



MEMORANDUM

Date: April 13, 2021

Re: Koshkonong Solar Energy Center - Project Water Quality
Improvements
File 0023582.00

To: Koshkonong Solar Energy Center, LLC

From: Westwood Professional Services

This memo summarizes permanent stormwater runoff improvements that will be realized by the construction of the proposed Koshkonong Solar Energy Center ("Project"). The Project is located in Dane County, Wisconsin within Christiana and Deerfield Townships. The overall Project Area encompasses 6,384 acres which includes the Study Area of 2,402 acres consisting of primary array acres, aggregate access roads, and associated solar infrastructure and facilities.

The Project consists of a low impact development (LID) design approach to minimize the amount of impervious surfaces within the Study Area while simultaneously utilizing established vegetation for stormwater management. The table below summarizes the various water quality improvements provided from the proposed Project:

Water Quality Characteristic	Existing Conditions	Proposed Conditions	± Δ (Load)	± Δ %
TSS Removal for Developed Study Area	333,399 lbs/year	42,511 lbs/year	-290,888 lbs/year	-87%
1-year 24-hour Runoff Rate	3,104 gal/s (415 cfs)	1,249 gal/s (167 cfs)	-1,840 gal/s	-60%
2-year 24-hour Runoff Rate	4,788 gal/s (640 cfs)	2,229 gal/s (298 cfs)	-2,559 gal/s	-54%
10-year 24-hour Runoff Rate	11,670 gal/s (1,560 cfs)	6,882 gal/s (920 cfs)	-4,788 gal/s	-41%
100-year 24-hour Runoff Rate	27,087 gal/s (3,621 cfs)	19,008 gal/s (2,541 cfs)	-8,079 gal/s	-30%
Infiltration Volume for Developed Study Area	8,630,163,735 gal (26,485 ac-ft)	8,822,741,676 gal (27,076 ac-ft)	+192,577,941 gal	+2.2%
Nitrogen Outflow for Developed Study Area	7,116 lbs/year	3,672 lbs/year	-3,444 lbs/year	-48%
Phosphorus Outflow for Developed Study Area	1,449 lbs/year	681 lbs/year	-768 lbs/year	-53%

PRELIMINARY STORMWATER MANAGEMENT REPORT

Koshkonong Solar Energy Center

Dane County, Wisconsin

APRIL 2021



PREPARED FOR:

Koshkonong Solar Energy Center, LLC

PREPARED BY:

Westwood

Preliminary Stormwater Management Report

Koshkonong Solar Energy Center

Dane County, Wisconsin

Prepared For:

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Project Number: R0023582.00

Date: April 13, 2021

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Exhibits

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Introduction

The Preliminary Stormwater Management Report summarizes the stormwater analysis for the Koshkonong Solar Energy Center ("Project"). This report was prepared per local and state requirements and is intended for submittal to these agencies for permitting review and approval.

The Project is located in Dane County, Wisconsin within Christiana and Deerfield Townships. The overall Project Area encompasses 6,384 acres which includes the Study Area of 2,402 acres consisting of primary array acres, aggregate access roads, and associated solar infrastructure and facilities. The Study Area's current use is mostly agricultural row crops and small areas of woods.

The proposed Project will be a solar facility consisting of solar modules and 73 acres of impervious surface including aggregate access roads, inverters, transformers, a substation, a battery energy storage system, and an O&M facility. The proposed Project will be converted to meadow conditions, including areas under the solar modules and areas around the proposed impervious areas. Due to the area between and beneath the panels being vegetated, panels are typically not considered an impervious surface.

FEMA has completed a study to determine flood hazards for the selected location; the Study Area does not contain FEMA flood areas. No preliminary or pending FEMA data was located that will affect the Study Area.

Minimal grading will be proposed in the Project and existing drainage patterns will be maintained.

HydroCAD modeling software was used to quantify the Study Area runoff, high water levels, and treatment volumes. P8 was used to show infiltration and TSS reduction.

The proposed analysis shows that the proposed Project meets the requirements of the Wisconsin Administrative Code and the Dane County Erosion Control and Stormwater Management requirements.

