITH AMENDED SOIL PER LANDSCAPE NOTES. WATER THOROUGHLY WITHIN TWO HOURS.
6. APPLY MULCH IN EVEN LAYER, KEEPING AWAY FROM ROOT FLARE. MULCH LIMITS FOR SHRUBS EXTEND TO ALL LIMITS OF PLANTING BED, SEE PLANS FOR BED LAYOUTS.

2 SHRUB PLANTING

NTS

3 LANDSCAPE NOTES

1. THE LANDSCAPE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING MATERIALS AND PLANTS SHOWN ON THE LANDSCAPE PLAN. THE CONTRACTOR IS RESPONSIBLE FOR THE COST TO REPAIR UTILITIES, ADJACENT LANDSCAPE, PUBLIC AND PRIVATE PROPERTY THAT IS DAMAGED BY THE CONTRACTOR OR THEIR SUBCONTRACTOR'S OPERATIONS DURING INSTALLATION OR DURING THE SPECIFIED MAINTENANCE PERIOD. CALL FOR UTILITY LOCATIONS PRIOR TO ANY EXCAVATION.
2. THE CONTRACTOR SHALL REPORT ANY DISCREPANCY IN PLAN VS. FIELD CONDITIONS IMMEDIATELY TO THE LANDSCAPE ARCHITECT, PRIOR TO CONTINUING WITH THAT PORTION OF WORK.
3. NO PLANTING WILL BE INSTALLED UNTIL ALL GRADING AND CONSTRUCTION HAS BEEN COMPLETED IN THE IMMEDIATE AREA.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REPAIR OF ANY OF THEIR TRENCHES OR EXCAVATIONS THAT SETTLE.
5. ALL PLANTS TO BE SPECIMEN GRADE, WELL BRANCHED, HEALTHY, FULL, PRE-INOCULATED AND FERTILIZED. PLANTS SHALL BE FREE FROM DISEASE, PESTS, WOUNDS, AND SCARS. PLANTS SHALL BE FREE FROM NOTICEABLE GAPS, HOLES, OR DEFORMITIES. PLANTS SHALL BE FREE FROM BROKEN OR DEAD BRANCHES. TRUNKS WILL BE WRAPPED IF NECESSARY TO PREVENT SUN SCALD AND INSECT DAMAGE. THE LANDSCAPE CONTRACTOR SHALL REMOVE THE WRAP AT THE PROPER TIME AS PART OF THIS CONTRACT.
6. THE OWNER'S REPRESENTATIVE MAY REJECT ANY PLANT MATERIALS THAT ARE DISEASED, DEFORMED, OR OTHERWISE NOT EXHIBITING SUPERIOR QUALITY.
7. ALL NURSERY STOCK SHALL BE GUARANTEED, BY THE CONTRACTOR, FOR ONE YEAR FROM DATE OF FINAL INSPECTION. THE GUARANTEE BEGINS ON THE DATE OF THE LANDSCAPE ARCHITECT'S OR OWNERS WRITTEN ACCEPTANCE OF THE INITIAL PLANTING. REPLACEMENT PLANT MATERIAL SHALL HAVE A ONE YEAR GUARANTEE COMMENCING UPON PLANTING.
8. PLANTS TO MEET AMERICAN STANDARD FOR NURSERY STOCK (ANSI Z60.1-2014 OR MOST CURRENT VERSION) REQUIREMENTS FOR SIZE AND TYPE SPECIFIED.
9. PRUNE PLANTS AS NECESSARY- PER STANDARD NURSERY PRACTICE AND TO CORRECT POOR BRANCHING OF EXISTING AND PROPOSED TREES.
10. TOPSOIL SHALL BE PROVIDED AND GRADED BY THE GENERAL CONTRACTOR UP TO 6 INCHES BELOW FINISHED GRADE IN TURF AREAS AND 18 INCHES IN PLANTING AREAS.
11. SEED/SOD LIMIT LINES ARE APPROXIMATE. CONTRACTOR SHALL SEED/SOD ALL AREAS WHICH ARE DISTURBED BY GRADING WITH THE SPECIFIED SEED/SOD MIXES.
12. EDGING TO BE A SPADED EDGE UNLESS INDICATED OTHERWISE ON THE PLANS. SPADED EDGE TO PROVIDE V-SHAPED DEPTH AND WIDTH TO CREATE SEPARATION BETWEEN MULCH AND GRASS. A SPADED BED EDGE SHALL SEPARATE MULCH BEDS FROM TURF OR SEEDED AREAS. A SPADED EDGE IS NOT REQUIRED ALONG CURBED EDGES.
13. CONTRACTOR SHALL INSTALL SHREDDED HARDWOOD MULCH AT A 3" DEPTH TO ALL TREES, SHRUB, PERENNIAL, AND GROUNDCOVER AREAS. TREES PLACED IN AREA COVERED BY TURF SHALL RECEIVE A 4 FT WIDE MAXIMUM TREE RING WITH 3" DEPTH SHREDDED HARDWOOD MULCH.
14. INSTALLATION OF TREES WITHIN PARKWAYS SHALL BE COORDINATED IN THE FIELD WITH LOCATIONS OF UNDERGROUND UTILITIES. TREES SHALL NOT BE LOCATED CLOSER THAN 5' FROM UNDERGROUND UTILITY LINES AND NO CLOSER THAN 10' FROM UTILITY STRUCTURES.
15. DO NOT DISTURB THE EXISTING PAVING, LIGHTING, OR LANDSCAPING THAT EXISTS ADJACENT TO THE SITE UNLESS OTHERWISE NOTED ON PLAN.
16. ALL DISTURBED AREAS TO BE SODDED OR SEEDED, UNLESS OTHERWISE NOTED. SOD/SEED SHALL BE LOCAL HARDY TURF GRASS MIX UNLESS, OTHERWISE NOTED.
17. PLANT QUANTITIES SHOWN ARE FOR THE CONVENIENCE OF THE OWNER AND JURISDICTIONAL REVIEW AGENCIES. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL PLANT QUANTITIES AS DRAWN.
18. THE CONTINUED MAINTENANCE OF ALL REQUIRED LANDSCAPING SHALL BE THE RESPONSIBILITY OF THE OWNER OF THE PROPERTY ON WHICH SAID MATERIALS ARE REQUIRED. ALL PLANT MATERIALS REQUIRED BY THIS SECTION SHALL BE MAINTAINED AS LIVING VEGETATION AND SHALL BE PROMPTLY REPLACED IF THE PLANT MATERIAL HAS DIED PRIOR TO FINAL ACCEPTANCE. PLANTING AREAS SHALL BE KEPT FREE OF TRASH, LITTER, AND WEEDS AT ALL TIMES.

PRELIMINARY - NOT FOR CONSTRUCTION

No.	REVISIONS	DATE

TurningPoint Energy

Kimley»Horn
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KHA PROJECT	
DATE	11/03/2023
SCALE	AS SHOWN
DESIGNED BY	AH
DRAWN BY	LAD
CHECKED BY	AK

LANDSCAPE NOTES AND DETAILS

TPE IL MH405, LLC

CITY OF CRYSTAL LAKE,
MCHENRY COUNTY, IL

SHEET NUMBER

LA-2

GROUND COVER MAINTENANCE REQUIREMENTS

MAINTENANCE PROGRAMS SHALL BE SITE SPECIFIC AND COORDINATED WITH THE LANDSCAPE CONTRACTOR AND COUNTY FOR ADEQUATE MAINTENANCE PROCEDURES. A FIVE YEAR STEWARDSHIP PROGRAM IS NECESSARY TO ENSURE PROPER ESTABLISHMENT AND HEALTH OF GROUND COVER, TO CONTROL INVASIVE SPECIES, AND TO PREVENT OVERGROWTH AND SHADING OF EQUIPMENT. AFTER THE FIFTH GROWING SEASON, PROGRAM IS TO BE REDUCED TO TWO VISITS PER YEAR, DEPENDENT UPON SITE CONDITIONS AND REQUIRED STRATEGIES TO MAINTAIN GOOD HEALTH OF THE SITE SUCH AS DETHACHING, ADDITIONAL MOWING, OR HERBICIDE TREATMENTS.

FIRST YEAR

SPRING:
-EARLIEST POSSIBLE INSTALLATION MAY OCCUR IN THE SPRING OF THE FIRST YEAR. NO MAINTENANCE ACTIONS ARE REQUIRED TO BE PERFORMED DURING THE FIRST SEASON OF INSTALL. IF SEED APPLICATION TAKES PLACE IN SUMMER OR FALL OF THE FIRST YEAR, MAINTENANCE AND MONITORING SHOULD START THE FOLLOWING SEASON.

SUMMER:
-SITE VISITS ARE TO BE PERFORMED THREE TIMES THROUGHOUT THE SUMMER AT THE MIDDLE OR END OF EACH MONTH, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING AT EACH VISIT.
-CONTROL INVASIVE WOODY AND HERBACEOUS FLORA THROUGH PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS.
-CONDUCT MOWING UP TO THREE TIMES MAXIMUM DURING THE SUMMER IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 16 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 16 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. NEWLY SEEDED AREAS SHOULD BE CUT BACK TO 10 INCHES IN HEIGHT.

FALL:
-SITE VISITS ARE TO BE PERFORMED THREE TIMES THROUGHOUT THE FALL AT THE MIDDLE OR END OF EACH MONTH, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING AT EACH VISIT.
-CONTROL INVASIVE WOODY AND HERBACEOUS FLORA THROUGH PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS.
-CONDUCT MOWING UP TO THREE TIMES MAXIMUM DURING THE FALL IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 16 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 16 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. NEWLY SEEDED AREAS SHOULD BE CUT BACK TO 10 INCHES IN HEIGHT.

SECOND YEAR

SPRING:
-SITE VISITS ARE TO BE PERFORMED THREE TIMES THROUGHOUT THE SPRING AT THE MIDDLE OR END OF EACH MONTH, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING AT EACH VISIT.
-DURING FIRST VISIT, MOWING SHOULD OCCUR TO CUT BACK ANY VEGETATION TO A HEIGHT OF 10 INCHES AND REMOVE DEAD STALKS AND SEED HEADS FROM THE PREVIOUS GROWING SEASON.
-CONTROL INVASIVE WOODY AND HERBACEOUS FLORA THROUGH PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS.
-CONDUCT MOWING UP TO THREE TIMES MAXIMUM DURING THE SPRING IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 16 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 16 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. SEEDED AREAS SHOULD BE CUT BACK TO 12 INCHES IN HEIGHT.
-PLANT SUPPLEMENTAL SEED AS NEEDED TO ADDRESS AREAS OF POOR COVERAGE AND TO INCREASE COMPETITION AND BIO-DIVERSITY.

SUMMER:
-SITE VISITS ARE TO BE PERFORMED THREE TIMES THROUGHOUT THE SUMMER AT THE MIDDLE OR END OF EACH MONTH, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING AT EACH VISIT.
-CONTROL INVASIVE WOODY AND HERBACEOUS FLORA THROUGH PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS.
-CONDUCT MOWING UP TO THREE TIMES MAXIMUM DURING THE SUMMER IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 16 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 16 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. SEEDED AREAS SHOULD BE CUT BACK TO 12 INCHES IN HEIGHT.

FALL:
-SITE VISITS ARE TO BE PERFORMED THREE TIMES THROUGHOUT THE FALL AT THE MIDDLE OR END OF EACH MONTH, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING AT EACH VISIT.
-CONTROL INVASIVE WOODY AND HERBACEOUS FLORA THROUGH PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS.
-CONDUCT MOWING UP TO THREE TIMES MAXIMUM DURING THE SUMMER IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 16 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 16 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. SEEDED AREAS SHOULD BE CUT BACK TO 12 INCHES IN HEIGHT.

THIRD, FOURTH, AND FIFTH YEAR

SPRING:
-SITE VISIT IS TO BE PERFORMED ONE TIME DURING THE EARLY SPRING, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING.
-MOWING SHOULD OCCUR TO CUT BACK ANY VEGETATION TO A HEIGHT OF 10 INCHES AND REMOVE DEAD STALKS AND SEED HEADS FROM THE PREVIOUS GROWING SEASON.
-IF INVASIVE WOODY AND HERBACEOUS FLORA HAVE BEEN IDENTIFIED, PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS ARE REQUIRED.

SUMMER:
-SITE VISIT IS TO BE PERFORMED ONE TIME DURING THE SUMMER, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING.
-MOWING SHOULD OCCUR IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 16 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 16 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. SEEDED AREAS SHOULD BE CUT BACK TO 12 INCHES IN HEIGHT.
-IF INVASIVE WOODY AND HERBACEOUS FLORA HAVE BEEN IDENTIFIED, PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS ARE REQUIRED.

FALL:
-SITE VISIT IS TO BE PERFORMED ONE TIME DURING THE FALL, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING.
-MOWING SHOULD OCCUR IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 24 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 24 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. SEEDED AREAS SHOULD BE CUT BACK TO 12 INCHES IN HEIGHT.
-IF INVASIVE WOODY AND HERBACEOUS FLORA HAVE BEEN IDENTIFIED, PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS ARE REQUIRED.

FOLLOWING THE FIFTH YEAR

-SITE VISITS ARE TO BE PERFORMED TWICE A YEAR, DURING THE EARLY SPRING AND LATE SUMMER, WITH MONITORING AND EVALUATION OF VEGETATION HEIGHT AND PRESENCE OF INVASIVE SPECIES OCCURRING AT EACH VISIT.
-DURING THE SPRING, MOWING SHOULD OCCUR TO CUT BACK ANY VEGETATION TO A HEIGHT OF 10 INCHES AND REMOVE DEAD STALKS AND SEED HEADS FROM THE PREVIOUS GROWING SEASON.
-DURING THE FALL, MOWING SHOULD OCCUR IN AREAS OF THE SITE IDENTIFIED TO HAVE VEGETATION OVER 24 INCHES IN HEIGHT. AREAS WITH HEIGHT UNDER 24 INCHES MAY REMAIN UNTIL THE NEXT SCHEDULED MONITORING VISIT. SEEDED AREAS SHOULD BE CUT BACK TO 12 INCHES IN HEIGHT.
-IF INVASIVE WOODY AND HERBACEOUS FLORA HAVE BEEN IDENTIFIED, PHYSICAL REMOVAL OR SPOT *HERBICIDE TREATMENTS ARE REQUIRED.

*ALL HERBICIDES ARE TO BE ANIMAL FRIENDLY AND APPLIED BY A TRAINED PERSONNEL.

PERFORMANCE STANDARDS

SATISFACTORY LANDSCAPE DEVELOPMENT ASSOCIATED WITH NATURALIZED VEGETATION WILL BE BASED ON THE FOLLOWING ITEMS.

FIRST YEAR:

WITHIN THREE MONTHS OF SEED INSTALLATION (OR THREE MONTHS AFTER THE START OF THE GROWING SEASON FOLLOWING DORMANT SEEDING), APPROXIMATELY 90 PERCENT OF THE SEEDED AREA, AS MEASURED BY AERIAL COVER, WILL BE VEGETATED OR OTHERWISE STABILIZED AGAINST EROSION. THE COVER CROP MAY BE INCLUDED IN THIS MEASUREMENT. IF MINIMUM IS NOT MET, ADDITIONAL SEEDING IS REQUIRED IN AREAS WITH POOR COVER.

SECOND YEAR:

BY THE END OF THE SECOND GROWING SEASON, THE PLANTED AREAS ARE DESIGNED TO HAVE A MINIMUM OF 50 PERCENT GROUND COVER BY SPECIES IN FINAL SEED MIX (NOT TO INCLUDE TEMPORARY COVER CROP OR UNDESIRABLE / INVASIVE SPECIES).

THIRD YEAR:

BY THE END OF THE THIRD GROWING SEASON, THE PLANTED AREAS ARE DESIGNED TO HAVE A MINIMUM OF 75 PERCENT GROUND COVER BY SPECIES IN FINAL SEED MIX (NOT TO INCLUDE TEMPORARY COVER CROP OR UNDESIRABLE / INVASIVE SPECIES).

IF PERFORMANCE STANDARD IS NOT MET AT EACH OBSERVATION, LANDSCAPE CONTRACTOR IS TO NOTIFY OWNER AND DEVELOP CORRECTIVE ACTION SUCH AS SEEDING OR HERBICIDE TREATMENT

GENERAL LANDSCAPE NOTES

1. THE LANDSCAPE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING MATERIALS AND PLANTS SHOWN ON THE LANDSCAPE PLAN. THE CONTRACTOR IS RESPONSIBLE FOR THE COST TO REPAIR UTILITIES, ADJACENT LANDSCAPE, PUBLIC AND PRIVATE PROPERTY THAT IS DAMAGED BY THE CONTRACTOR OR THEIR SUBCONTRACTOR'S OPERATIONS DURING INSTALLATION OR DURING THE SPECIFIED MAINTENANCE PERIOD. CALL FOR UTILITY LOCATIONS PRIOR TO ANY EXCAVATION.
2. THE CONTRACTOR SHALL REPORT ANY DISCREPANCY IN PLAN VS. FIELD CONDITIONS IMMEDIATELY TO THE LANDSCAPE ARCHITECT, PRIOR TO CONTINUING WITH THAT PORTION OF WORK.
3. NO PLANTING WILL BE INSTALLED UNTIL ALL GRADING AND CONSTRUCTION HAS BEEN COMPLETED IN THE IMMEDIATE AREA.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REPAIR OF ANY OF THEIR TRENCHES OR EXCAVATIONS THAT SETTLE..
5. DO NOT DISTURB THE EXISTING PAVING, LIGHTING, OR LANDSCAPING THAT EXISTS ADJACENT TO THE SITE UNLESS OTHERWISE NOTED ON PLAN.
6. PLANT QUANTITIES SHOWN ARE FOR THE CONVENIENCE OF THE OWNER AND JURISDICTIONAL REVIEW AGENCIES. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL PLANT QUANTITIES AS DRAWN.
7. THE CONTINUED MAINTENANCE OF ALL REQUIRED LANDSCAPING SHALL BE THE RESPONSIBILITY OF THE OWNER OF THE PROPERTY ON WHICH SAID MATERIALS ARE REQUIRED. ALL PLANT MATERIALS REQUIRED BY THIS SECTION SHALL BE MAINTAINED AS LIVING VEGETATION AND SHALL BE PROMPTLY REPLACED IF THE PLANT MATERIAL HAS DIED PRIOR TO FINAL ACCEPTANCE.
8. NO GENERAL SPRAY OF HERBICIDES IS TO BE USED FOR ANY SEEDED AREAS.
9. ONLY HERBICIDES FORMULATED FOR ANIMAL SAFETY SHALL BE USED.
10. ALL WORK DEEMED NATURAL AREA TO BE SEEDED OR PLANTED SHALL BE PERFORMED BY A QUALIFIED LANDSCAPE CONTRACTOR.
11. SEED SHALL BE OBTAINED FROM SOURCE SPECIALIZING IN NATIVE SPECIES, WHERE AVAILABLE OR AS APPROVED BY CLIENT OR CLIENT'S REPRESENTATIVE.
12. ALL SEED MIXES SHALL BE INSTALLED WITH A COVER CROP DEPENDENT ON SEASON AND REQUIREMENTS SPECIFIED PER SEED MIX / SEED SUPPLIER.

ESTABLISHMENT NOTES AND STANDARDS

SEED AREA ESTABLISHMENT

PREPARATION

-SOIL IN AREAS OF EXISTING AGRICULTURAL USAGE IS RECOMMENDED TO BE TESTED FOR HIGH LEVELS OF HERBICIDES, AND AMENDED APPROPRIATELY TO BRING CONCENTRATION DOWN TO LEVELS APPROPRIATE FOR COMMON GRASSES. SOILS IDENTIFIED TO BE HIGH IN HERBICIDES OR CONTAMINATES SHOULD BE EVALUATED BY AN ENVIRONMENTAL SPECIALIST OR SOIL SCIENTIST TO DETERMINE REQUIRED METHODS OF REMEDIATION.
-SOILS SHALL BE UNIFORM, WITHOUT EXCESSIVE FURROWS, RUTS, OR RIDGES, AND LOW AREAS WHERE WATER MAY COLLECT.
-SOILS SHOULD BE CLEARED OF TRASH, DEBRIS, AND INVASIVE SPECIES PRIOR TO FINAL SEEDING APPLICATION.
-SOIL PREPARATION SHALL OCCUR WHEN WEATHER PERMITS AND TIMING ALLOWS FOR AT LEAST A FOLLOWING 48 HOURS WHERE SEEDING AND STABILIZATION METHODS MAY TAKE PLACE.

TIMING

-TO PROMOTE EARLY AND STRONG ESTABLISHMENT OF SPECIFIED SEED MIX, DORMANT SEASON SEED APPLICATION SHOULD BE UTILIZED IF POSSIBLE AND AS CONSTRUCTION TIMELINE PERMITS.
-DORMANT SEASON SEEDING SHOULD UTILIZE WINTER-TOLERANT SEED FROM THE SPECIFIED SEED MIX, ALONG WITH 20-30 LBS PER ACRE OF A WINTER NURSE CROP SUCH AS SECALE CEREALE, PISUM SATIVUM, OR AVENA SATIVA.
-TO APPLY DORMANT SEED, SITE SHOULD BE CLEARED OF INVASIVE WEEDS, LIGHTLY TILLED OR DISKED, THEN DRILL APPLIED ACROSS THE ENTIRE AREA OF AGRICULTURAL SOIL.
-ACTIVE SEASON SEED APPLICATION SHOULD BE PERFORMED BETWEEN APRIL 1ST AND MAY 30TH, AFTER RISK OF MAJOR FREEZING CONDITIONS IS MINIMIZED, FOR IDEAL ESTABLISHMENT AND MINIMIZING INVASIVE SPECIES COMPETITION.

APPLICATION

-SEED MIXTURES SHALL BE MECHANICALLY DRILLED.
-NO STRAW MULCH IS REQUIRED, UNLESS NEEDED FOR STEEP SLOPES, SOIL STABILIZATION, OR OTHER AREAS THAT ARE IDENTIFIED FOR EROSION PREVENTION.
-SEED SHALL BE APPLIED AT INDICATED RATES WITH COVER CROP OATS, JAPANESE MILLET, WINTER WHEAT, ANNUAL RYE, OR SPECIFIED CROP DEPENDENT ON SEASON AND SOIL CONDITIONS.
-SEED SPECIES SHALL BE LOCALLY SOURCED WHEN FEASIBLE.
-FINAL SEED MIX MAY VARY DEPENDENT UPON SPECIFIC SPECIES AVAILABILITY AND TIME OF INSTALLATION.
-FINAL SEED MIX SHALL BE APPROVED BY OWNER, OWNER'S REPRESENTATIVE, OR LANDSCAPE ARCHITECT.
-IF SEEDING IS PERFORMED PRIOR TO FINAL SITE INSTALLATION, ADDITIONAL SEED MAY BE APPLIED BY A LOW SPREADER IN AREAS THAT WERE DISTURBED.
-SITE SHOULD BE MONITORED FOLLOWING INSTALLATION FOR AREAS IDENTIFIED FOR ADDITIONAL RESEEDING UNTIL SEED MIX IS SUFFICIENTLY ESTABLISHED.

INVASIVE WEED CONTROL, MONITORING, AND MANAGEMENT

-A WORK PLAN SHOULD BE DEVELOPED TO AVOID THE SPREAD OF INVASIVE PLANTS FROM THESE AREAS.
-IF SUBSTANTIAL AREAS OF INVASIVE HERBACEOUS SPECIES ARE FOUND PRIOR TO OR AFTER PROJECT DEVELOPMENT, FOLIAR OR BROADCAST HERBICIDE APPLICATIONS MAY BE REQUIRED.
-FOR INVASIVE TREES, SHRUBS, AND VINES, MANAGEMENT MAY REQUIRE CUT-STEM HERBICIDE TREATMENTS.
-ALL INVASIVE SPECIES MANAGEMENT SHOULD BE CONDUCTED DURING THE SUMMER MONTHS WHILE THE TARGET PLANTS ARE ACTIVELY GROWING.
-TREATMENTS SHOULD BE CONDUCTED ACCORDING TO MAINTENANCE PLANS EACH YEAR AND SHOULD BE SEPARATED BY AT LEAST TWO WEEKS.
-HERBICIDE USE REPORTING WILL ADHERE TO ALL APPLICATOR LICENSING REQUIREMENTS.

TREE AND SHRUB INSTALLATION

-ALL PLANTS TO BE SPECIMEN GRADE, WELL BRANCHED, HEALTHY, FULL, PRE-INOCULATED, AND FERTILIZED. PLANTS SHALL BE FREE FROM DISEASE, PESTS, WOUNDS, AND SCARS. PLANTS SHALL BE FREE FROM NOTICEABLE GAPS, HOLES, OR DEFORMITIES. PLANTS SHALL BE FREE FROM BROKEN OR DEAD BRANCHES.
-TRUNKS WILL BE WRAPPED IF NECESSARY TO PREVENT SUN SCALD AND INSECT DAMAGE. THE LANDSCAPE CONTRACTOR SHALL REMOVE THE WRAP AT THE PROPER TIME AS PART OF THIS CONTRACT.
-THE OWNER'S REPRESENTATIVE MAY REJECT ANY PLANT MATERIALS THAT ARE DISEASED, DEFORMED, OR OTHERWISE NOT EXHIBITING SUPERIOR QUALITY.
-ALL NURSERY STOCK SHALL BE GUARANTEED, BY THE CONTRACTOR, FOR ONE YEAR FROM DATE OF FINAL INSPECTION. THE GUARANTEE BEGINS ON THE DATE OF THE LANDSCAPE ARCHITECT'S OR OWNER'S WRITTEN ACCEPTANCE OF THE INITIAL PLANTING. REPLACEMENT PLANT MATERIAL SHALL HAVE A ONE YEAR GUARANTEE COMMENCING UPON PLANTING.
-PLANTS ARE TO MEET AMERICAN STANDARD FOR NURSERY STOCK (ANSI Z60.1-2014 OR MOST CURRENT VERSION) REQUIREMENTS FOR SIZE AND TYPE SPECIFIED.
-PRUNE PLANTS AS NECESSARY PER STANDARD NURSERY PRACTICE AND TO CORRECT POOR BRANCHING OF EXISTING AND PROPOSED TREES.
-CONTRACTOR SHALL INSTALL SHREDDED HARDWOOD MULCH AT A 3" DEPTH TO ALL TREE AND SHRUB AREAS. TREES PLACED IN AREA COVERED BY TURF SHALL RECEIVE A 4' WIDE TREE RING WITH 3" DEPTH SHREDDED HARDWOOD MULCH.

PRELIMINARY - NOT FOR CONSTRUCTION

No.	REVISIONS	DATE

TurningPoint Energy

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KHA PROJECT

DATE	11/03/2023
SCALE	AS SHOWN
DESIGNED BY	AH
DRAWN BY	LAD
CHECKED BY	AK

MAINTENANCE AND MONITORING AND PLAN

TPE IL MH405, LLC
CITY OF CRYSTAL LAKE, MCHENRY COUNTY, IL

SHEET NUMBER
LA-3

Wetland Delineation Report

MH405

City of Crystal Lake

McHenry County, Illinois

Prepared for:

TPE IL MH405, LLC
3720 S Dahlia Street
Denver, CO 80237

Prepared by:

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November 2023

Kimley»Horn

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1 Introduction

Wetland scientists Mason Kunkel and Cassie Baumgartner with Kimley-Horn and Associates, Inc. conducted a wetland investigation and field delineation for TPE IL MH405, LLC and the MH405 project in the City of Crystal Lake, McHenry County, Illinois. The wetland investigation and delineation included parcel number 13-23-400-005 (the "study area"). The study area is shown on **Figure 1.** The study area consists primarily of undeveloped agricultural land.

A routine level 2 (onsite) wetland delineation, as outlined in the *1987 Corps of Engineers Wetlands Delineation Manual* (January 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (Version 2.0) (August 2010)* occurred on October 26, 2023. The purpose of this delineation was to identify the extent of wetlands within the study area. The information will be used to facilitate project design and determine if aquatic resource impacts are avoidable and/or if minimization of impacts can result from design modifications.

2 Project Description

TPE IL MH405, LLC is proposing a community scale solar development. The project will primarily consist of ground mounted solar panels, racking, associated electrical components, with security fencing and interior access roads.

3 Statement of Qualifications

Kimley-Horn has extensive experience completing wetland investigations and delineations across the United States. Kimley-Horn's personnel has been trained to use the *1987 Corps of Engineers Wetlands Delineation Manual (USACE, 1987)* along with the applicable regional supplements. Kimley-Horn has experience completing off-site hydrology analysis, historic aerial reviews, and difficult or atypical situation delineations.

Ashley Payne earned a Bachelor of Arts Degree in Environmental Biology from Saint Mary's University of Minnesota. She is an environmental scientist with over 14 years of experience specializing in wetland services environmental documentation and assessments, and geographic information systems mapping and data collection. During the last 14 years, she has successfully completed hundreds of delineations for various types of projects. In the last seven years, Ashley's primary focus has been the delineation of agricultural fields for future development. She is familiar with completing historic aerial reviews and off-site hydrology determinations which are required for delineation of farmed wetlands. Ashley has also obtained environmental permits for clients through efficient and thorough preparation of permit applications, and by coordinating with agency personnel. Ashley is a certified delineator in the state of Minnesota and her primary focus is environmental work in the Midwest. She has extensive experience working in Minnesota, Illinois, Wisconsin, Michigan, Iowa, and South Dakota.

Keller Leet-Otley earned a Bachelor of Arts Degree in Environmental Science from Colby College. He is an environmental scientist who specializes in wetland delineation and permitting, geographic information systems mapping, and threatened and endangered species due diligence. He has led the delineation of agricultural fields, roadway corridors, and undeveloped areas for future development and transit projects. He is proficient using ArcGIS to produce client specific exhibits for various project types. Keller has prepared environmental permit applications and documentation for public and private sector clients. He is a certified delineator in the state of Minnesota and his focus is environmental work in the upper Midwest.

Mason Kunkel earned a Bachelor of Science Degree in Biology with an emphasis in Wildlife Conservation from Western Colorado University. He is a biologist who specializes in wetland delineation and geographic

information systems mapping. He has assisted with the delineation of agricultural fields, roadway corridors, and undeveloped areas for future development and transit projects. He is proficient using ArcGIS to produce client specific exhibits for various project types. He is familiar with completing historic aerial reviews and off-site hydrology determinations which are required for delineation of farmed wetlands. He has extensive experience working in Minnesota, Iowa, Illinois, and Michigan.

Cassie Baumgartner earned a Bachelor of Science degree in Environmental Science, Policy, and Management, from the University of Minnesota. Cassie has experience in Phase I Environmental Site Assessments, natural resource surveying and permitting, threatened and endangered species due diligence, NPDES stormwater compliance, and specializes in wetland delineations and geographic information systems mapping. She has completed wetland delineations for both public and private sector clients throughout the Midwest and is proficient in wetland delineations in agricultural areas.

4 Regulatory Requirements

A summary of the permit requirements that may pertain to the project is provided below. Any activity planned within areas identified as wetland must be coordinated with and approved by the appropriate agencies prior to commencement of such activities.

4.1 State and Federal Regulations

The regulatory authority of the U.S. Army Corps of Engineers (USACE) covers Waters of the United States (WOTUS) in accordance with Section 404 of the Clean Water Act. Generally, the USACE reviews delineations to determine whether wetlands are jurisdictional (i.e., WOTUS). On December 30, 2022, the U.S. Environmental Protection Agency (EPA) and Department of the Army ("the agencies") announced the final "Revised Definition of 'Waters of the United States'" rule. The rule took effect on March 20, 2023. Based on a preliminary federal injunction on April 12, 2023, the Revised Definition was revoked and the pre-2015 regulatory regime is in effect for 27 states. In Illinois, the 2023 Revised Definition of the Waters of the United States is in effect as of the date of this report.

Based on the May 25, 2023 ruling of Sackett v. EPA (2023), the Clean Waters Act's use of "waters" encompasses only relatively permanent, standing, or continuously flowing bodies, ordinarily called streams, oceans, rivers, and lakes. Wetlands qualify as WOTUS only if "indistinguishable from waters of the United States," having a continuous surface connection to bodies that are waters of the United States in their own right, with no clear division between waters and wetlands. As of September 8, 2023, the EPA and the Department of the Army amended the WOTUS rule to conform to the 2023 Supreme Court decision in Sackett v. EPA.

Section 10 of the Rivers and Harbors Act requires that regulated activities conducted below the ordinary high-water mark elevation of navigable Waters of the U.S. or mean high water mark for tidal waters be approved/permitted by the USACE. Regulated activities include the placement/removal of structures, work involving dredging, disposal of dredged material, filling, excavation, or any other disturbance of soils/sediments or modification of a navigable waterway. Navigable Waters of the U.S. are those waters that are subject to the ebb and flow of the tide shoreward to the mean high-water mark and/or are presently used or have been used in the past or may be susceptible to use to transport interstate or foreign commerce.

At this time, Illinois does not regulate wetlands under Section 404, or require setback buffers for wetlands on private land.

4.2 Local Regulations

The City of Crystal Lake comprehensive plan for the northwest sub-area denotes the wetland in the northern boundary of the study area as Lilly Pond Marsh and requires a 100-foot buffer to protect the water quality of the feature. McHenry County requires all development activities impacting wetlands to comply with

Chapter 17.60.060 in the County Code of Ordinances. According to the McHenry County Code of Ordinances, development activities that create an impact within a wetland, WOTUS, isolated waters of the county, or their associated buffers, regardless of the Corps of Engineers jurisdiction, must submit a stormwater management permit application. Additionally, McHenry County Code of Ordinances states that a minimum 30 foot buffer is required for any USACE jurisdictional wetland between 0.25 and 0.5 acres and a 50 foot buffer for any wetland over 0.5 acres. Linear features with a tributary area over 20 acres require a 50 foot buffer, and a 100 foot buffer may be required for higher classifications of linear features.

5 Mapping and Background Information

Prior to field reconnaissance, potential wetland areas within the project study areas were identified through a desktop review of United States Geological Survey (USGS) topographic maps, National Wetlands Inventory (NWI), National Hydrography Dataset (NHD), Illinois Department of Natural Resources (IDNR) Public Waters, LiDAR, the soil survey for McHenry County, Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), aerial photography, and antecedent precipitation for a location near the study area. The selected resources are described below:

5.1 Topography

The 1992 McHenry IL 7.5-minute USGS topographic map and 2-foot contours derived from a digital elevation model (DEM) from USGS were reviewed for the study area. According to the USGS topographic map (see **Figure 2**), the study area is undeveloped land with a pond located on the northern boundary of the study area. The 2-foot contour data depicts the study area sloping northeast towards the mapped wetland and southeast offsite. The study area ranges from 944 feet (above mean sea level) to 918 feet, see **Figure 3**.

5.2 National Wetlands Inventory

NWI mapping, available from the U.S. Fish and Wildlife Service (USFWS) Wetland Mapper (updated in 2020), depicts potential wetland areas and waterbodies based on stereoscopic analysis of high altitude and aerial photographs and was reviewed for the study area. According to the NWI map, there are three wetlands in the study area, including one freshwater pond and two freshwater emergent wetlands along the northern boundary of the study area, **see Figure 3**.

5.3 National Hydrography Dataset

The NHD, available from USGS, depicts drainage networks and related features, including rivers, streams, canals, lakes, and ponds. The NHD dataset is not field verified. According to NHD mapping, there is one NHD waterbody on the northern border of the study area, **see Figure 3**. No NHD-mapped linear features are located in the study area or vicinity of the study area.

5.4 IDNR Public Waters

The IDNR Public Waters viewer depicts IDNR Public Waters. According to the Public Waters viewer, there are no Public Waters within the study area or the vicinity of the study area.

5.5 Soil Survey

The Natural Resources Conservation Service's (NRCS) *Web Soil Survey* for McHenry County was reviewed for the study area. According to the survey, there are 10 soil map units within the study area which are generally silt loams and clay loams. The majority of the study area was mapped with soils with a non-hydric soil rating of 0% or a predominantly non-hydric soil rating between 4% and 15%. A minor portion of

the study area is mapped with a predominantly hydric rating of 90%. Maps and information obtained from NRCS online web soil survey are included in **Figure 4** and **Appendix A**.

5.6 Federal Emergency Management Agency Floodplain

The FEMA FIRM was reviewed for the study area. According to FEMA, the study area is located in Zone X of panels 17111C0200J and 17111C0215J (effective November 16, 2006), which is outside the designated 100-year floodplain zones, see **Figure 5**.

5.7 Aerial Photography Review

Aerial photography, acquired from Google Earth, was reviewed to identify the potential for wetlands across the study area. Fourteen photos were reviewed between 1999 and 2021, available in **Appendix B**. These photos were used to determine the presence of wetland hydrology using industry accepted offsite hydrology analysis for areas showing crop stress or other potential wetland signatures. Each image was interpreted for the presence or lack of hydrologic indicators.

Two Areas of Investigation (AOIs) were identified in the study area. AOIs 1 and 2 had wetland signatures in less than 30% of the historic aerials with normal precipitation conditions, lacked hydric soils and hydrology indicators in the field; thus, these areas were not delineated as wetland. The AOIs are shown in **Appendix B**.

5.8 Precipitation

Precipitation data for the study area were obtained from the U.S. Department of Agriculture (USDA) Agricultural Applied Climate Information System (AgACIS). NRCS WETS (Wetlands) tables were reviewed for a climate station within the vicinity of the study area to determine the current hydrologic conditions for the site and if those conditions are typical for this time of year. Antecedent precipitation was determined by comparing the precipitation levels during the three months preceding the site visit to the 30-year historical average. The data shows the October and September had normal precipitation conditions and August had drier than normal precipitation conditions. In conclusion, the field visit constituted normal precipitation conditions. This information is included in **Appendix C**.

6 Field Investigation

A routine level 2 (onsite) wetland delineation, as outlined in the *1987 Corps of Engineers Wetlands Delineation Manual* (January 1987) along with the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (Version 2.0) (August 2010)* occurred on October 26, 2023.

During the onsite delineation, vegetation, soils, and current hydrologic characteristics were evaluated at each wetland area and area of investigation identified within the study area. Wetland boundaries were digitally recorded with a Geode GPS with sub-meter accuracy until one or more of the three criteria were no longer present. The sample point locations, wetland boundaries, and aquatic resources are shown in **Figure 6**.

In addition to wetlands that were investigated and delineated, non-wetland aquatic features were sought but none were delineated. Non-wetland aquatic features are defined based on the observation of the following characteristics:

- Flow
    - Perennial: contains water at all times of the year except during extreme drought
    - Intermittent: contains water occasionally or seasonally
    - Ephemeral: contains water only during and immediately after periods of rainfall or snowmelt

- Ordinary High Water Mark (OHWM): The limit line on the shore established by the fluctuation of the water surface. It is shown by such things as a clear line impressed on the bank, shelving, changes in soil character, destruction of terrestrial vegetation, the presence of litter and debris, or other features influenced by the surrounding area
- Bank Shape
    - Undercut: banks that overhang the stream channel
    - Steep: bank slope of approximately greater than 30 degrees
    - Gradual: bank slope of approximately 30 degrees or less

Sample points were completed for all observed wetlands. Historic aerials were reviewed for sample points taken in agricultural fields (See **Appendix B**). The field data sheets are included in **Appendix D**. Study area photos can be found in **Appendix E**. Photo locations map is included in **Figure 6**.

7 Summary of Results

Table 1: Wetland Delineation Summary

Resource ID	Wetland Plant Community	Cowardin Classification[1]	Size (acres)[2]	NWI?	Hydric Soils?[3]	Photo ID	Associated Sample Points	NOTES	Regulatory Status[4]
Wetlands									
Wetland 1	Seasonally Flooded Basin / Open Water Pond	PEM1A / PUBGx	5.8	PEM1C/ PEM1F/ PUBGx	Yes	1,2,3,4	SP-1 (Wet) SP-2 (Up)	Wetland located in depression along the northern boundary of the study area. The wetland collects runoff from the surrounding landscape. The wetland boundary was based on the change in topography, presence of hydric soil, and hydrophytic vegetation dominance. The resource appears to drain northeast off-site towards Lily Lake. No culvert was visible, but the off-site connection was assumed.	USACE Jurisdictional: wetland has a continuous surficial connection to a Traditionally Navigable Water (TNW).

[1] The Cowardin Classification System codes are found here: https://www.fws.gov/wetlands/documents/Wetlands-and-Deepwater-Habitats-Classification-chart.pdf
[2] Size of wetland features and additional areas investigated provided in acres within the study area.
[3] Areas identified as hydric contain partially hydric soils (equal to or greater than 33% of soil component) mapped within the resource area.
[4] Regulatory Status is based on best professional judgment and has not been verified with agency staff.

8 Report Preparation

The procedures followed for this wetland delineation are in accordance with the *Corps of Engineers Wetlands Delineation Manual* and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (Version 2.0) (August 2010).

This report describes study area conditions for a specific date in time and is generally valid for a period of five years from the date of the final field investigation and delineation, which was October 26, 2023.

9 Conclusion

The field delineation identified one wetland within the study area which is described in Table 1. The wetland is anticipated to be USACE-jurisdictional.

10 Disclaimer

Kimley-Horn has prepared this document based on limited field observations and our interpretation, as scientists, of applicable regulations and agency guidance. While Kimley-Horn believes our interpretation to be accurate, final authority to interpret the regulations lies with the appropriate regulatory agencies. Regulatory agencies occasionally issue guidance that changes the interpretation of published regulations. Guidance issued after the date of this report has the potential to invalidate our conclusions and/or recommendations and may cause a need to reevaluate our conclusions and/or recommendations.

Because Kimley-Horn has no regulatory authority, the Client understands that proceeding based solely upon this document does not protect the Client from potential sanction or fines from the applicable regulatory agencies. The Client acknowledges that they have the opportunity to submit documentation to the regulatory agencies for concurrence prior to proceeding with any work. If the Client elects not to do so, then the Client proceeds at their sole risk.

Kimley»Horn

December 21, 2023

Prepared For: TPE Development, LLC

Prepared By: Tad Hardy, P.E.
Kimley-Horn

Subject: ***Illinois Community Solar - Noise Assessment***

Executive Summary

The purpose of this technical memorandum is to evaluate potential noise levels associated with the operational equipment for a 5MW Community Solar site in Illinois (a "Project"). A Project will consist of solar panels mounted on a racking system spanning 20-40 acres and up to forty (40) string inverters on a single equipment pad within the project area.

Noise Regulations

The Illinois Pollution Control Board (IPCB) noise regulations are based on allowable octave band sound pressure levels during daytime and nighttime hours. According to Title 35 (Environmental Protection), Subtitle H (Noise), Chapter I (Pollution Control Board), Part 901 (Sound Emission Standards and Limitations for Property Line-Noise Sources), a facility operating in an agricultural field (Class C Land) cannot cause an exceedance of sound levels at any point within a residential land use (Class A Land) during daytime hours as shown in **Table 1**.

Table 1: Maximum Allowable Sound Emitted to Class A Land During Daytime Hours

Octave Band Center Frequency (Hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class A Land from		
	Class C Land	Class B Land	Class A Land
31.5	**75**	72	72
63	**74**	71	71
125	**69**	65	65
250	**64**	57	57
500	**58**	51	51
1000	**52**	45	45
2000	**47**	39	39
4000	**43**	34	34
8000	**40**	32	32

Since the solar array does not generate power at night, the equipment will not operate at night and will comply with the IPCB nighttime hour limits.

Noise Assessment

Noise levels from anticipated operational equipment likely to be installed at a proposed Project were evaluated to assist with determining a conservative distance that the equipment should be located from the edge of the project boundary.

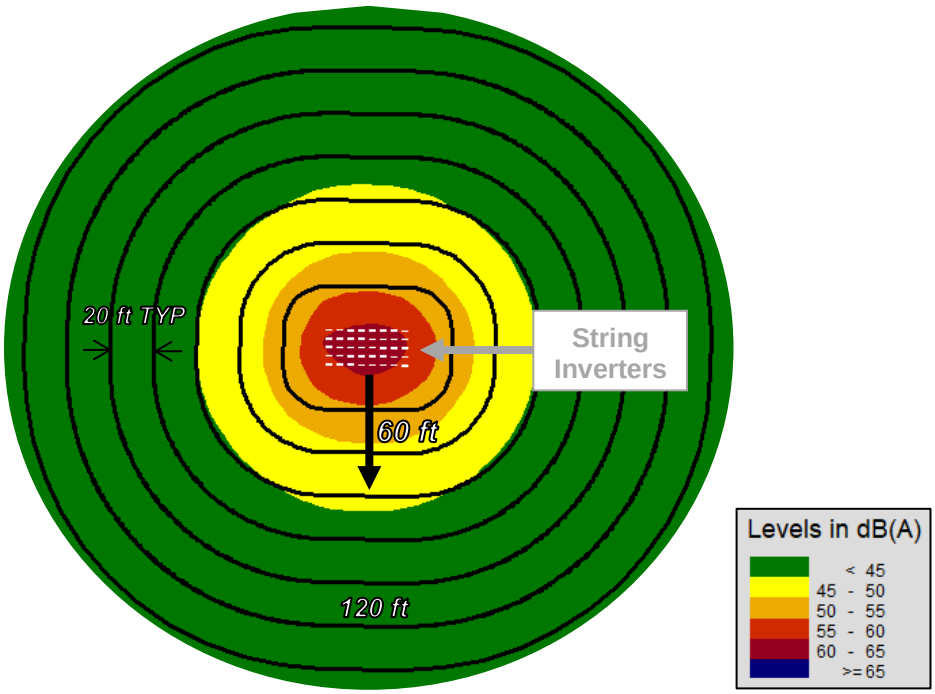
String Inverters

String inverters generate steady, unvarying noise that can create issues when located near noise-sensitive uses. It was assumed that up to forty (40) string inverters would be located on an equipment pad within a proposed solar site. Based on noise emission levels for string inverter equipment, a reference sound level of 65 dB(A) at 1 meter (i.e., 3 feet) for each inverter was used, which is typical for these types of inverters. **Table 2** shows the octave band emission levels for a typical string inverter used for reference. The sound from the simultaneous operation of the string inverters was calculated using SoundPLAN. The anticipated noise level contours from the operation of inverter equipment are shown in **Figure 1**.

Table 2: Sound Emissions for String Inverter

Octave Band Center Frequency	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2kHz	4 kHz	8kHz
Frequency Sound Level	58	57	59	59	66	57	56	56	51

Figure 1: Anticipated Noise Level Contours for String Inverter Operations



Recommendations and Conclusions

Based on the analysis of this memo, if the equipment pad is located greater than 40 feet from the project boundary, operational noise levels are anticipated to be in compliance with the IPCB noise regulations. See **Table 3** below for the SoundPLAN-predicted octave band noise levels at a distance of approximately 40 feet from the string inverter equipment pad.

Table 3: Predicted Octave Band Sound Emissions for String Inverter Operations

Octave Band Center Frequency	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2kHz	4 kHz	8kHz
Maximum Octave Band SPLs from Inverters	46.8	45.8	44.6	42.5	49.2	42.0	41.7	41.5	35.8

STANDARD AGRICULTURAL IMPACT MITIGATION AGREEMENT
between
TPE IL MH405, LLC

and the
ILLINOIS DEPARTMENT OF AGRICULTURE
Pertaining to the Construction of a Commercial Solar Energy Facility
in
McHenry County, Illinois

Pursuant to the Renewable Energy Facilities Agricultural Impact Mitigation Act (505 ILCS 147), the following standards and policies are required by the Illinois Department of Agriculture (IDOA) to help preserve the integrity of any Agricultural Land that is impacted by the Construction and Deconstruction of a Commercial Solar Energy Facility. They were developed with the cooperation of agricultural agencies, organizations, Landowners, Tenants, drainage contractors, and solar energy companies to comprise this Agricultural Impact Mitigation Agreement (AIMA).

TPE IL MH405, LLC, hereafter referred to as Commercial Solar Energy Facility Owner, or simply as Facility Owner, plans to develop and/or operate a 4.99MWac Commercial Solar Energy Facility in McHenry County [GPS Coordinates: 42.270694°, -88.374333°], which will consist of up to 46 acres that will be covered by solar facility related components, such as solar panel arrays, racking systems, access roads, an onsite underground collection system, inverters and transformers and any affiliated electric transmission lines. This AIMA is made and entered between the Facility Owner and the IDOA.

If Construction does not commence within four years after this AIMA has been fully executed, this AIMA shall be revised, with the Facility Owner's input, to reflect the IDOA's most current Solar Farm Construction and Deconstruction Standards and Policies. This AIMA, and any updated AIMA, shall be filed with the County Board by the Facility Owner prior to the commencement of Construction.

The below prescribed standards and policies are applicable to Construction and Deconstruction activities occurring partially or wholly on privately owned agricultural land.

Conditions of the AIMA

The mitigative actions specified in this AIMA shall be subject to the following conditions:

A. All Construction or Deconstruction activities may be subject to County or other local requirements. However, the specifications outlined in this AIMA shall be the minimum standards applied to all Construction or Deconstruction activities. IDOA may utilize any legal means to enforce this AIMA.

B. Except for Section 17. B. through F., all actions set forth in this AIMA are subject to modification through negotiation by Landowners and the Facility Owner, provided such changes are negotiated in advance of the respective Construction or Deconstruction activities.

C. The Facility Owner may negotiate with Landowners to carry out the actions that Landowners wish to perform themselves. In such instances, the Facility Owner shall offer Landowners the area commercial rate for their machinery and labor costs.

D. All provisions of this AIMA shall apply to associated future Construction, maintenance, repairs, and Deconstruction of the Facility referenced by this AIMA.

E. The Facility Owner shall keep the Landowners and Tenants informed of the Facility's Construction and Deconstruction status, and other factors that may have an impact upon their farming operations.

F. The Facility Owner shall include a statement of its adherence to this AIMA in any environmental assessment and/or environmental impact statement.

G. Execution of this AIMA shall be made a condition of any Conditional/Special Use Permit. Not less than 30 days prior to the commencement of Construction, a copy of this AIMA shall be provided by the Facility Owner to each Landowner that is party to an Underlying Agreement. In addition, this AIMA shall be incorporated into each Underlying Agreement.

H. The Facility Owner shall implement all actions to the extent that they do not conflict with the requirements of any applicable federal, state and local rules and regulations and other permits and approvals that are obtained by the Facility Owner for the Facility.

I. No later than 45 days prior to the Construction and/or Deconstruction of a Facility, the Facility Owner shall provide the Landowner(s) with a telephone number the Landowner can call to alert the Facility Owner should the Landowner(s) have questions or concerns with the work which is being done or has been carried out on his/her property.

J. If there is a change in ownership of the Facility, the Facility Owner assuming ownership of the Facility shall provide written notice within 90 days of ownership transfer, to the Department, the County, and to Landowners of such change. The Financial Assurance requirements and the other terms of this AIMA shall apply to the new Facility Owner.

K. The Facility Owner shall comply with all local, state and federal laws and regulations, specifically including the worker protection standards to protect workers from pesticide exposure.

L. Within 30 days of execution of this AIMA, the Facility Owner shall use Best Efforts to provide the IDOA with a list of all Landowners that are party to an Underlying Agreement and known Tenants of said Landowner who may be affected by the Facility. As the list of Landowners and Tenants is updated, the Facility Owner shall notify the IDOA of any additions or deletions.

M. If any provision of this AIMA is held to be unenforceable, no other provision shall be affected by that holding, and the remainder of the AIMA shall be interpreted as if it did not contain the unenforceable provision.

Definitions

Abandonment	When Deconstruction has not been completed within 12 months after the Commercial Solar Energy Facility reaches the end of its useful life. For purposes of this definition, a Commercial Solar Energy Facility shall be presumed to have reached the end of its useful life if the Commercial Solar Energy Facility Owner fails, for a period of 6 consecutive months, to pay the Landowner amounts owed in accordance with an Underlying Agreement.

Aboveground Cable	Electrical power lines installed above ground surface to be utilized for conveyance of power from the solar panels to the solar facility inverter and/or point of interconnection to utility grid or customer electric meter.
Agricultural Impact Mitigation Agreement (AIMA)	The Agreement between the Facility Owner and the Illinois Department of Agriculture (IDOA) described herein.
Agricultural Land	Land used for Cropland, hayland, pastureland, managed woodlands, truck gardens, farmsteads, commercial ag-related facilities, feedlots, livestock confinement systems, land on which farm buildings are located, and land in government conservation programs used for purposes as set forth above.
Best Efforts	Diligent, good faith, and commercially reasonable efforts to achieve a given objective or obligation.
Commercial Operation Date	The calendar date of which the Facility Owner notifies the Landowner, County, and IDOA in writing that commercial operation of the facility has commenced. If the Facility Owner fails to provide such notifications, the Commercial Operation Date shall be the execution date of this AIMA plus 6 months.
Commercial Solar Energy Facility (Facility)	A solar energy conversion facility equal to or greater than 500 kilowatts in total nameplate capacity, including a solar energy conversion facility seeking an extension of a permit to construct granted by a county or municipality before June 29, 2018. "Commercial solar energy facility" does not include a solar energy conversion facility: (1) for which a permit to construct has been issued before June 29, 2018; (2) that is located on land owned by the commercial solar energy facility owner; (3) that was constructed before June 29, 2018; or (4) that is located on the customer side of the customer's electric meter and is primarily used to offset that customer's electricity load and is limited in nameplate capacity to less than or equal to 2,000 kilowatts.
Commercial Solar Energy Facility Owner deemed (Facility Owner)	A person or entity that owns a commercial solar energy facility. A Commercial Solar Energy Facility Owner is not nor shall it be to be a public utility as defined in the Public Utilities Act.
County	The County or Counties where the Commercial Solar Energy Facility is located.
Construction	The installation, preparation for installation and/or repair of a Facility.
Cropland	Land used for growing row crops, small grains or hay; includes land which was formerly used as cropland, but is currently enrolled in a government conservation program; also includes pastureland that is classified as Prime Farmland.

Deconstruction	The removal of a Facility from the property of a Landowner and the restoration of that property as provided in the AIMA.
Deconstruction Plan	A plan prepared by a Professional Engineer, at the Facility's expense, that includes: (1) the estimated Deconstruction cost, in current dollars at the time of filing, for the Facility, considering among other things: i. the number of solar panels, racking, and related facilities involved; ii. the original Construction costs of the Facility; iii. the size and capacity, in megawatts of the Facility; iv. the salvage value of the facilities (if all interests in salvage value are subordinate to that of the Financial Assurance holder if abandonment occurs); v. the Construction method and techniques for the Facility and for other similar facilities; and (2) a comprehensive detailed description of how the Facility Owner plans to pay for the Deconstruction of the Facility.
Department	The Illinois Department of Agriculture (IDOA).
Financial Assurance	A reclamation or surety bond or other commercially available financial assurance that is acceptable to the County, with the County or Landowner as beneficiary.
Landowner	Any person with an ownership interest in property that is used for agricultural purposes and that is party to an Underlying Agreement.
Prime Farmland	Agricultural Land comprised of soils that are defined by the USDA Natural Resources Conservation Service (NRCS) as "Prime Farmland" (generally considered to be the most productive soils with the least input of nutrients and management).
Professional Engineer	An engineer licensed to practice engineering in the State of Illinois.
Soil and Water Conservation District (SWCD)	A unit of local government that provides technical and financial assistance to eligible Landowners for the conservation of soil and water resources.
Tenant	Any person, apart from the Facility Owner, lawfully residing or leasing/renting land that is subject to an Underlying Agreement.
Topsoil	The uppermost layer of the soil that has the darkest color or the highest content of organic matter; more specifically, it is defined as the "A" horizon.
Underlying Agreement	The written agreement between the Facility Owner and the Landowner(s) including, but not limited to, an easement, option, lease, or license under the terms of which another person has constructed, constructs, or intends to construct a Facility on the property of the Landowner.

Underground Cable	Electrical power lines installed below the ground surface to be utilized for conveyance of power within a Facility or from a Commercial Solar Energy Facility to the electric grid.
USDA Natural Resources Conservation Service (NRCS)	An agency of the United States Department of Agriculture that provides America's farmers with financial and technical assistance to aid with natural resources conservation.

Construction and Deconstruction Standards and Policies

1. Support Structures

A. Only single pole support structures shall be used for the Construction and operation of the Facility on Agricultural Land. Other types of support structures, such as lattice towers or H-frames, may be used on nonagricultural land.

B. Where a Facility's Aboveground Cable will be adjacent and parallel to highway and/or railroad right-of-way, but on privately owned property, the support structures shall be placed as close as reasonably practicable and allowable by the applicable County Engineer or other applicable authorities to the highway or railroad right-of-way. The only exceptions may be at jogs or weaves on the highway alignment or along highways or railroads where transmission and distribution lines are already present.

C. When it is not possible to locate Aboveground Cable next to highway or railroad right-of-way, Best Efforts shall be expended to place all support poles in such a manner to minimize their placement on Cropland (i.e., longer than normal above ground spans shall be utilized when traversing Cropland).

2. Aboveground Facilities

Locations for facilities shall be selected in a manner that is as unobtrusive as reasonably possible to ongoing agricultural activities occurring on the land that contains or is adjacent to the Facility.

3. Guy Wires and Anchors

Best Efforts shall be made to place guy wires and their anchors, if used, out of Cropland, pastureland and hayland, placing them instead along existing utilization lines and on land other than Cropland. Where this is not feasible, Best Efforts shall be made to minimize guy wire impact on Cropland. All guy wires shall be shielded with highly visible guards.

4. Underground Cabling Depth

A. Underground electrical cables located outside the perimeter of the (fence) of the solar panels shall be buried with:

1. a minimum of 5 feet of top cover where they cross Cropland.
2. a minimum of 5 feet of top cover where they cross pastureland or other non-Cropland classified as Prime Farmland.
3. a minimum of 3 feet of top cover where they cross pastureland and other Agricultural Land not classified as Prime Farmland.

4. a minimum of 3 feet of top cover where they cross wooded/brushy land.

B. Provided that the Facility Owner removes the cables during Deconstruction, underground electric cables may be installed to a minimum depth of 18 inches:

1. Within the fenced perimeter of the Facility; or

2. When buried under an access road associated with the Facility provided that the location and depth of cabling is clearly marked at the surface.

C. If Underground Cables within the fenced perimeter of the solar panels are installed to a minimum depth of 5 feet, they may remain in place after Deconstruction.

5. Topsoil Removal and Replacement

A. Any excavation shall be performed in a manner to preserve topsoil. Best Efforts shall be made to store the topsoil near the excavation site in such a manner that it will not become intermixed with subsoil materials.

B. Best Efforts shall be made to store all disturbed subsoil material near the excavation site and separate from the topsoil.

C. When backfilling an excavation site, Best Efforts shall be used to ensure the stockpiled subsoil material will be placed back into the excavation site before replacing the topsoil.

D. Refer to Section 7 for procedures pertaining to rock removal from the subsoil and topsoil.

E. Refer to Section 8 for procedures pertaining to the repair of compaction and rutting of the topsoil.

F. Best Efforts shall be performed to place the topsoil in a manner so that after settling occurs, the topsoil's original depth and contour will be restored as close as reasonably practicable. The same shall apply where excavations are made for road, stream, drainage ditch, or other crossings. In no instance shall the topsoil materials be used for any other purpose unless agreed to explicitly and in writing by the Landowner.

G. Based on the mutual agreement of the landowner and Facility Owner, excess soil material resulting from solar facility excavation shall either be removed or stored on the Landowner’s property and reseeded per the applicable National Pollution Discharge Elimination System (NPDES) permit/Stormwater Pollution Prevention Plan (SWPPP). After the Facility reaches the end of its Useful Life, the excess subsoil material shall be returned to an excavation site or removed from the Landowner’s property, unless otherwise agreed to by Landowner.

6. Rerouting and Permanent Repair of Agricultural Drainage Tiles

The following standards and policies shall apply to underground drainage tile line(s) directly or indirectly affected by Construction and/or Deconstruction:

A. Prior to Construction, the Facility Owner shall work with the Landowner to identify drainage tile lines traversing the property subject to the Underlying Agreement to the extent reasonably practicable. All drainage tile lines identified in this manner shall be shown on the Construction and Deconstruction Plans.

B. The location of all drainage tile lines located adjacent to or within the footprint of the Facility shall be recorded using Global Positioning Systems (GPS) technology. Within 60 days after Construction is complete, the Facility Owner shall provide the Landowner, the IDOA, and the respective County Soil and Water Conservation District (SWCD) with "as built" drawings (strip maps) showing the location of all drainage tile lines by survey station encountered in the Construction of the Facility, including any tile line repair location(s), and any underground cable installed as part of the Facility.

C. **Maintaining Surrounding Area Subsurface Drainage**

If drainage tile lines are damaged by the Facility, the Facility Owner shall repair the lines or install new drainage tile line(s) of comparable quality and cost to the original(s), and of sufficient size and appropriate slope in locations that limit direct impact from the Facility. If the damaged tile lines cause an unreasonable disruption to the drainage system, as determined by the Landowner, then such repairs shall be made promptly to ensure appropriate drainage. Any new line(s) may be located outside of, but adjacent to the perimeter of the Facility. Disrupted adjacent drainage tile lines shall be attached thereto to provide an adequate outlet for the disrupted adjacent tile lines.

D. **Re-establishing Subsurface Drainage Within Facility Footprint**

Following Deconstruction and using Best Efforts, if underground drainage tile lines were present within the footprint of the facility and were severed or otherwise damaged during original Construction, facility operation, and/or facility Deconstruction, the Facility Owner shall repair existing drainage tiles or install new drainage tile lines of comparable quality and cost to the original, within the footprint of the Facility with sufficient capacity to restore the underground drainage capacity that existed within the footprint of the Facility prior to Construction. Such installation shall be completed within 12 months after the end of the useful life of the Facility and shall be compliant with Figures 1 and 2 to this Agreement or based on prudent industry standards if agreed to by Landowner.

E. If there is any dispute between the Landowner and the Facility Owner on the method of permanent drainage tile line repair, the appropriate County SWCD's opinion shall be considered by the Facility Owner and the Landowner.

F. During Deconstruction, all additional permanent drainage tile line repairs beyond those included above in Section 6.D. must be made within 30 days of identification or notification of the damage, weather and soil conditions permitting. At other times, such repairs must be made at a time mutually agreed upon by the Facility Owner and the Landowner. If the Facility Owner and Landowner cannot agree upon a reasonable method to complete this restoration, the Facility Owner may implement the recommendations of the appropriate County SWCD and such implementation constitutes compliance with this provision.

G. Following completion of the work required pursuant to this Section, the Facility Owner shall be responsible for correcting all drainage tile line repairs that fail due to Construction and/or Deconstruction for one year following the completion of Construction or Deconstruction, provided those repairs were made by the Facility Owner. The Facility Owner shall not be responsible for drainage tile repairs that the Facility Owner pays the Landowner to perform.

7. Rock Removal

With any excavations, the following rock removal procedures pertain only to rocks found in the uppermost 42 inches of soil, the common freeze zone in Illinois, which emerged or were brought to the site as a result of Construction and/or Deconstruction.

A. Before replacing any topsoil, Best Efforts shall be taken to remove all rocks greater than 3 inches in any dimension from the surface of exposed subsoil which emerged or were brought to the site as a result of Construction and/or Deconstruction.

B. If trenching, blasting, or boring operations are required through rocky terrain, precautions shall be taken to minimize the potential for oversized rocks to become interspersed in adjacent soil material.

C. Rocks and soil containing rocks removed from the subsoil areas, topsoil, or from any excavations, shall be removed from the Landowner's premises or disposed of on the Landowner's premises at a location that is mutually acceptable to the Landowner and the Facility Owner.

8. Repair of Compaction and Rutting

A. Unless the Landowner opts to do the restoration work on compaction and rutting, after the topsoil has been replaced post-Deconstruction, all areas within the boundaries of the Facility that were traversed by vehicles and Construction and/or Deconstruction equipment that exhibit compaction and rutting shall be restored by the Facility Owner. All prior Cropland shall be ripped at least 18 inches deep or to the extent practicable, and all pasture and woodland shall be ripped at least 12 inches deep or to the extent practicable. The existence of drainage tile lines or underground utilities may necessitate less ripping depth. The disturbed area shall then be disked.

B. All ripping and disking shall be done at a time when the soil is dry enough for normal tillage operations to occur on Cropland adjacent to the Facility.

C. The Facility Owner shall restore all rutted land to a condition as close as possible to its original condition upon Deconstruction, unless necessary earlier as determined by the Landowner.

D. If there is any dispute between the Landowner and the Facility Owner as to what areas need to be ripped/disked or the depth at which compacted areas should be ripped/disked, the appropriate County SWCD’s opinion shall be considered by the Facility Owner and the Landowner.

9. Construction During Wet Weather

Except as provided below, construction activities are not allowed on agricultural land during times when normal farming operations, such as plowing, disking, planting or harvesting, cannot take place due to excessively wet soils. With input from the landowner, wet weather conditions may be determined on a field by field basis.

A. Construction activities on prepared surfaces, surfaces where topsoil and subsoil have been removed, heavily compacted in preparation, or otherwise stabilized (e.g. through cement mixing) may occur at the discretion of the Facility Owner in wet weather conditions.

B. Construction activities on unprepared surfaces will be done only when work will not result in rutting which may mix subsoil and topsoil. Determination as to the potential of subsoil and topsoil mixing will be made in consultation with the underlying Landowner, or, if approved by the Landowner, his/her designated tenant or designee.

10. Prevention of Soil Erosion

A. The Facility Owner shall work with Landowners and create and follow a SWPPP to prevent excessive erosion on land that has been disturbed by Construction or Deconstruction of a Facility.

B. If the Landowner and Facility Owner cannot agree upon a reasonable method to control erosion on the Landowner's property, the Facility Owner shall consider the recommendations of the appropriate County SWCD to resolve the disagreement.

C. The Facility Owner may, per the requirements of the project SWPPP and in consultation with the Landowner, seed appropriate vegetation around all panels and other facility components to prevent erosion. The Facility Owner must utilize Best Efforts to ensure that all seed mixes will be as free of any noxious weed seeds as possible. The Facility Owner shall consult with the Landowner regarding appropriate varieties to seed.

11. Repair of Damaged Soil Conservation Practices

Consultation with the appropriate County SWCD by the Facility Owner shall be carried out to determine if there are soil conservation practices (such as terraces, grassed waterways, etc.) that will be damaged by the Construction and/or Deconstruction of the Facility. Those conservation practices shall be restored to their preconstruction condition as close as reasonably practicable following Deconstruction in accordance with USDA NRCS technical standards. All repair costs shall be the responsibility of the Facility Owner.

12. Compensation for Damages to Private Property

The Facility Owner shall reasonably compensate Landowners for damages caused by the Facility Owner. Damage to Agricultural Land shall be reimbursed to the Landowner as prescribed in the applicable Underlying Agreement.

13. Clearing of Trees and Brush

A. If trees are to be removed for the Construction or Deconstruction of a Facility, the Facility Owner shall consult with the Landowner to determine if there are trees of commercial or other value to the Landowner.

B. If there are trees of commercial or other value to the Landowner, the Facility Owner shall allow the Landowner the right to retain ownership of the trees to be removed and the disposition of the removed trees shall be negotiated prior to the commencement of land clearing.

14. Access Roads

A. To the extent practicable, access roads shall be designed to not impede surface drainage and shall be built to minimize soil erosion on or near the access roads.

B. Access roads may be left intact during Construction, operation or Deconstruction through mutual agreement of the Landowner and the Facility Owner unless otherwise restricted by federal, state, or local regulations.

C. If the access roads are removed, Best Efforts shall be expended to assure that the land shall be restored to equivalent condition(s) as existed prior to their construction, or as otherwise agreed to by the Facility Owner and the Landowner. All access roads that are removed shall be ripped to a depth of 18 inches. All ripping shall be performed consistent with Section 8.

15. Weed/Vegetation Control

A. The Facility Owner shall provide for weed control in a manner that prevents the spread of weeds. Chemical control, if used, shall be done by an appropriately licensed pesticide applicator.

B. The Facility Owner shall be responsible for the reimbursement of all reasonable costs incurred by owners of agricultural land where it has been determined by the appropriate state or county entity that weeds have spread from the Facility to their property. Reimbursement is contingent upon written notice to the Facility Owner. Facility Owner shall reimburse the property owner within 45 days after notice is received.

C. The Facility Owner shall ensure that all vegetation growing within the perimeter of the Facility is properly and appropriately maintained. Maintenance may include, but not be limited to, mowing, trimming, chemical control, or the use of livestock as agreed to by the Landowner.

D. The Deconstruction plans must include provisions for the removal of all weed control equipment used in the Facility, including weed-control fabrics or other ground covers.

16. Indemnification of Landowners

The Facility Owner shall indemnify all Landowners, their heirs, successors, legal representatives, and assigns from and against all claims, injuries, suits, damages, costs, losses, and reasonable expenses resulting from or arising out of the Commercial Solar Energy Facility, including Construction and Deconstruction thereof, and also including damage to such Facility or any of its appurtenances, except where claims, injuries, suits, damages, costs, losses, and expenses are caused by the negligence or intentional acts, or willful omissions of such Landowners, and/or the Landowners heirs, successors, legal representatives, and assigns.

17. Deconstruction Plans and Financial Assurance of Commercial Solar Energy Facilities

A. Deconstruction of a Facility shall include the removal/disposition of all solar related equipment/facilities, including the following utilized for operation of the Facility and located on Landowner property:

1. Solar panels, cells and modules;
2. Solar panel mounts and racking, including any helical piles, ground screws, ballasts, or other anchoring systems;
3. Solar panel foundations, if used (to depth of 5 feet);

4. Transformers, inverters, energy storage facilities, or substations, including all components and foundations; however, Underground Cables at a depth of 5 feet or greater may be left in place;
5. Overhead collection system components;
6. Operations/maintenance buildings, spare parts buildings and substation/switching gear buildings unless otherwise agreed to by the Landowner;
7. Access Road(s) unless Landowner requests in writing that the access road is to remain;
8. Operation/maintenance yard/staging area unless otherwise agreed to by the Landowner; and
9. Debris and litter generated by Deconstruction and Deconstruction crews.

B. The Facility Owner shall, at its expense, complete Deconstruction of a Facility within twelve (12) months after the end of the useful life of the Facility.

C. During the County permit process, or if none, then prior to the commencement of construction, the Facility Owner shall file with the County a Deconstruction Plan. The Facility Owner shall file an updated Deconstruction Plan with the County on or before the end of the tenth year of commercial operation.

D. The Facility Owner shall provide the County with Financial Assurance to cover the estimated costs of Deconstruction of the Facility. Provision of this Financial Assurance shall be phased in over the first 11 years of the Project's operation as follows:

1. On or before the first anniversary of the Commercial Operation Date, the Facility Owner shall provide the County with Financial Assurance to cover ten (10) percent of the estimated costs of Deconstruction of the Facility as determined in the Deconstruction Plan.
2. On or before the sixth anniversary of the Commercial Operation Date, the Facility Owner shall provide the County with Financial Assurance to cover fifty (50) percent of the estimated costs of Deconstruction of the Facility as determined in the Deconstruction Plan.
3. On or before the eleventh anniversary of the Commercial Operation Date, the Facility Owner shall provide the County with Financial Assurance to cover one hundred (100) percent of the estimated costs of Deconstruction of the Facility as determined in the updated Deconstruction Plan provided during the tenth year of commercial operation.

The Financial Assurance shall not release the surety from liability until the Financial Assurance is replaced. The salvage value of the Facility may only be used to reduce the estimated costs of Deconstruction if the County agrees that all interests in the salvage value are subordinate or have been subordinated to that of the County if Abandonment occurs.

E. The County may, but is not required to, reevaluate the estimated costs of Deconstruction of any Facility after the tenth anniversary, and every five years thereafter, of the Commercial Operation Date. Based on any reevaluation, the County may require changes in the level of Financial Assurance used to calculate the phased Financial Assurance levels described in Section 17.D. required from the Facility Owner. If the County is unable to its satisfaction to perform the investigations necessary to approve the Deconstruction Plan filed by the Facility Owner, then the County and Facility may mutually agree on the selection of a Professional Engineer independent of the Facility Owner to conduct any necessary investigations. The Facility Owner shall be responsible for the cost of any such investigations.

F. Upon Abandonment, the County may take all appropriate actions for Deconstruction including drawing upon the Financial Assurance.

Concurrence of the Parties to this AIMA

The Illinois Department of Agriculture and TPE IL MH405, LLC concur that this AIMA is the complete AIMA governing the mitigation of agricultural impacts that may result from the Construction and Deconstruction of the solar farm project in McHenry County within the State of Illinois.

The effective date of this AIMA commences on the date of execution.

STATE OF ILLINOIS
DEPARTMENT OF AGRICULTURE

By: Jerry Costello II, Director

By Tess Feagans, General Counsel

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December 13, 2023

Health and Safety Impacts of Solar Photovoltaics:

A California-Focused Forward to the Health and Safety Impacts of Solar Photovoltaics white paper published by the N.C. Clean Energy Technology Center at North Carolina State University in May 2017

By: Thomas H. Cleveland, P.E., lead author of the North Carolina white paper
RE: Soscol Ferry Road Solar, a proposed 1.98 MW_{AC} PV facility in Napa, CA
Date: July 31, 2019

For the last several years North Carolina (NC) has trailed only California in the capacity of annual solar photovoltaic (PV) installed. For most of that time North Carolina's PV development was nearly entirely distribution-connected ground-mounted solar facilities, most commonly 5 MW_{AC} projects. More recently, North Carolina is developing a mixture of transmission-connected PV facilities between 20 and 75 MW_{AC} and distribution-connected facilities of 1 to 5 MW_{AC}, but still has relatively few commercial or residential PV projects. As the state quickly transitioned from zero utility-scale solar facilities to over 400 utility-scale solar facilities concerns about the health and safety impacts of photovoltaics were raised at countless public hearings across the state and in many meetings of state officials and regulators, including several NC general assembly committee meetings. These concerns led to several years of engagement on this topic by the NC Clean Energy Technology Center at North Carolina State University that resulted in a detailed, peer-reviewed university white paper on the latest scientific understanding regarding PV health and safety impacts, with a focus on North Carolina.

Naturally, there is also interest in the potential health and safety impacts of PV in California, where there is significantly more installed solar capacity than in North Carolina, in a mixture of residential, commercial, and small- and large-scale ground-mounted utility-scale solar projects. While there are massive similarities between the PV installations and their potential health and safety impacts in each state, there are some differences in policy, climate, industry practices, electricity regulation, and more that are worth highlighting. This forward is an attempt by the lead researcher and author of the North Carolina white paper to provide a supplement to the original paper that clearly demonstrates the applicability of the paper to PV in California and to offer California-specific supplements or modifications where the original paper had a North Carolina focus.

Most importantly, all the white paper's conclusions about the negligible negative health and safety impacts of photovoltaics apply fully in California, as well as anywhere in the United States. Similarly, there is nothing unique about the 1.98 MW_{AC} Soscol Ferry Road Solar project that would cause any health or safety impacts different than those discussed in the N.C. white paper.

Throughout the white paper there are instances of North Carolina-specific information, or issues where the situation in California is different than it is in North Carolina. The following is a list of the significant instances of either situation, in the order they appear in the white paper, along with the relevant California-specific information.

- Type of PV Technology Used: Crystalline silicon, Cadmium Telluride (CdTe), and CIGS are all being installed in California as they are in N.C. Since the publication of the N.C. report the author has confirmed the recent installation of utility-scale projects using CIGS modules, but these are still not common. Like in NC, the majority of the current PV installation capacity in California is crystalline silicon, also like NC these are generally Tier I modules. The Soscol Ferry Rd. project will use Tier I crystalline silicon modules.
- Design Wind Speed: The ASCE 7-2016 design wind speed in the vast majority of California, including in Napa County where the Soscol Ferry Road Solar project is located, is 90-95 MPH, which is much lower than the design wind speeds of hurricane-prone eastern N.C. where most PV development in the state is located. A few mountainous regions of California have design wind speeds over 100 MPG, however these extreme

terrains are unlikely to install ground-mounted PV systems.

- Offset Electricity Fuel Mix: The white paper includes a rough estimation that the fuel mix of the generators offset by PV energy production in N.C. is 90% natural gas and 10% coal. From this mix an estimate of the reduction in cadmium emissions due to PV was calculated. The 10% coal estimate is certainly too high for California. An offset fuel mix for California could be reasonably estimated as 100% natural gas, resulting in about 75% of the cadmium emissions savings calculated for NC.

- PV Module Recycling: The white paper included local reports from PV developers in North Carolina of recycling damaged PV modules. It is quite possible that the same is occurring in California, but the author does not have data on the current common waste management practices for damaged PV modules in California. The Electric Power Research Institute (EPRI) published two extensive reports on the Photovoltaic Module Recycling in the United States (April 2018) and Insights in Photovoltaic Recycling Processes in Europe (December 2017), which are great sources for current information on PV module recycling. The EPRI report on recycling in the U.S. states that there are commercial recyclers in the U.S. accepting and recycling PV modules, using processes not unlike those described in the white paper.

- PV Module Washing: Unlike North Carolina, many regions of California regularly experience long periods of time with little to no rain, which can result in enough accumulation of dirt on the PV modules that it justifies occasionally washing the modules to renew their performance. In North Carolina there is generally a heavy rain often enough to keep the panels clean enough to not require manual panel washing. This difference does not have an impact on the health or safety impact of the photovoltaic modules other than perhaps some increased risk of electric shock when washing the modules. Proper installation, maintenance, and washing techniques should reduce this risk to near zero.

- Vegetation Maintenance: The climate in many regions of California, including Napa County where the Soscol Ferry Road Solar project is located, cause the growth of vegetation requiring maintenance to be less vigorous than the vegetation in moist North Carolina. Thus, PV sites in California use similar vegetation maintenance techniques to North Carolina however they need to spend less time and make fewer trips to adequately maintain vegetation on site.

- California Hazardous Waste Policy:
  - As explained in the white paper, in the United States a waste material is considered hazardous waste if the results of a Toxicity Characteristic Leaching Procedure (TCLP) test find concentrations of any of 40 hazardous chemicals above the allowed EPA concentration limit for that chemical. However, in California, materials must additionally meet the more stringent Hazardous Waste Control Law (HWCL), which is like the Reduction of Hazardous Substances (ROHS) directive, adopted in February 2003 by the European Union (EU).[i]
  - In 2015, California passed SB-489 directing the CA DTSC (Department of Toxic Substances Control) to write rules to reclassify PV modules as universal waste, even if they fail TCLP. These rules exclude physically damaged, fractured, or fragmented PV modules that are no longer recognizable as PV modules.[ii] A primary goal of the legislation is to allow producers of waste PV modules to avoid difficult and costly waste determination procedures. In April 2019 the CA DTSC proposed rules to implement SB-489. After the public comment period that ended in June 2019 DTSC may adjust and adopt the rules.[iii]

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[i] *Program on Technology Innovation: Feasibility Study on Photovoltaic Module Recycling in the United States, Technical Update, April 2018*; Electric Power Research Institute (EPRI); April 2018.

[ii] ibid

[iii] (webpage) Beveridge & Diamond law firm; News alert: California Department of Toxic Substances Control Proposes Regulation Classifying Discarded Solar Panels as Universal Waste ; https://www.bdlaw.com/publications/california-department-of-toxic-substances-control-proposes-regulation-classifying-discarded-solar-panels-as-universal-waste/ (last accessed 7/22/2019)

NC CLEAN ENERGY
TECHNOLOGY CENTER

Health and Safety Impacts of Solar Photovoltaics

MAY 2017



NC STATE UNIVERSITY

Health and Safety Impacts of Solar Photovoltaics

The increasing presence of utility-scale solar photovoltaic (PV) systems (sometimes referred to as solar farms) is a rather new development in North Carolina's landscape. Due to the new and unknown nature of this technology, it is natural for communities near such developments to be concerned about health and safety impacts. Unfortunately, the quick emergence of utility-scale solar has cultivated fertile grounds for myths and half-truths about the health impacts of this technology, which can lead to unnecessary fear and conflict.

Photovoltaic (PV) technologies and solar inverters are not known to pose any significant health dangers to their neighbors. The most important dangers posed are increased highway traffic during the relative short construction period and dangers posed to trespassers of contact with high voltage equipment. This latter risk is mitigated by signage and the security measures that industry uses to deter trespassing. As will be discussed in more detail below, risks of site contamination are much less than for most other industrial uses because PV technologies employ few toxic chemicals and those used are used in very small quantities. Due to the reduction in the pollution from fossil-fuel-fired electric generators, the overall impact of solar development on human health is overwhelmingly positive. This pollution reduction results from a partial replacement of fossil-fuel fired generation by emission-free PV-generated electricity, which reduces harmful sulfur dioxide (SO_2), nitrogen oxides (NO_x), and fine particulate matter ($PM_{2.5}$). Analysis from the National Renewable Energy Laboratory and the Lawrence Berkeley National Laboratory, both affiliates of the U.S. Department of Energy, estimates the health-related air quality benefits to the southeast region from solar PV generators to be worth 8.0 ¢ per kilowatt-hour of solar generation.[1] This is in addition to the value of the electricity and suggests that the air quality benefits of solar are worth more than the electricity itself.

Even though we have only recently seen large-scale installation of PV technologies, the technology and its potential impacts have been studied since the 1950s. A combination of this solar-specific research and general scientific research has led to the scientific community having a good understanding of the science behind potential health and safety impacts of solar energy. This paper utilizes the latest scientific literature and knowledge of solar practices in N.C. to address the health and safety risks associated with solar PV technology. These risks are extremely small, far less than those associated with common activities such as driving a car, and vastly outweighed by health benefits of the generation of clean electricity.

This paper addresses the potential health and safety impacts of solar PV development in North Carolina, organized into the following four categories:

(1) Hazardous Materials
(2) Electromagnetic Fields (EMF)
(3) Electric Shock and Arc Flash
(4) Fire Safety

1. Hazardous Materials

One of the more common concerns towards solar is that the panels (referred to as "modules" in the solar industry) consist of toxic materials that endanger public health. However, as shown in this section, solar energy systems may contain small amounts of toxic materials, but these materials do not endanger public health. To understand potential toxic hazards coming from a solar project, one must understand system installation, materials used, the panel end-of-life protocols, and system operation. This section will examine these aspects of a solar farm and the potential for toxicity impacts in the following subsections:

(1.2) Project Installation/Construction
(1.2) System Components
    1.2.1 Solar Panels: Construction and Durability
    1.2.2 Photovoltaic technologies
        (a) Crystalline Silicon
        (b) Cadmium Telluride (CdTe)
        (c) CIS/CIGS
    1.2.3 Panel End of Life Management
    1.2.4 Non-panel System Components
(1.3) Operations and Maintenance

1.1 Project Installation/Construction

The system installation, or construction, process does not require toxic chemicals or processes. The site is mechanically cleared of large vegetation, fences are constructed, and the land is surveyed to layout exact installation locations. Trenches for underground wiring are dug and support posts are driven into the ground. The solar panels are bolted to steel and aluminum support structures and wired together. Inverter pads are installed, and an inverter and transformer are installed on each pad. Once everything is connected, the system is tested, and only then turned on.



Figure 1: Utility-scale solar facility (5 MW_{AC}) located in Catawba County. Source: Strata Solar

1.2 System Components

1.2.1 Solar Panels: Construction and Durability

Solar PV panels typically consist of glass, polymer, aluminum, copper, and semiconductor materials that can be recovered and recycled at the end of their useful life.[2] Today there are two PV technologies used in PV panels at utility-scale solar facilities, silicon, and thin film. As of 2016, all thin film used in North Carolina solar facilities are cadmium telluride (CdTe) panels from the US manufacturer First Solar, but there are other thin film PV panels available on the market, such as Solar Frontier's CIGS panels. Crystalline silicon technology consists of silicon wafers which are made into cells and assembled into panels, thin film technologies consist of thin layers of semiconductor material deposited onto glass, polymer or metal substrates. While there are differences in the components and manufacturing processes of these two types of solar technologies, many aspects of their PV panel construction are very similar. Specifics about each type of PV chemistry as it relates to toxicity are covered in subsections a, b, and c in section 1.2.2; on crystalline silicon, cadmium telluride, and CIS/CIGS respectively. The rest of this section applies equally to both silicon and thin film panels.

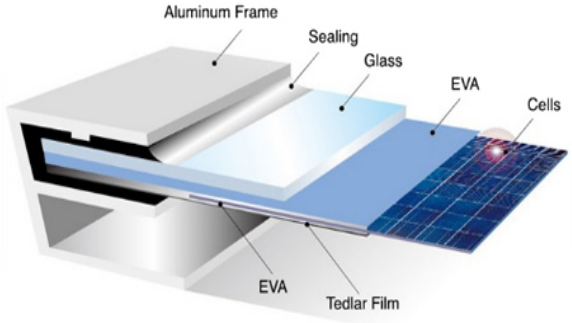


Figure 2: Components of crystalline silicon panels. The vast majority of silicon panels consist of a glass sheet on the topside with an aluminum frame providing structural support. Image Source: www.riteksolar.com.tw

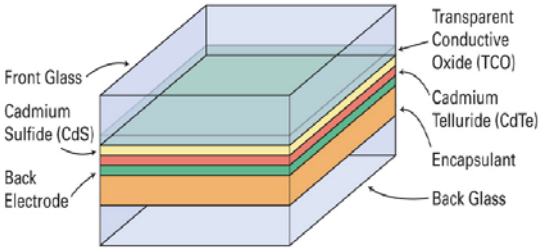


Figure 3: Layers of a common frameless thin-film panel (CdTe). Many thin film panels are frameless, including the most common thin-film panels, First Solar's CdTe. Frameless panels have protective glass on both the front and back of the panel. Layer thicknesses not to scale. Image Source: www.homepower.com

To provide decades of corrosion-free operation, PV cells in PV panels are encapsulated from air and moisture between two layers of plastic. The encapsulation layers are protected on the top with a layer of tempered glass and on the backside with a polymer sheet. Frameless modules include a protective layer of glass on the rear of the panel, which may also be tempered. The plastic ethylene-vinyl acetate (EVA) commonly provides the cell encapsulation. For decades, this same material has been used between layers of tempered glass to give car windshields and hurricane windows their great strength. In the same way that a car windshield cracks but stays intact, the EVA layers in PV panels keep broken panels intact (see Figure 4). Thus, a damaged module does not generally create small pieces of debris; instead, it largely remains together as one piece.



Figure 4: The mangled PV panels in this picture illustrate the nature of broken solar panels; the glass cracks but the panel is still in one piece. Image Source: http://img.alibaba.com/photo/115259576/broken_solar_panel.jpg

PV panels constructed with the same basic components as modern panels have been installed across the globe for well over thirty years.[3] The long-term durability and performance demonstrated over these decades, as well as the results of accelerated lifetime testing, helped lead to an industry-standard 25-year power production warranty for PV panels. These power warranties warrant a PV panel to produce at least 80% of their original nameplate production after 25 years of use. A recent SolarCity and DNV GL study reported that today's quality PV panels should be expected to reliably and efficiently produce power for thirty-five years.[4]

Local building codes require all structures, including ground mounted solar arrays, to be engineered to withstand anticipated wind speeds, as defined by the local wind speed requirements. Many racking products are available in versions engineered for wind speeds of up to 150 miles per hour, which is significantly higher than the wind speed requirement anywhere in North Carolina. The strength of PV mounting structures were demonstrated during Hurricane Sandy in 2012 and again during Hurricane Matthew in 2016. During Hurricane Sandy, the many large-scale solar facilities in New Jersey and New York at that time suffered only minor damage.[5] In the fall of 2016, the US and Caribbean experienced destructive winds and torrential rains from Hurricane Matthew, yet one leading solar tracker manufacturer reported that their numerous systems in the impacted area received zero damage from wind or flooding.[6]

In the event of a catastrophic event capable of damaging solar equipment, such as a tornado, the system will almost certainly have property insurance that will cover the cost to cleanup and repair the project. It is in the best interest of the system owner to protect their investment against such risks. It is also in their interest to get the project repaired and producing full power as soon as possible. Therefore, the investment in adequate insurance is a wise business practice for the system owner. For the same

reasons, adequate insurance coverage is also generally a requirement of the bank or firm providing financing for the project.

1.2.2 Photovoltaic (PV) Technologies

a. Crystalline Silicon

This subsection explores the toxicity of silicon-based PV panels and concludes that they do not pose a material risk of toxicity to public health and safety. Modern crystalline silicon PV panels, which account for over 90% of solar PV panels installed today, are, more or less, a commodity product. The overwhelming majority of panels installed in North Carolina are crystalline silicon panels that are informally classified as Tier I panels. Tier I panels are from well-respected manufacturers that have a good chance of being able to honor warranty claims. Tier I panels are understood to be of high quality, with predictable performance, durability, and content. Well over 80% (by weight) of the content of a PV panel is the tempered glass front and the aluminum frame, both of which are common building materials. Most of the remaining portion are common plastics, including polyethylene terephthalate in the backsheet, EVA encapsulation of the PV cells, polyphenyl ether in the junction box, and polyethylene insulation on the wire leads. The active, working components of the system are the silicon photovoltaic cells, the small electrical leads connecting them together, and to the wires coming out of the back of the panel. The electricity generating and conducting components makeup less than 5% of the weight of most panels. The PV cell itself is nearly 100% silicon, and silicon is the second most common element in the Earth's crust. The silicon for PV cells is obtained by high-temperature processing of quartz sand (SiO_2) that removes its oxygen molecules. The refined silicon is converted to a PV cell by adding extremely small amounts of boron and phosphorus, both of which are common and of very low toxicity.

The other minor components of the PV cell are also generally benign; however, some contain lead, which is a human toxicant that is particularly harmful to young children. The minor components include an extremely thin antireflective coating (silicon nitride or titanium dioxide), a thin layer of aluminum on the rear, and thin strips of silver alloy that are screen-printed on the front and rear of cell.[7] In order for the front and rear electrodes to make effective electrical contact with the proper layer of the PV cell, other materials (called glass frit) are mixed with the silver alloy and then heated to etch the metals into the cell. This glass frit historically contains a small amount of lead (Pb) in the form of lead oxide. The 60 or 72 PV cells in a PV panel are connected by soldering thin solder-covered copper tabs from the back of one cell to the front of the next cell. Traditionally a tin-based solder containing some lead (Pb) is used, but some manufacturers have switched to lead-free solder. The glass frit and/or the solder may contain trace amounts of other metals, potentially including some with human toxicity such as cadmium. However, testing to simulate the potential for leaching from broken panels, which is discussed in more detail below, did not find a potential toxicity threat from these trace elements. Therefore, the tiny amount of lead in the grass frit and the solder is the only part of silicon PV panels with a potential to create a negative health impact. However, as described below, the very limited amount of lead involved and its strong physical and chemical attachment to other components of the PV panel means that even in worst-case scenarios the health hazard it poses is insignificant.

As with many electronic industries, the solder in silicon PV panels has historically been a lead-based solder, often 36% lead, due to the superior properties of such solder. However, recent advances in lead-free solders have spurred a trend among PV panel manufacturers to reduce or remove the lead in their panels. According to the 2015 Solar Scorecard from the Silicon Valley Toxics Coalition, a group that tracks environmental responsibility of photovoltaic panel manufacturers, fourteen companies (increased from twelve companies in 2014) manufacture PV panels certified to meet the European Restriction of

Hazardous Substances (RoHS) standard. This means that the amount of cadmium and lead in the panels they manufacture fall below the RoHS thresholds, which are set by the European Union and serve as the world's de facto standard for hazardous substances in manufactured goods.[8] The Restriction of Hazardous Substances (RoHS) standard requires that the maximum concentration found in any homogenous material in a produce is less than 0.01% cadmium and less than 0.10% lead, therefore, any solder can be no more than 0.10% lead.[9]

While some manufacturers are producing PV panels that meet the RoHS standard, there is no requirement that they do so because the RoHS Directive explicitly states that the directive does not apply to photovoltaic panels.[10] The justification for this is provided in item 17 of the current RoHS Directive: "The development of renewable forms of energy is one of the Union's key objectives, and the contribution made by renewable energy sources to environmental and climate objectives is crucial. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources (4) recalls that there should be coherence between those objectives and other Union environmental legislation. Consequently, this Directive should not prevent the development of renewable energy technologies that have no negative impact on health and the environment and that are sustainable and economically viable."

The use of lead is common in our modern economy. However, only about 0.5% of the annual lead consumption in the U.S. is for electronic solder for all uses; PV solder makes up only a tiny portion of this 0.5%. Close to 90% of lead consumption in the US is in batteries, which do not encapsulate the pounds of lead contained in each typical automotive battery. This puts the lead in batteries at great risk of leaching into the environment. Estimates for the lead in a single PV panel with lead-based solder range from 1.6 to 24 grams of lead, with 13g (less than half of an ounce) per panel seen most often in the literature.[11] At 13 g/panel[12], each panel contains one-half of the lead in a typical 12-gauge shotgun shell. This amount equates to roughly 1/750th of the lead in a single car battery. In a panel, it is all durably encapsulated from air or water for the full life of the panel.[14]

As indicated by their 20 to 30-year power warranty, PV modules are designed for a long service life, generally over 25 years. For a panel to comply with its 25-year power warranty, its internal components, including lead, must be sealed from any moisture. Otherwise, they would corrode and the panel's output would fall below power warranty levels. Thus, the lead in operating PV modules is not at risk of release to the environment during their service lifetime. In extreme experiments, researchers have shown that lead can leach from crushed or pulverized panels.[15, 16] However, more real-world tests designed to represent typical trash compaction that are used to classify waste as hazardous or non-hazardous show no danger from leaching.[17, 18] For more information about PV panel end-of-life, see the Panel Disposal section.

As illustrated throughout this section, silicon-based PV panels do not pose a material threat to public health and safety. The only aspect of the panels with potential toxicity concerns is the very small amount of lead in some panels. However, any lead in a panel is well sealed from environmental exposure for the operating lifetime of the solar panel and thus not at risk of release into the environment.

b. Cadmium Telluride (CdTe) PV Panels

This subsection examines the components of a cadmium telluride (CdTe) PV panel. Research demonstrates that they pose negligible toxicity risk to public health and safety while significantly reducing the public's exposure to cadmium by reducing coal emissions. As of mid-2016, a few hundred MWs of

cadmium telluride (CdTe) panels, all manufactured by the U.S. company First Solar, have been installed in North Carolina.

Questions about the potential health and environmental impacts from the use of this PV technology are related to the concern that these panels contain cadmium, a toxic heavy metal. However, scientific studies have shown that cadmium telluride differs from cadmium due to its high chemical and thermal stability.[19] Research has shown that the tiny amount of cadmium in these panels does not pose a health or safety risk.[20] Further, there are very compelling reasons to welcome its adoption due to reductions in unhealthy pollution associated with burning coal. Every GWh of electricity generated by burning coal produces about 4 grams of cadmium air emissions.[21] Even though North Carolina produces a significant fraction of our electricity from coal, electricity from solar offsets much more natural gas than coal due to natural gas plants being able to adjust their rate of production more easily and quickly. If solar electricity offsets 90% natural gas and 10% coal, each 5-megawatt (5 MW_{AC}, which is generally 7 MW_{DC}) CdTe solar facility in North Carolina keeps about 157 grams, or about a third of a pound, of cadmium *out of* our environment.[22, 23]

Cadmium is toxic, but all the approximately 7 grams of cadmium in one CdTe panel is in the form of a chemical compound cadmium telluride,[24] which has $1/100^{th}$ the toxicity of free cadmium.[25] Cadmium telluride is a very stable compound that is non-volatile and non-soluble in water. Even in the case of a fire, research shows that less than 0.1% of the cadmium is released when a CdTe panel is exposed to fire. The fire melts the glass and encapsulates over 99.9% of the cadmium in the molten glass.[27]

It is important to understand the source of the cadmium used to manufacture CdTe PV panels. The cadmium is a byproduct of zinc and lead refining. The element is collected from emissions and waste streams during the production of these metals and combined with tellurium to create the CdTe used in PV panels. If the cadmium were not collected for use in the PV panels or other products, it would otherwise either be stockpiled for future use, cemented and buried, or disposed of.[28] Nearly all the cadmium in old or broken panels can be recycled which can eventually serve as the primary source of cadmium for new PV panels.[29]

Similar to silicon-based PV panels, CdTe panels are constructed of a tempered glass front, one instead of two clear plastic encapsulation layers, and a rear heat strengthened glass backing (together >98% by weight). The final product is built to withstand exposure to the elements without significant damage for over 25 years. While not representative of damage that may occur in the field or even at a landfill, laboratory evidence has illustrated that when panels are ground into a fine powder, very acidic water is able to leach portions of the cadmium and tellurium,[30] similar to the process used to recycle CdTe panels. Like many silicon-based panels, CdTe panels are reported (as far back ask 1998[31]) to pass the EPA's Toxic Characteristic Leaching Procedure (TCLP) test, which tests the potential for crushed panels in a landfill to leach hazardous substances into groundwater.[32] Passing this test means that they are classified as non-hazardous waste and can be deposited in landfills.[33, 34] For more information about PV panel end-of-life, see the Panel Disposal section.

There is also concern of environmental impact resulting from potential catastrophic events involving CdTe PV panels. An analysis of worst-case scenarios for environmental impact from CdTe PV panels, including earthquakes, fires, and floods, was conducted by the University of Tokyo in 2013. After reviewing the extensive international body of research on CdTe PV technology, their report concluded, "Even in the worst-case scenarios, it is unlikely that the Cd concentrations in air and sea water will exceed the environmental regulation values."[35] In a worst-case scenario of damaged panels abandoned on the ground, insignificant amounts of cadmium will leach from the panels. This is because this scenario is

much less conducive (larger module pieces, less acidity) to leaching than the conditions of the EPA's TCLP test used to simulate landfill conditions, which CdTe panels pass.[36]

First Solar, a U.S. company, and the only significant supplier of CdTe panels, has a robust panel take-back and recycling program that has been operating commercially since 2005.[37] The company states that it is "committed to providing a commercially attractive recycling solution for photovoltaic (PV) power plant and module owners to help them meet their module (end of life) EOL obligation simply, cost-effectively and responsibly." First Solar global recycling services to their customers to collect and recycle panels once they reach the end of productive life whether due to age or damage. These recycling service agreements are structured to be financially attractive to both First Solar and the solar panel owner. For First Solar, the contract provides the company with an affordable source of raw materials needed for new panels and presumably a diminished risk of undesired release of Cd. The contract also benefits the solar panel owner by allowing them to avoid tipping fees at a waste disposal site. The legal contract helps provide peace of mind by ensuring compliance by both parties when considering the continuing trend of rising disposal costs and increasing regulatory requirements.

c. CIS/CIGS and other PV technologies

Copper indium gallium selenide PV technology, often referred to as CIGS, is the second most common type of thin-film PV panel but a distant second behind CdTe. CIGS cells are composed of a thin layer of copper, indium, gallium, and selenium on a glass or plastic backing. None of these elements are very toxic, although selenium is a regulated metal under the Federal Resource Conservation and Recovery Act (RCRA).[38] The cells often also have an extremely thin layer of cadmium sulfide that contains a tiny amount of cadmium, which is toxic. The promise of high efficiency CIGS panels drove heavy investment in this technology in the past. However, researchers have struggled to transfer high efficiency success in the lab to low-cost full-scale panels in the field.[39] Recently, a CIGS manufacturer based in Japan, Solar Frontier, has achieved some market success with a rigid, glass-faced CIGS module that competes with silicon panels. Solar Frontier produces the majority of CIS panels on the market today.[40] Notably, these panels are RoHS compliant,[41] thus meeting the rigorous toxicity standard adopted by the European Union even thought this directive exempts PV panels. The authors are unaware of any completed or proposed utility-scale system in North Carolina using CIS/CIGS panels.

1.2.3 Panel End-of-Life Management

Concerns about the volume, disposal, toxicity, and recycling of PV panels are addressed in this subsection. To put the volume of PV waste into perspective, consider that by 2050, when PV systems installed in 2020 will reach the end of their lives, it is estimated that the global annual PV panel waste tonnage will be 10% of the 2014 global e-waste tonnage.[42] In the U.S., end-of-life disposal of solar products is governed by the Federal Resource Conservation and Recovery Act (RCRA), as well as state policies in some situations. RCRA separates waste into hazardous (not accepted at ordinary landfill) and solid waste (generally accepted at ordinary landfill) based on a series of rules. According to RCRA, the way to determine if a PV panel is classified as hazardous waste is the Toxic Characteristic Leaching Procedure (TCLP) test. This EPA test is designed to simulate landfill disposal and determine the risk of hazardous substances leaching out of the landfill.[43, 44, 45] Multiple sources report that most modern PV panels (both crystalline silicon and cadmium telluride) pass the TCLP test.[46, 47] Some studies found that some older (1990s) crystalline silicon panels, and perhaps some newer crystalline silicon panels (specifics are not given about vintage of panels tested), do not pass the lead (Pb) leachate limits in the TCLP test.[48, 49]

The test begins with the crushing of a panel into centimeter-sized pieces. The pieces are then mixed in an acid bath. After tumbling for eighteen hours, the fluid is tested for forty hazardous substances that all must be below specific threshold levels to pass the test. Research comparing TCLP conditions to conditions of damaged panels in the field found that simulated landfill conditions provide overly conservative estimates of leaching for field-damaged panels.[50] Additionally, research in Japan has found no detectable Cd leaching from cracked CdTe panels when exposed to simulated acid rain.[51]

Although modern panels can generally be landfilled, they can also be recycled. Even though recent waste volume has not been adequate to support significant PV-specific recycling infrastructure, the existing recycling industry in North Carolina reports that it recycles much of the current small volume of broken PV panels. In an informal survey conducted by the NC Clean Energy Technology Center survey in early 2016, seven of the eight large active North Carolina utility-scale solar developers surveyed reported that they send damaged panels back to the manufacturer and/or to a local recycler. Only one developer reported sending damaged panels to the landfill.

The developers reported at that time that they are usually paid a small amount per panel by local recycling firms. In early 2017, a PV developer reported that a local recycler was charging a small fee per panel to recycle damaged PV panels. The local recycling firm known to authors to accept PV panels described their current PV panel recycling practice as of early 2016 as removing the aluminum frame for local recycling and removing the wire leads for local copper recycling. The remainder of the panel is sent to a facility for processing the non-metallic portions of crushed vehicles, referred to as "fluff" in the recycling industry.[52] This processing within existing general recycling plants allows for significant material recovery of major components, including glass which is 80% of the module weight, but at lower yields than PV-specific recycling plants. Notably almost half of the material value in a PV panel is in the few grams of silver contained in almost every PV panel produced today. In the long-term, dedicated PV panel recycling plants can increase treatment capacities and maximize revenues resulting in better output quality and the ability to recover a greater fraction of the useful materials.[53] PV-specific panel recycling technologies have been researched and implemented to some extent for the past decade, and have been shown to be able to recover over 95% of PV material (semiconductor) and over 90% of the glass in a PV panel.[54]

A look at global PV recycling trends hints at the future possibilities of the practice in our country. Europe installed MW-scale volumes of PV years before the U.S. In 2007, a public-private partnership between the European Union and the solar industry set up a voluntary collection and recycling system called PV CYCLE. This arrangement was later made mandatory under the EU's WEEE directive, a program for waste electrical and electronic equipment.[55] Its member companies (PV panel producers) fully finance the association. This makes it possible for end-users to return the member companies' defective panels for recycling at any of the over 300 collection points around Europe without added costs. Additionally, PV CYCLE will pick up batches of 40 or more used panels at no cost to the user. This arrangement has been very successful, collecting and recycling over 13,000 tons by the end of 2015.[56]

In 2012, the WEEE Directive added the end-of-life collection and recycling of PV panels to its scope.[57] This directive is based on the principle of extended-producer-responsibility. It has a global impact because producers that want to sell into the EU market are legally responsible for end-of-life management. Starting in 2018, this directive targets that 85% of PV products "put in the market" in Europe are recovered and 80% is prepared for reuse and recycling.

The success of the PV panel collection and recycling practices in Europe provides promise for the future of recycling in the U.S. In mid-2016, the US Solar Energy Industry Association (SEIA) announced that they are starting a national solar panel recycling program with the guidance and support of many

leading PV panel producers.[58] The program will aggregate the services offered by recycling vendors and PV manufacturers, which will make it easier for consumers to select a cost-effective and environmentally responsible end-of-life management solution for their PV products. According to SEIA, they are planning the program in an effort to make the entire industry landfill-free. In addition to the national recycling network program, the program will provide a portal for system owners and consumers with information on how to responsibly recycle their PV systems.

While a cautious approach toward the potential for negative environmental and/or health impacts from retired PV panels is fully warranted, this section has shown that the positive health impacts of reduced emissions from fossil fuel combustion from PV systems more than outweighs any potential risk. Testing shows that silicon and CdTe panels are both safe to dispose of in landfills, and are also safe in worst case conditions of abandonment or damage in a disaster. Additionally, analysis by local engineers has found that the current salvage value of the equipment in a utility scale PV facility generally exceeds general contractor estimates for the cost to remove the entire PV system.[59, 60, 61]

1.2.4 Non-Panel System Components (racking, wiring, inverter, transformer)

While previous toxicity subsections discussed PV panels, this subsection describes the non-panel components of utility-scale PV systems and investigates any potential public health and safety concerns. The most significant non-panel component of a ground-mounted PV system is the mounting structure of the rows of panels, commonly referred to as "racking". The vertical post portion of the racking is galvanized steel and the remaining above-ground racking components are either galvanized steel or aluminum, which are both extremely common and benign building materials. The inverters that make the solar generated electricity ready to send to the grid have weather-proof steel enclosures that protect the working components from the elements. The only fluids that they might contain are associated with their cooling systems, which are not unlike the cooling system in a computer. Many inverters today are RoHS compliant.

The electrical transformers (to boost the inverter output voltage to the voltage of the utility connection point) do contain a liquid cooling oil. However, the fluid used for that function is either a non-toxic mineral oil or a biodegradable non-toxic vegetable oil, such as BIOTEMP from ABB. These vegetable transformer oils have the additional advantage of being much less flammable than traditional mineral oils. Significant health hazards are associated with old transformers containing cooling oil with toxic PCBs. Transfers with PCB-containing oil were common before PCBs were outlawed in the U.S. in 1979. PCBs still exist in older transformers in the field across the country.

Other than a few utility research sites, there are no batteries on- or off-site associated with utility-scale solar energy facilities in North Carolina, avoiding any potential health or safety concerns related to battery technologies. However, as battery technologies continue to improve and prices continue to decline we are likely to start seeing some batteries at solar facilities. Lithium ion batteries currently dominate the world utility-scale battery market, which are not very toxic. No non-panel system components were found to pose any health or environmental dangers.

1.4 Operations and Maintenance – Panel Washing and Vegetation Control

Throughout the eastern U.S., the climate provides frequent and heavy enough rain to keep panels adequately clean. This dependable weather pattern eliminates the need to wash the panels on a regular basis. Some system owners may choose to wash panels as often as once a year to increase production, but most in N.C. do not regularly wash any PV panels. Dirt build up over time may justify panel washing a few times over the panels' lifetime; however, nothing more than soap and water are required for this activity.

The maintenance of ground-mounted PV facilities requires that vegetation be kept low, both for aesthetics and to avoid shading of the PV panels. Several approaches are used to maintain vegetation at NC solar facilities, including planting of limited-height species, mowing, weed-eating, herbicides, and grazing livestock (sheep). The following descriptions of vegetation maintenance practices are based on interviews with several solar developers as well as with three maintenance firms that together are contracted to maintain well over 100 of the solar facilities in N.C. The majority of solar facilities in North Carolina maintain vegetation primarily by mowing. Each row of panels has a single row of supports, allowing sickle mowers to mow under the panels. The sites usually require mowing about once a month during the growing season. Some sites employ sheep to graze the site, which greatly reduces the human effort required to maintain the vegetation and produces high quality lamb meat.[62]

In addition to mowing and weed eating, solar facilities often use some herbicides. Solar facilities generally do not spray herbicides over the entire acreage; rather they apply them only in strategic locations such as at the base of the perimeter fence, around exterior vegetative buffer, on interior dirt roads, and near the panel support posts. Also unlike many row crop operations, solar facilities generally use only general use herbicides, which are available over the counter, as opposed to restricted use herbicides commonly used in commercial agriculture that require a special restricted use license. The herbicides used at solar facilities are primarily 2-4-D and glyphosate (Round-up®), which are two of the most common herbicides used in lawns, parks, and agriculture across the country. One maintenance firm that was interviewed sprays the grass with a class of herbicide known as a growth regulator in order to slow the growth of grass so that mowing is only required twice a year. Growth regulators are commonly used on highway roadsides and golf courses for the same purpose. A commercial pesticide applicator license is required for anyone other than the landowner to apply herbicides, which helps ensure that all applicators are adequately educated about proper herbicide use and application. The license must be renewed annually and requires passing of a certification exam appropriate to the area in which the applicator wishes to work. Based on the limited data available, it appears that solar facilities in N.C. generally use significantly less herbicides per acre than most commercial agriculture or lawn maintenance services.

2. Electromagnetic Fields (EMF)

PV systems do not emit any material during their operation; however, they do generate electromagnetic fields (EMF), sometimes referred to as radiation. EMF produced by electricity is non-ionizing radiation, meaning the radiation has enough energy to move atoms in a molecule around (experienced as heat), but not enough energy to remove electrons from an atom or molecule (ionize) or to damage DNA. As shown below, modern humans are all exposed to EMF throughout our daily lives without negative health impact. Someone outside of the fenced perimeter of a solar facility is not exposed to significant EMF from the solar facility. Therefore, there is no negative health impact from the EMF

produced in a solar farm. The following paragraphs provide some additional background and detail to support this conclusion.

Since the 1970s, some have expressed concern over potential health consequences of EMF from electricity, but no studies have ever shown this EMF to cause health problems.[63] These concerns are based on some epidemiological studies that found a slight increase in childhood leukemia associated with average exposure to residential power-frequency magnetic fields above 0.3 to 0.4 μT (microteslas) (equal to 3.0 to 4.0 mG (milligauss)). μT and mG are both units used to measure magnetic field strength. For comparison, the average exposure for people in the U.S. is one mG or 0.1 μT, with about 1% of the population with an average exposure in excess of 0.4 μT (or 4 mG).[64] These epidemiological studies, which found an association but not a causal relationship, led the World Health Organization's International Agency for Research on Cancer (IARC) to classify ELF magnetic fields as "possibly carcinogenic to humans". Coffee also has this classification. This classification means there is limited evidence but not enough evidence to designate as either a "probable carcinogen" or "human carcinogen". Overall, there is very little concern that ELF EMF damages public health. The only concern that does exist is for long-term exposure above 0.4 μT (4 mG) that may have some connection to increased cases of childhood leukemia. In 1997, the National Academies of Science were directed by Congress to examine this concern and concluded:

> "Based on a comprehensive evaluation of published studies relating to the effects of power-frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human-health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects."[65]

There are two aspects to electromagnetic fields, an electric field and a magnetic field. The electric field is generated by voltage and the magnetic field is generated by electric current, i.e., moving electrons. A task group of scientific experts convened by the World Health Organization (WHO) in 2005 concluded that there were no substantive health issues related to *electric* fields (0 to 100,000 Hz) at levels generally encountered by members of the public.[66] The relatively low voltages in a solar facility and the fact that electric fields are easily shielded (i.e., blocked) by common materials, such as plastic, metal, or soil means that there is no concern of negative health impacts from the electric fields generated by a solar facility. Thus, the remainder of this section addresses magnetic fields. Magnetic fields are not shielded by most common materials and thus can easily pass through them. Both types of fields are strongest close to the source of electric generation and weaken quickly with distance from the source.

The direct current (DC) electricity produced by PV panels produce stationary (0 Hz) electric and magnetic fields. Because of minimal concern about potential risks of stationary fields, little scientific research has examined stationary fields' impact on human health.[67] In even the largest PV facilities, the DC voltages and currents are not very high. One can illustrate the weakness of the EMF generated by a PV panel by placing a compass on an operating solar panel and observing that the needle still points north.

While the electricity throughout the majority of a solar site is DC electricity, the inverters convert this DC electricity to alternating current (AC) electricity matching the 60 Hz frequency of the grid. Therefore, the inverters and the wires delivering this power to the grid are producing non-stationary EMF, known as extremely low frequency (ELF) EMF, normally oscillating with a frequency of 60 Hz. This frequency is at the low-energy end of the electromagnetic spectrum. Therefore, it has less energy than

other commonly encountered types of non-ionizing radiation like radio waves, infrared radiation, and visible light.

The wide use of electricity results in background levels of ELF EMFs in nearly all locations where people spend time – homes, workplaces, schools, cars, the supermarket, etc. A person's average exposure depends upon the sources they encounter, how close they are to them, and the amount of time they spend there.[68] As stated above, the average exposure to magnetic fields in the U.S. is estimated to be around one mG or 0.1 μT, but can vary considerably depending on a person's exposure to EMF from electrical devices and wiring.[69] At times we are often exposed to much higher ELF magnetic fields, for example when standing three feet from a refrigerator the ELF magnetic field is 6 mG and when standing three feet from a microwave oven the field is about 50 mG.[70] The strength of these fields diminish quickly with distance from the source, but when surrounded by electricity in our homes and other buildings moving away from one source moves you closer to another. However, unless you are inside of the fence at a utility-scale solar facility or electrical substation it is impossible to get very close to the EMF sources. Because of this, EMF levels at the fence of electrical substations containing high voltages and currents are considered "generally negligible".[71, 72]

The strength of ELF-EMF present at the perimeter of a solar facility or near a PV system in a commercial or residential building is significantly lower than the typical American's average EMF exposure.[73, 74] Researchers in Massachusetts measured magnetic fields at PV projects and found the magnetic fields dropped to very low levels of 0.5 mG or less, and in many cases to less than background levels (0.2 mG), at distances of no more than nine feet from the residential inverters and 150 feet from the utility-scale inverters.[75] Even when measured within a few feet of the utility-scale inverter, the ELF magnetic fields were well below the International Commission on Non-Ionizing Radiation Protection's recommended magnetic field level exposure limit for the general public of 2,000 mG.[76] It is typical that utility scale designs locate large inverters central to the PV panels that feed them because this minimizes the length of wire required and shields neighbors from the sound of the inverter's cooling fans. Thus, it is rare for a large PV inverter to be within 150 feet of the project's security fence.

Anyone relying on a medical device such as pacemaker or other implanted device to maintain proper heart rhythm may have concern about the potential for a solar project to interfere with the operation of his or her device. However, there is no reason for concern because the EMF outside of the solar facility's fence is less than 1/1000 of the level at which manufacturers test for ELF EMF interference, which is 1,000 mG.[77] Manufacturers of potentially affected implanted devices often provide advice on electromagnetic interference that includes avoiding letting the implanted device get too close to certain sources of fields such as some household appliances, some walkie-talkies, and similar transmitting devices. Some manufacturers' literature does not mention high-voltage power lines, some say that exposure in public areas should not give interference, and some advise not spending extended periods of time close to power lines.[78]

3. Electric Shock and Arc Flash Hazards

There is a real danger of electric shock to anyone entering any of the electrical cabinets such as combiner boxes, disconnect switches, inverters, or transformers; or otherwise coming in contact with voltages over 50 Volts.[79] Another electrical hazard is an arc flash, which is an explosion of energy that can occur in a short circuit situation. This explosive release of energy causes a flash of heat and a shockwave, both of which can cause serious injury or death. Properly trained and equipped technicians and electricians know how to safely install, test, and repair PV systems, but there is always some risk of

injury when hazardous voltages and/or currents are present. Untrained individuals should not attempt to inspect, test, or repair any aspect of a PV system due to the potential for injury or death due to electric shock and arc flash, The National Electric Code (NEC) requires appropriate levels of warning signs on all electrical components based on the level of danger determined by the voltages and current potentials. The national electric code also requires the site to be secured from unauthorized visitors with either a six-foot chain link fence with three strands of barbed wire or an eight-foot fence, both with adequate hazard warning signs.

4. Fire Safety

The possibility of fires resulting from or intensified by PV systems may trigger concern among the general public as well as among firefighters. However, concern over solar fire hazards should be limited because only a small portion of materials in the panels are flammable, and those components cannot self-support a significant fire. Flammable components of PV panels include the thin layers of polymer encapsulates surrounding the PV cells, polymer backsheets (framed panels only), plastic junction boxes on rear of panel, and insulation on wiring. The rest of the panel is composed of non-flammable components, notably including one or two layers of protective glass that make up over three quarters of the panel's weight.

Heat from a small flame is not adequate to ignite a PV panel, but heat from a more intense fire or energy from an electrical fault can ignite a PV panel.[80] One real-world example of this occurred during July 2015 in an arid area of California. Three acres of grass under a thin film PV facility burned without igniting the panels mounted on fixed-tilt racks just above the grass.[81] While it is possible for electrical faults in PV systems on homes or commercial buildings to start a fire, this is extremely rare.[82] Improving understanding of the PV-specific risks, safer system designs, and updated fire-related codes and standards will continue to reduce the risk of fire caused by PV systems.

PV systems on buildings can affect firefighters in two primary ways, 1) impact their methods of fighting the fire, and 2) pose safety hazard to the firefighters. One of the most important techniques that firefighters use to suppress fire is ventilation of a building's roof. This technique allows superheated toxic gases to quickly exit the building. By doing so, the firefighters gain easier and safer access to the building, Ventilation of the roof also makes the challenge of putting out the fire easier. However, the placement of rooftop PV panels may interfere with ventilating the roof by limiting access to desired venting locations.

New solar-specific building code requirements are working to minimize these concerns. Also, the latest National Electric Code has added requirements that make it easier for first responders to safely and effectively turn off a PV system. Concern for firefighting a building with PV can be reduced with proper fire fighter training, system design, and installation. Numerous organizations have studied fire fighter safety related to PV. Many organizations have published valuable guides and training programs. Some notable examples are listed below.

- The International Association of Fire Fighters (IAFF) and International Renewable Energy Council (IREC) partnered to create an online training course that is far beyond the PowerPoint click-and-view model. The self-paced online course, "Solar PV Safety for Fire Fighters," features rich video content and simulated environments so fire fighters can practice the knowledge they've learned. www.iaff.org/pvsafetytraining
- Photovoltaic Systems and the Fire Code: Office of NC Fire Marshal
- Fire Service Training, Underwriter's Laboratory

- Firefighter Safety and Response for Solar Power Systems, National Fire Protection Research Foundation
- Bridging the Gap: Fire Safety & Green Buildings, National Association of State Fire Marshalls
- Guidelines for Fire Safety Elements of Solar Photovoltaic Systems, Orange County Fire Chiefs Association
- Solar Photovoltaic Installation Guidelines, California Department of Forestry & Fire Protection, Office of the State Fire Marshall
- PV Safety & Firefighting, Matthew Paiss, Homepower Magazine
- PV Safety and Code Development: Matthew Paiss, Cooperative Research Network

Summary

The purpose of this paper is to address and alleviate concerns of public health and safety for utility-scale solar PV projects. Concerns of public health and safety were divided and discussed in the four following sections: (1) Toxicity, (2) Electromagnetic Fields, (3) Electric Shock and Arc Flash, and (4) Fire. In each of these sections, the negative health and safety impacts of utility-scale PV development were shown to be negligible, while the public health and safety benefits of installing these facilities are significant and far outweigh any negative impacts.

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Published by the N.C. Clean Energy Technology Center at N.C. State University

NC CLEAN ENERGY TECHNOLOGY CENTER

Groundwater / Drinking Water Protection Practices for Agricultural Lands

April 2021



MINNESOTA

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This document was developed to provide guidance to local governments on a range of drinking water/groundwater protection programs and initiatives, including grants from state and federal agencies and public and private conservation easement programs. It will be updated periodically as new information becomes available.

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Introduction

Purpose

This guide was developed to assist local government and watershed staff, water utilities, and other interest groups in identifying the most effective groundwater and drinking water protection strategies for agricultural land in their regions. It draws on the findings of the *Minnesota Nitrogen Fertilizer Management Plan (NFMP)*, the *Minnesota Agricultural BMP Handbook*, and related research to suggest practices – both agricultural and non-agricultural – that will minimize risks to drinking water and public health.

Nitrogen fertilizer (including both artificial fertilizer and manure) is used in current agricultural crop production systems to increase the productivity of these systems. However, nitrate that is not utilized by the crop may leach into the groundwater, where it is a public health concern, especially for pregnant women and infants under six months of age. The drinking water standard, known as the Health Risk Limit, is 10 milligrams of nitrate (measured as nitrogen) per liter of drinking water (mg/L).[1]

Note: *This guide focuses on groundwater as a drinking water source, rather than surface water. Likewise, the focus is on nitrate that originates from agricultural sources, not from other potential nitrate sources such as septic systems.*

The practices in this guide are applicable to public water suppliers, to owners of private wells, and to farmers and agricultural landowners with an interest in managing the land to protect the quality of their drinking water.

The susceptibility of groundwater to contamination from nitrate and other chemicals depends on multiple factors, including properties of soils and geologic materials, land use practices, and climate factors such as the amount and intensity of precipitation.

The practices emphasized in this guide are targeted to protect highly vulnerable drinking water supplies and groundwater resources on soils that are coarse-textured, have shallow depth to groundwater or bedrock, or are located in karst geology. Some of the practices may also be appropriate for marginal soils – those that are erosive, flood-prone, or otherwise less well-suited to row crop agriculture. Many practices align with the Alternative Management Tools[2] (AMTs) identified in the NFMP, defined as "locally developed solutions for addressing groundwater nitrate problems that are implemented on a site-specific basis." AMTs fall into four major categories:

1. **Utilizing new technologies**, such as controlled release fertilizers and precision agriculture;
2. **Developing new crop varieties**, such as varieties that use nitrogen more efficiently;
3. **Increasing continuous cover** through use of perennial crops, cover crops and diversified crop rotations; and
4. **Retiring cropland** through conservation easements and other means.

Managing Risks to Drinking Water Supplies

Groundwater is the source of drinking water for approximately 75% of Minnesota's population, with 54% served by public water systems and 20% by private wells. Based on MDA and MDH monitoring data, elevated nitrate levels in drinking water may indicate the presence of other contaminants, such as

[1] Minnesota Department of Health, "Nitrate in Drinking Water." https://www.health.state.mn.us/communities/environment/water/docs/contaminants/nitratefctsht.pdf

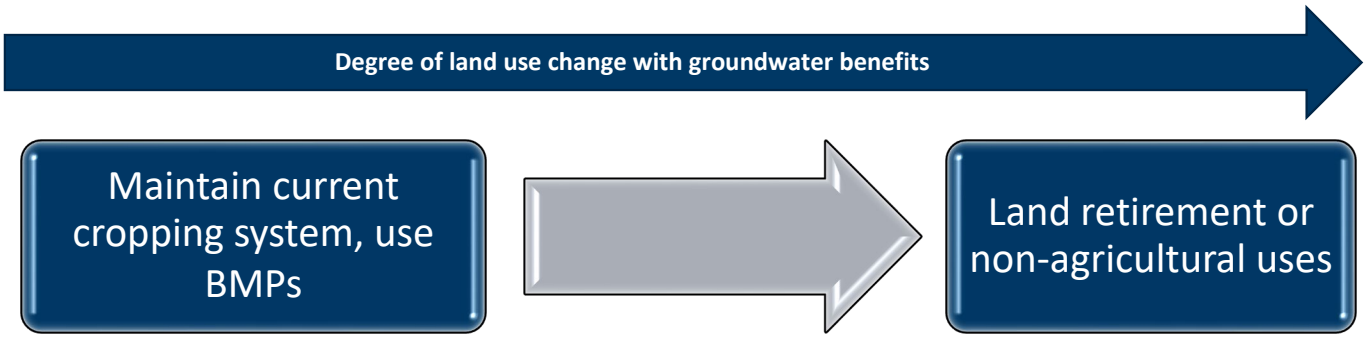
[2] Minnesota Department of Agriculture, "Alternative Management Tools." https://www.mda.state.mn.us/chemicals/fertilizers/nutrient-mgmt/nitrogenplan/nitrogenmgmt/amts

bacteria or pesticides. Preventing nitrate contamination of drinking water supplies is typically much more cost-effective than removing the contamination.[3]

In 2016-2017, 27 public water systems recorded a source water sample between 5 and 10 mg/L of nitrate and 10 systems recorded levels over 10 mg/L. Raw (source) water that exceeds the health risk limit of 10 mg/L nitrate-N is typically blended with water at a lower concentration. However, blending water from deeper wells can also increase the concentration of naturally-occurring chemicals such as iron, manganese, and radium. Some public water suppliers have had to install reverse osmosis treatment systems to remove nitrate and other contaminants to meet state and federal drinking water standards.

Groundwater Protection Practices

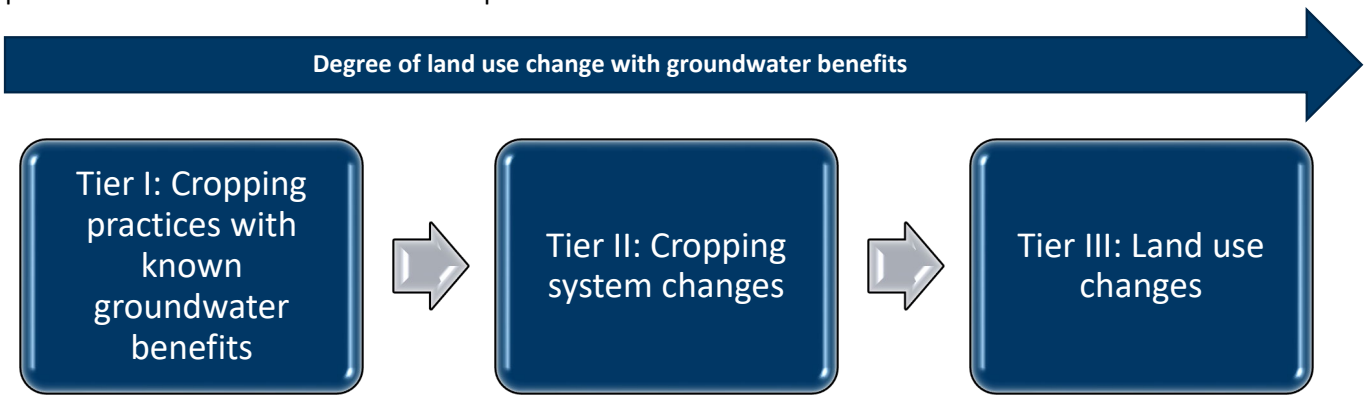
Conservation programs tend to focus mostly on two ends of the groundwater protection spectrum: best management practices (BMPs) applied to the existing cropping system, or land retirement, whether temporary or permanent, often through a conservation easement or conversion to a non-agricultural land use.



In practice, protecting or improving drinking water often depends on efforts made by many individual landowners employing a variety of BMPs, land retirement, and other practices in a given area.

There is increasing interest among conservation professionals and local governments, including public water suppliers, in practices that transition from a system based solely on annual row crops toward one that incorporates perennials and extended crop rotations to improve water quality and soil health.

Agricultural cost-share programs and easement programs can provide technical and financial assistance. However, technical and financial assistance is not always available or adequate for these mid-spectrum practices. The enhanced version of the spectrum looks like this:



[3] https://www.health.state.mn.us/communities/environment/water/swp/reqrec.html#Wellhead

The three tiers are discussed below under "The Groundwater/Drinking Water Protection Spectrum."

Selecting the Right Groundwater Protection Practices

Applicability to Local Water Plans and Watershed Planning

Both local water management plans traditionally developed by counties and the major watershed-scale plans now being developed under the One Watershed One Plan Program must address both surface water and groundwater resource issues. Groundwater Restoration and Protection Strategies (GRAPS) are interagency reports prepared by the Department of Health to inform the One Watershed One Plan process. The GRAPS report compiles information on groundwater resources in a particular watershed to help identify key groundwater quality and quantity concerns.

Water management plans establish a framework for future implementation. If a plan identifies specific groundwater protection strategies, those strategies are more likely to be funded under state and federal grant and cost-share programs.

Working with Producers

The practices outlined in this document may also be helpful to local governments, conservation district and watershed district staff, and others who work with individual producers interested in exploring alternatives to their current mix of crops and methods. Each practice should be evaluated for use at both a farm scale and a field scale for applicability. A variety of conservation programs and practices can be deployed across a single property, depending on its specific mix of resources and vulnerabilities.

Regional Effectiveness

Some of the practices described in this guide are broadly applicable across all agricultural landscapes, while others are likely to be most effective in specific areas. For example, nutrient management practices are most critical on the coarse-textured soils that are most susceptible to leaching of nitrate into groundwater. These soils are primarily found in Minnesota's Central Sands region. Areas of karst topography in southeastern Minnesota are also highly vulnerable, since the fractured limestone bedrock in this region allows nitrate to readily move downward into groundwater.

In highly vulnerable Drinking Water Supply Management Areas (DWSMAs), the most effective practices for reducing nitrate pollution are those that convert land from annual row crops to perennial crops or non-agricultural uses. In less vulnerable areas, practices such as cover crops or crop rotations may be appropriate. A localized assessment of soils, geology, and the mix of crops and livestock in each DWSMA can help to determine an appropriate balance of conservation practices to minimize nitrogen loss.

The Groundwater / Drinking Water Protection Spectrum

As noted above, the major practices discussed in this guide are grouped into three tiers – a generalized set of categories based on the degree to which they change or depart from conventional cropping systems and practices. The level of groundwater protection provided by each practice will vary depending on many factors, including the land area covered, the vulnerability of that land to contamination, and the intensity of the practice. Individual practices may not be sufficient to protect groundwater on their own, but stacking of complementary practices can increase their effectiveness. For example, cover crops combined with crop rotation can reduce the amount of nitrogen fertilizer needed in subsequent years. Practices that improve soil health also improve water retention, enhancing

the effectiveness of irrigation and drainage water management. Note that *practices that primarily benefit surface water quality, such as riparian buffers, conservation tillage and prescribed grazing, are not included in this groundwater/drinking water-focused spectrum*.

Tier I – Cropping Practices with Known Groundwater Benefits. These include management practices that provide measurable benefits within conventional cropping systems that have high potential for nutrient/pesticide leaching, such as continuous corn and/or irrigation.

1. Integrated Pest Management (595)
2. Irrigation Water Management (442) and Irrigation System Sprinkler (449)
3. Irrigation Water Nitrogen Credits
4. Karst Sinkhole Treatment (525)
5. Nutrient Management (590)

Tier II – Cropping System Changes. These involve practices that change or modify cropping systems to lower the inherent risk of nitrogen loss, such as introducing crop rotations with perennial crops.

1. Agroforestry, including Tree Crops / Silvopasture
2. Cover Crops (340), including Harvestable Cover Crops
3. Conservation Crop Rotation (328)
4. Forage and Biomass Planting (512)
5. Perennial Crops for Food, etc.
6. Pollinator Conservation Planting/ Honey Bee Production
7. Specialty and Short-Season Crops (with Cover Cropping, Nutrient Management)

Tier III – Land Use Changes. These practices take land out of agricultural production, transitioning to land retirement or non-agricultural land uses. Land may be converted to natural vegetation and wetlands under several federal and state easement programs, to energy development or to limited urban development combined with open space.

1. Conservation Cover (327), Critical Area Planting (342)
2. Open Space Design/Limited Development
3. Outdoor Recreational Uses
4. Solar Farm with Pollinator Habitat/Perennials

For each of the listed practices, NRCS practice numbers are noted as applicable. Goals are drawn from the "Purposes" section for each NRCS conservation practice standard, focusing on the groundwater-related goals.

Grant, Loan and Easement Programs

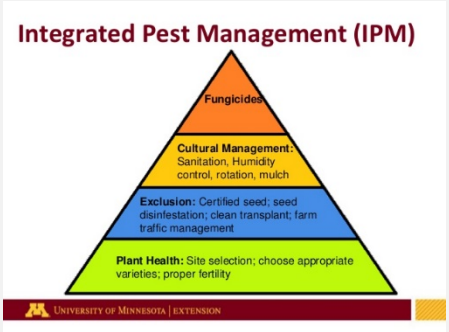
A selection of state, federal, and related programs that support these practices are profiled below under "Grant, Loan and Easement Programs for Groundwater/Drinking Water Protection." Funding is available for most practices through the federal NRCS programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). Other state and federal programs include:

- AgBMP Loan Program (MDA)
- Minnesota Agricultural Water Quality Certification Program (MAWQCP)
- Conservation Reserve Program (CRP)
- Conservation Reserve Enhancement Program (CREP)
- Other Easement Programs
- Outdoor Heritage Fund (Lessard-Sams Outdoor Heritage Council)
- Projects and Practices (Clean Water Fund) Grants: Drinking Water Subprogram

- Reinvest In Minnesota Reserve (RIM) Program (stand-alone)
- Source Water Projection Grants (MDH)
- Wellhead Protection Partners Grants (BWSR)

Tier I: Cropping Practices with Known Groundwater Benefits

The management practices in this tier are considered to provide measurable benefits within conventional cropping systems that may have naturally high potential for nutrient and pesticide leaching, such as continuous corn and or irrigation.

Practice – Tier I	Regional Effectiveness
Integrated Pest Management (595): Site-specific evaluation and plan for pest management to avoid unnecessary use of pesticides. Methods include herbicide banding rather than broadcast application, conservation tillage, and use of biological pest controls. • Funding: EQIP can provide 50-90% of establishment cost. • NRCS guidance includes practices for mitigating potential negative impacts of pesticides on pollinators using IPM, in *Agronomy Technical Note 9*, 2014. The MDA is responsible for development, promotion and evaluation of pesticide management BMPs. For further information: https://www.mda.state.mn.us/protecting/waterprotection/pmp *Goals: Prevent or mitigate off-site pesticide risks to water quality from leaching, solution runoff, etc. Prevent or mitigate risks to ecosystems from drift and volatilization, and risks to pollinators from contact.* **Impact on groundwater:** By increasing the efficiency of application, IPM can reduce the amount of pesticide and herbicides infiltrating into groundwater by avoiding unnecessary application and reducing rates of application. (MDA 2017).	 All regions
Irrigation Water Management (442) and Irrigation System Sprinkler (449): Determining and controlling the volume, frequency and application rate of irrigation water in a planned, efficient manner. Irrigation sprinkler systems are modified under this practice (449) to use lower-pressure nozzles to improve efficiency and reduce energy use. *Goals: Improve irrigation water use efficiency, minimize soil erosion, decrease degradation of surface and groundwater resources, etc.* **Impact on groundwater:** Research shows that by reducing irrigation water use, irrigation water management can reduce nitrate leaching to groundwater. Split fertilizer applications also reduce loss of nitrate from corn crops on irrigated sandy soils (MDA 2017).	 Most applicable to Coarse-Textured Soils

Irrigation Water Nitrogen Credits: Taking nitrogen fertilizer credits for nitrate present in irrigation water. This is an accompanying practice to Irrigation Water Management – crediting nitrogen from irrigation water reduces the amount of nitrogen fertilizer needed and related costs. "The University of Minnesota recommends crediting nitrogen from irrigation water as part of nitrogen fertilizer best management practices (BMPs) on irrigated soils. Proper nitrogen crediting and use of nitrogen BMP's are tools that will help the irrigator make profitable production decisions and that will also help protect water quality."[4] **Impact on groundwater:** Crediting can reduce fertilizer use, thus reducing potential nitrate leaching to groundwater.	 Most applicable to Coarse-Textured Soils
Karst Sinkhole Treatment (525): Treatment with a vegetated buffer (25 ft. min.) around the sinkhole and management of nutrients and pesticides within the surrounding watershed. *Goals: Improve ground and surface water quality, conserve soil and water resources.* **Impact on groundwater:** Localized impact avoiding leaching and intrusion of nutrients and pesticides around sinkholes.	 Applicable in karst topography - Southeast
Nutrient Management (590): The 4Rs of nutrient management – apply the Right nutrient source at the Right rate at the Right time in the Right place – to improve nutrient use efficiency by the crop and to minimize nutrient losses to the surface and groundwater. The Nitrogen Fertilizer BMPs form the core of the Minnesota Nitrogen Fertilizer Management Plan (NFMP) for groundwater protection. The Alternative Management Tools listed in the NFMP include detailed descriptions of advanced nutrient management such as variable rate applications and remote sensing (i.e., precision agriculture), sub-surface banding and controlled-release fertilizer methods. The Groundwater Protection Rule and extensive guidance materials outline practices for each Nitrogen BMP Region and for Coarse-Textured Soils (Sand Plain and localized areas). The rule: • Restricts the application of nitrogen fertilizer in the fall and on frozen soils in areas with vulnerable groundwater and in DWSMAs with elevated nitrate (≥5.4 mg/L) • Can require mitigation practices in DWSMAs with elevated nitrate greater than 8.0 mg/L if BMPs are not followed or if	 Most applicable to Coarse-Textured Soils

[4] http://www.chsprairielakes.com/about-us/latest-news/irrigation-water-nitrogen-crediting-service/

nitrate in groundwater increases.[5] Localized planning, assessment and modeling work may all be needed to determine the actual need for N reduction. *Goals (NRCS): Minimize pollution of surface and groundwater resources; conserve nutrients for plant production, improve soil health, etc.* **Impact on groundwater:** Nitrate loss to groundwater is high in coarse-textured soils, especially with irrigation. Reducing N rate (through use of in-season split applications, appropriate N source and inhibitors) and eliminating N applications during periods of little or no plant uptake (such as Fall through Preplant) will have the greatest impact on N leaching. However, it can be difficult to achieve sufficient reductions without reducing N application below the economically optimum rate (MDA 2017). Manure management methods to reduce water quality impacts include techniques such as stacking solid manure on a concrete pad and using water diversion systems, catch basins, and grass buffer strips to hold and filter runoff.[6] Land application of manure must meet setbacks from water features and use agronomic rates. Proper crediting of N in manure can reduce the need for fertilizer application. See MPCA guidance on land application of manure.	

Tier II: Cropping System Changes

These practices modify or change management of conventional summer annual crops to include longer crop rotations with small grains or perennials, forage and biomass planting, cover crops, and grazing practices that utilize forage crops. Because the return on these practices is more uncertain, higher incentives – and longer contracts with farmers – than those available through EQIP or other federal programs may be necessary. State funding programs have generally not been oriented toward establishment of harvestable perennial crops, but this approach is now being used in a few key wellhead protection areas to support planting of Kernza[7] and alfalfa and has potential for broader applicability.

[5] Groundwater Protection Rule has exceptions and detailed provisions not captured in this summary. See https://www.mda.state.mn.us/nfr for details.

[6] See https://extension.umn.edu/manure-management/tips-reduce-water-quality-issues. State rules (MR 7020.2125) establish requirements for manure stockpiling sites and MPCA provides detailed technical guidelines for this practice.

[7] https://www.mda.state.mn.us/2020-2021-forever-green-projects

Practice – Tier II	Regional Effectiveness
Agroforestry, including Tree Crops / Silvopasture: See Alley Cropping (311), Tree and Shrub Establishment (612) and Woody Residue Treatment (384) "Agroforestry is the intentional combining of agricultural and forestry practices to improve environmental quality, productivity, and economic returns." (UM Extension). • Practices include alley cropping, windbreaks, living snow fences, silvopasture (integrating livestock grazing and tree planting), riparian buffers • Alley cropping may be used to improve soil health, reduce runoff and erosion, increase carbon storage, etc. Plantings include fast-growing woody species or nut or fruit trees, nursery stock trees, etc. • No cost information is available – length of time to maturity is obstacle for some tree crops. *Goals (NRCS): Enhance or diversify a farm enterprise, improve water quality, reduce excess nutrients in runoff and groundwater, reduce soil erosion, increase carbon storage, wildlife habitat, etc.* **Impact on groundwater:** Similar impacts to riparian forest buffers (390, 391) and vegetative filters. Riparian vegetation can promote the settling of sediment and associated pollutants, including nitrates. However, Nitrogen removal varies widely by buffer width, hydrological flow path, and vegetative cover (MDA 2017).	 Potentially valuable against wind erosion in western MN Potential in SE, SC, historically forested "Big Woods" region
Cover Crops (340): Grasses, legumes, and forbs planted for seasonal vegetative cover, soil health, water retention, etc. Many cover crops are grazed and some can be harvested for food or forage. • Funding availability: EQIP, CSP, AgBMP Loan Program, and several SWCD and other LGU programs • NRCS-MN offers a detailed Cover Crop Seeding Guide (Technical Note 33) and calculation tool. • Additional cover crop calculator tools are available that quantify costs and benefits.[8] • Minnesota Cover Crop Research from the Minnesota Office for Soil Health • Growing season length, lack of needed equipment and logistics, and the trial-and-error nature of practice are frequently-cited obstacles to widespread adoption. • Cover crops have great potential in combination with short-season crops, e.g., canning crops, small grains. • Harvestable cover crops include winter camelina, pennycress, winter rye. Many cover crops can also be grazed. (Winter	 

[8] http://mccc.msu.edu/selector-tool/

Practice – Tier II	Regional Effectiveness
camelina is approved by NRCS as a recommended cover for MN.) *Goals: Reduce erosion, reduce water quality degradation by utilizing excessive soil nutrients, improve soil health and organic matter, etc.* **Impact on groundwater:** Cover crops can take up nutrients that would otherwise be lost from the field through surface or drainage water or infiltration. Studies in Minnesota and Iowa show reductions in nitrate loads in drainage water by over 60% with rye and oat cover crops (MDA 2017). Studies of winter camelina in particular show large decreases in nitrate loads in groundwater.	All regions, currently most widely used in South, Southeast
Conservation Crop Rotation (328): Planned succession of crops on the same field, including at least one low nitrogen input crop or two or more years of hay in a 5-year rotation. Studies suggest crop rotation leads to more efficient recovery of N by crops and is more effective at limiting nitrate leaching than timing of N fertilizer applications. • Various models of crop rotation include: 1) Adding perennials; 2) Extended rotation with small grains; 3) Grazed pasture in a 6-7 year rotation (consider no-till planting alfalfa after soybeans).[9] • Funding: EQIP; AgBMP Loan Program for capital costs. CSP also funds crop rotation to address soil erosion, organic matter improvement, and other soil health improvements. • If goal of practice is to reduce water quality degradation due to excess nutrients, NRCS practice standard recommends deep-rooted crops with quick germination and root system formation. *Goals: Reduce erosion and water quality degradation; improve soil moisture efficiency; provide feed and forage for livestock, food and cover habitat for wildlife, etc.* **Impact on groundwater:** Research indicates that perennial grasses and alfalfa have substantially less nitrate loss than row crops in a corn-soybean rotation (MDA 2017). A 4-year rotation incorporating alfalfa has been shown to have greater benefits than a 2- or 3-year rotation. Conservation crop rotation can lead to more efficient use of nitrogen (N) by crops, requiring less N input and less N susceptible to leaching.	  All regions, but most important for Central Sands, SE, SW

[9] NRCS, Iowa: Cropland Conservation Practices https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd332005.pdf

Practice – Tier II	Regional Effectiveness
Forage and Biomass Planting (512): Perennial vegetation utilized for pasture, hay, or biomass production. • Funding availability: EQIP, CSP, AgBMP Loan Program • Costs will differ widely depending on crop and practice. • Often in combination with Prescribed Grazing (528), and Forage Harvest Management (511) for hay, silage, haylage. *Goals: Improve livestock nutrition, health, soil and water quality, reduce erosion, produce feedstock for biofuel, etc.* **Impact on groundwater:** Similar to Conservation Crop Rotation above, planting of forage and biomass crops can reduce nitrate leaching compared to row crops in a corn-soybean rotation. According to an NRCS study, "once established, these perennial species… improve water infiltration, reduce runoff, retain nutrients that might otherwise enter a waterway… build soil organic matter [and] increase soil nitrogen through root and nodule turnover."[10]	 Central Sands, SE, SW – link to cattle on landscape and markets for hay / biomass
Perennial Crops for Food, etc. (Conservation Crop Rotation (328); not included under forage and biomass crops above): • Alfalfa • Kernza for food (the grain of intermediate wheatgrass, already classified as a forage crop) is now recognized by NRCS as part of Conservation Crop Rotation (328); allows grazing and grain harvest in one season. • Other emerging crops such as tree crops (hazelnuts, elderberries), perennial sunflowers, etc. • Small grains (oats, barley, flax) • Funding availability is uncertain but is becoming available in wellhead protection areas under approved watershed management plans (One Watershed One Plan). The potential for incorporating perennial crops into additional NRCS conservation practices is being explored. (Practice has been available for organic transitions but not conventional crops.) **Impact on groundwater:** Research indicates substantial reductions in nitrate leaching from Kernza and alfalfa (FGI, 2020). Small grains if followed by cover crops/relay crops can maximize cover crop benefits.	 Potentially all regions, with variability by crop

[10] Barker, D., et. al. 2012. Forage and Biomass Planting. Chapter 2 in *Conservation Outcomes from Pastureland and Hayland Practices: Assessment, Recommendations, and Knowledge Gaps*. NRCS. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1080494.pdf

Practice – Tier II	Regional Effectiveness
Pollinator Conservation / Honey Bee Production (multiple NRCS practices, but primarily Conservation Cover (327)): The Xerces Society has developed various guidance documents under 327[11]. See also "Conservation Work for Honeybees" – over three dozen NRCS conservation practices provide benefits to pollinators. EQIP funding provides additional incentives for including pollinator habitat as a supplement to other practices. **Impact on groundwater:** Research in this area is ongoing. Impacts are likely similar to those of Forage and Biomass Plantings (above).	 All regions
Specialty and Short-Season Crops (with Cover Cropping, Nutrient Management): Alternative small-scale specialty crops – including organic crops – can be part of a transition from a corn-soy monoculture.[12] If cultivated intensively, these crops can pose as great a concern as row crops for nitrate contamination. However, if combined with cover cropping and effective nutrient management, these practices can be effective in protecting groundwater. • Specialty crops are defined by the USDA as: fruits and vegetables, tree nuts, dried fruits, horticulture and nursery crops, floriculture, and processed products with 50% or more specialty crop content. • Canning crops and other short-season crops are considered "low-hanging fruit" for cover cropping, (due to longer time for cover crop establishment). • MDA offers Specialty Crop Block Grants (USDA-funded) to improve operational efficiencies, reduce costs or other barriers, increase access to distribution systems and new markets; and for research and development, compliance with federal standards. • Renewing the Countryside offers Specialty Crop Enhancement Teams in southeast and south central Minnesota. Program is intended to help edible specialty crop producers overcome obstacles, increase profits and grow operations. • U MN Extension Regional Sustainable Development Partnership Program works to develop supply chains for crops and systems that increase diversity on the landscape, by connecting U of MN researchers with community innovators.	  All regions, depending on crop and seasonal extension methods

[11] Biology Jobsheet #18: Establishment of Introduced Grasses and Legumes; Honey Bee Habitat (2016)

Biology Jobsheet #16: Native Habitat Development for Pollinators, Honey Bees and Monarchs (2018)

Biology Tech. Note No. 78: Using 2014 Farm Bill Programs for Pollinator Conservation (2015)

[12] USDA provides resources for small and mid-sized producers: https://www.usda.gov/topics/farming/resources-small-and-mid-sized-farmers

Practice – Tier II	Regional Effectiveness
• FSA Organic Certification Cost-Share funding available for organic certification, up to 75% of costs. • FSA microloan programs available for small, beginning, and non-traditional farm operations such as truck farms, CSAs, etc. **Impact on groundwater:** This strategy is designed to improve the economics of alternative practices, not to directly impact groundwater resources.	

Tier III: Land Use Changes

These practices take land entirely or partially out of agricultural production, placing it into wildlife habitat, protected open space, or other land uses, including options for limited development. Funding through federal and state easement programs and private not-for-profit land trusts and conservation organizations may be available. Funding through the Outdoor Heritage Fund (see below under Programs) is available for many habitat-related land retirement programs.

Practice – Tier III	Regional Effectiveness
Conservation Cover (327); Critical Area Planting (342): Conversion of land from an intensive cropping system to permanent native or non-native vegetation. Generally undertaken under one of the easement or land retirement programs listed below under "Programs." *Goals: Reduce soil erosion, soil quality degradation; improve water quality, develop wildlife habitat, reduce air quality impacts.* **Impact on groundwater:** Conservation cover reduces nitrate losses in surface runoff by significant amounts (MDA 2017). Additional research on groundwater impacts are needed; however, conversion of land in vulnerable DWSMAs from row crops to conservation cover has resulted in decreases in nitrate concentrations.	 All regions
Open Space Design/Limited Development: The concept of "limited development" is used by land trusts, other nonprofits, and private developers to protect significant natural areas or public open space while allowing development of less sensitive portions of a site. Leading organizations in this sphere include The Nature Conservancy (TNC), the Trust for Public Land, and the Minnesota Land Trust. These non-profits have partnered with DNR and other agencies to conduct land transactions, since they can often move more quickly than public agencies. Private developers have also employed conservation design techniques to protect significant open space, often using easements for permanent protection. • TNC – "has bought land in critical conservation areas (especially land that buffers and surrounds core natural areas), placed conservation easements on the land and then resold the restricted property. This is referred to as a "conservation buyer" project."	 All regions, given proximity to urban areas, sufficient development pressure Photo: Fields of St. Croix Conservation Development, Lake Elmo

Practice – Tier III	Regional Effectiveness
• In a DWSMA, any development would need to treat all stormwater to a very high level or move it off the site for treatment. • Grants to LGUs and other consortiums could be used for this purpose. **Impact on groundwater:** Impacts are likely to be indirect but are contingent on the manner in which open space and other land uses are designed.	
Outdoor Recreational Uses: Includes game farm/hunting preserve, wildlife management areas, waterfowl production areas, etc. • Worthington Wells WMA is one example of conversion of cropland to public wildlife management area. (Pheasants Forever, DNR, and multiple partners protect over 95% of highly vulnerable acres in Worthington DWSMA.) **Impact on groundwater:** Similar to Conservation Cover.	 All regions; vulnerable DWSMAs
Solar Farm with Pollinator Habitat/Perennials: Many solar installations include native prairie plantings. BWSR offers a Habitat Friendly Solar Program that promotes the planting and management of wildlife habitat with an emphasis on pollinator benefits on solar projects Project sponsors must use DNR's Prairie Establishment & Maintenance Technical Guide for Solar Projects, fill out BWSR's Solar Site Pollinator Habitat Assessment form for Project Planning, and work with habitat restoration experts. A follow-up assessment is required after three years of vegetation establishment and every three years afterwards. **Impact on groundwater:** Research is ongoing, but impacts are likely to be similar to those of Conservation Cover and/or Forage and Biomass Planting.	 All regions, depending on access to power grid

Grant, Loan and Easement Programs for Groundwater/Drinking Water Protection

This section highlights several federal and state grant and loan programs that can be targeted toward groundwater protection. It does not encompass all programs and may not capture the most recent guidance (since programs can change from year to year), but rather is intended as a starting point for further exploration.

AgBMP Loan Program: This MDA program provides low-interest loans to farmers, rural landowners, and agriculture supply businesses to solve existing water quality problems. The purpose is to encourage agricultural Best Management Practices that prevent or reduce runoff from feedlots, farm fields and other pollution problems identified by the local government in water plans.	
MN Ag Water Quality Certification Program (MAWQCP): A voluntary program for farmers and agricultural landowners to proactively implement water quality conservation practices and management into comprehensive farm management systems. The program is a partnership with federal, state, public, and private collaborators. Certification systematically identifies and then mitigates risks to water quality on a field-by-field basis; every field and crop on a farm must meet MAWQCP's criteria. Participants receive priority for technical and financial assistance to implement practices and improve soil health. Farmers who become MAWQCP-certified obtain regulatory certainty for ten years as complying with any new water quality rules or laws during that time.	
Environmental Quality Incentive Program (EQIP): Voluntary conservation program from NRCS that helps agricultural producers in a manner that promotes agricultural production and environmental quality as compatible goals. Through EQIP, agricultural producers receive financial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land. Eligible practices, payment rates, prioritization of resource concerns, and ranking criteria are developed based on input and recommendations from both the State Technical Advisory Committee (STAC) and Local Work Groups. Although EQIP is available statewide, eligibility criteria, complicated procedures and limited funding can all reduce participation. The 2018 Farm Bill specifies that 10% of financial assistance must be dedicated to source water protection.	
Conservation Stewardship Program (CSP): For producers already implementing conservation practices, CSP offers opportunities to expand on these efforts by offering enhancements and additional practices. In Minnesota, CSP applications are evaluated on a regional basis addressing priority resources concerns within four geographic regions. CSP contracts are for five years with an option to renew. CSP offers two types of payments: 1. Payments to maintain the existing level of conservation based on the land uses included in the contract and NRCS assessment of existing stewardship, and 2. Payments to implement additional conservation activities.	

Conservation Reserve Program (CRP): A program of the USDA's Farm Service Agency, CRP provides annual rental payments to producers to increase conservation practices on ecologically sensitive cropland and pastureland. Includes Continuous, General, Grasslands, and CREP (listed below). Under general CRP sign-up, producers submit competitive bids during specified enrollment periods, and contracts are scored and awarded based on an environmental benefits index. Under continuous sign-up, environmentally sensitive agricultural land can be devoted to conservation practices and enrolled in CRP at any time. The CRP Grasslands program allows grazing, but for a lower payment than typical CRP payments. Producers are generally given ten- to 15-year contracts with annual rental payments and restoration cost-share assistance. Haying, grazing, or other income-producing activities allowed, but with a significant penalty.

The disadvantages of CRP are its temporary nature, limited availability, and declining land base. In Minnesota, CRP has declined from 1.83 million acres in 2007 to 1.03 million acres in 2020.

CRP enrollment was capped at 24 million acres nationally by 2018 in the 2014 federal Farm Bill. The 2018 Farm Bill raised the cap to 27 million acres.





Conservation Reserve Enhancement Program (CREP): A state-level sub-program of CRP, with the federal government contributing up to 80 percent of the cost of the CREP. The current Minnesota CREP was approved in 2017 with the goal of taking marginal land out of production and replacing it with natural vegetation and wetlands that protect water quality and provide increased habitat. It includes $350 million from USDA and $150 million from the State of Minnesota. In this new CREP, up to 60,000 acres can be enrolled across 54 counties, primarily targeting riparian and marginal agricultural land. CREP combines an initial 15-year CRP contract with a permanent RIM easement. Payments are based on current CRP rental rates and RIM rates that approximate 90% of the value of the land. CREP payments will always be higher than those provided for BMPs or contracts for other practices. Payment rates were updated in 2018.

CREP encompasses four practices, one of which is wellhead protection (CP-2). The other three practices are Grass Filter Strips (Buffers) and Wetland Restoration (non-floodplain and floodplain).

In limited situations RIM-only cropland and non-cropland may be allowed as a part of a MN CREP application to make the easement area more manageable and to provide greater benefits to the landowner and the resources. (See also RIM stand-alone summary below).



Applies in designated counties in southern and western Minnesota

Other Easement Programs:

- **Private and Local Easement Programs:** A number of private not-for-profit conservation organizations and LGUs work with landowners to restore high quality natural habitat on their lands, typically through conservation easement. Easement-holders in Minnesota include the Minnesota Land Trust, The Nature Conservancy, Pheasants Forever, and a number of local and regional foundations and governments. Dakota County operates an easement program to protect farmland and natural areas, and Washington County purchases conservation easements on high priority conservation areas.
- **Wetland Reserve Easements (WREP):** Under the Wetlands Reserve Easements program, NRCS helps to restore, protect and enhance enrolled wetlands. Eligible lands include:
    - Farmed or converted wetlands that can successfully be restored;
    - Croplands or grasslands subject to flooding; and
    - Riparian areas that link protected wetland areas.

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/



Photo: Vermillion River, Dakota County. Vermillion River Watershed JPO

Outdoor Heritage Fund (Lessard-Sams Outdoor Heritage Council)

The Lessard-Sams Outdoor Heritage Council (LSOHC) provides annual funding recommendations to the legislature from the Outdoor Heritage Fund, one of four funds created by the Clean Water, Land and Legacy Amendment. Funding is allocated to projects that restore, protect, and enhance wetlands, prairies, forests, and habitat for fish, game, and wildlife. Proposals must be consistent with the Council's visions for Minnesota's ecological sections. Agricultural regions of the state generally fall into the Prairie, Forest/Prairie Transition, and Southeast Forest ecological sections. Funding goes to state agencies, local governments, and conservation organizations for land and easement acquisition and habitat restoration programs.



Projects and Practices (Clean Water Fund) Grants: Drinking Water Subprogram: This competitive CWF grant administered by BWSR makes an investment in on-the-ground projects and practices that will protect or restore water quality in lakes, rivers or streams, or will protect groundwater or drinking water. Surface water activities are the focus of the primary Projects and Practices grant.

The Drinking Water Subprogram sets aside up to 20% of the total available funding for projects that protect drinking water. Appropriate practices could include soil health practices, perennial crops, increased incentives for conservation practice adoption, stormwater treatment and sealing of unused public or private wells. (See factsheet, Clean Water Fund Drinking Water Protection Grant).



All regions
Photo Minnesota River Basin Data Center

Reinvest In Minnesota Reserve (RIM) Program - stand-alone program: The primary land acquisition program for state-held conservation easements and restoration of wetlands and native grasslands on private lands in MN. Payment is a lump sum after the easement is recorded, based on Assessor's Township Average Market Values (ATAMV) for tillable land (updated annually by BWSR). RIM been primarily used in combination with CREP recently, since that maximizes leverage over federal funds. However, stand-alone RIM will be considered in situations where CREP is not feasible or acceptable.	 All regions
Source Water Protection Grants: These MDH-administered Clean Water Fund grants to public water suppliers provide funding in various categories: • Plan Implementation Grants: To implement MDH-approved wellhead protection plans for community or nontransient noncommunity water suppliers. Maximum $10,000; no match required. • Competitive Grants: To implement source water protection practices and manage potential contamination sources, whether or not a wellhead protection plan is in place. Maximum $10,000 ($30,000 for combined applications); match required. • Transient grants: To support wellhead protection measures addressing potential contamination sources for noncommunity transient systems such as campgrounds, lodging, etc. Maximum $10,000; match required.	 Activities within DWSMAs
Wellhead Protection Partner Grants: This pilot program from BWSR allows grants to local governments for perpetual or long-term protection of wellhead protection areas with very high or high vulnerability supplies. In cases where CREP or RIM-only easements are not feasible, grants can be used to protect the wellhead area by easement, fee acquisition, or other long-term (20-year minimum) protection mechanism.	 DWSMAs with high or very high vulnerability

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Acronyms

ACEP	Agricultural Conservation Easement Program
BMP	Best Management Practice
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
DNR	Minnesota Department of Natural Resources
DWSMA	Drinking Water Supply Management Area
FSA	Farm Service Agency
MAWQCP	Minnesota Agricultural Water Quality Certification Program
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
NRCS	Natural Resources Conservation Service
RIM	Reinvest in Minnesota Reserve Program
SWCD	Soil and Water Conservation District
USDA	U.S. Department of Agriculture