Data Sources

TABLE 1: DATA SOURCES

Task	Format	Source	Use
Elevation	2-foot NED	Wisconsin View	Model Elevations
Crop Data	Shapefile	USDA 2013 Crop Data Layer	Landcover
Soils	Shapefile	USGS SSURGO Dataset	Curve Numbers
Precipitation	PDF File	NOAA Atlas 14	Design Storms
Project Area	Shapefile	Koshkonong Solar Energy Center, LLC	Define Model Extents
2014 Aerial Photography	ArcGIS Map Service	USDA FSA	Reference

Project Area Conditions

Project Area Location

The Project Area is located in Dane County, Wisconsin within Christiana and Deerfield Townships.

Historical Use

A review of aerial photographs shows that the Project Area is currently used and has historically been used for agricultural row crops with small areas of woods.

Topography Description

The existing topographic information used in this analysis was obtained from USGS National Elevation Set 2-foot NED elevation data obtained from Wisconsin View. Slopes within the Project Area are generally within the 0 to 6% range with minor areas with 6 to 12% slopes.

Drainage Patterns

The Study Area runoff is split into 42 drainage areas based on discharge locations and existing low areas. Existing ditches flow near the drainage areas routing runoff once it leaves the Project. Drainage areas are shown in Exhibits 5 and 6.

Discharge Locations

The Study Area has eight (8) ultimate discharge locations. Discharge locations are shown in Exhibits 5 and 6.

Soils

Soils data was downloaded from SSURGO and can be found in Exhibit 3.

The Study Area consists primarily of Hydrologic Soil Group (HSG) B and C soils. Type B soils have moderate runoff potential and infiltration rates. Type C soils have moderate runoff potential and low infiltration rates.

Infiltration

Based on the extent and prevalence of Silt Loam being present in the Study Area, an infiltration rate of 0.13 in/hour (from Wisconsin Administrative Code) was used for the analysis of the Study Area.

Methodology

Existing and proposed conditions are modeled in HydroCAD software. HydroCAD is a widely accepted hydrologic and hydraulic modeling package based on TR-20 unit hydrograph equations. It models stormwater runoff discharge rates and velocities from ponds, culverts, outlet control structures, and stream reaches.

Hydrology

Curve Number Methodology, based on the NRCS-TR 55 method, was used in the modeling for predicting direct runoff. Curve numbers were assigned by reviewing the soil and landcover data for each drainage area.

Time of concentrations were calculated for each drainage area in HydroCAD using the lag method. The lag method uses the hydraulic length (distance traveled by a drop of water from the

most distant part of the subcatchment to the outlet point) and the average land slope (average slope of entire watershed). The overall curve number for the drainage area along with the lag information is used to get the time of concentration for the drainage area.

Atlas 14 precipitation and distribution data for the 1-year, 2-year, 10-year, and 100-year 24-hour storm events were used as input for the analysis (Appendix A).

P8 Urban Catchment Model

Program for Predicting Polluting Particle Passage Thru Pits, Puddles, and Ponds (P8) is a model that simulates the generation and transport of stormwater runoff pollutants in urban watershed areas. It models and evaluates the effectiveness of runoff treatment measures including detention ponds, infiltration basins, swales, and vegetated buffers. Runoff calculations are based off the SCS curve number method (based off landcover and soil conditions) and evapotranspiration and mass balance equations. Local precipitation and air temperature files are used as input for the analysis.

Existing Conditions

The existing Study Area consists of row crops and wooded areas. Cover for the analysis was determined using the USDA 2013 Crop Data Layer and aerial photos. Curve numbers were assigned based on Wisconsin Administrative Code NR 151.123, see Table 2 below for summary.

TABLE 2: EXISTING CONDITIONS COVER

Cover	CN	Area [ac]
Cropland, HSG B	69	1,909.79
Cropland, HSG C	78	11.49
Woodland, HSG B	55	475.22
Woodland, HSG C	70	5.80
Total		2,402.30

Proposed Conditions

The proposed Project will be a solar facility consisting of solar modules and 73 acres of impervious surface including aggregate access roads, inverters, transformers, a substation, a battery energy storage system, and an O&M facility. The solar modules will be elevated above grade and the finished ground conditions below will be completely pervious by converting to a vegetated filter of meadow grass. The proposed meadow below the solar arrays will act as vegetated filters to treat runoff from the proposed impervious.

Minimal grading is proposed to meet the tolerances of the proposed solar array and drainage conditions will remain the same as existing.

TABLE 3: PROPOSED CONDITIONS COVER

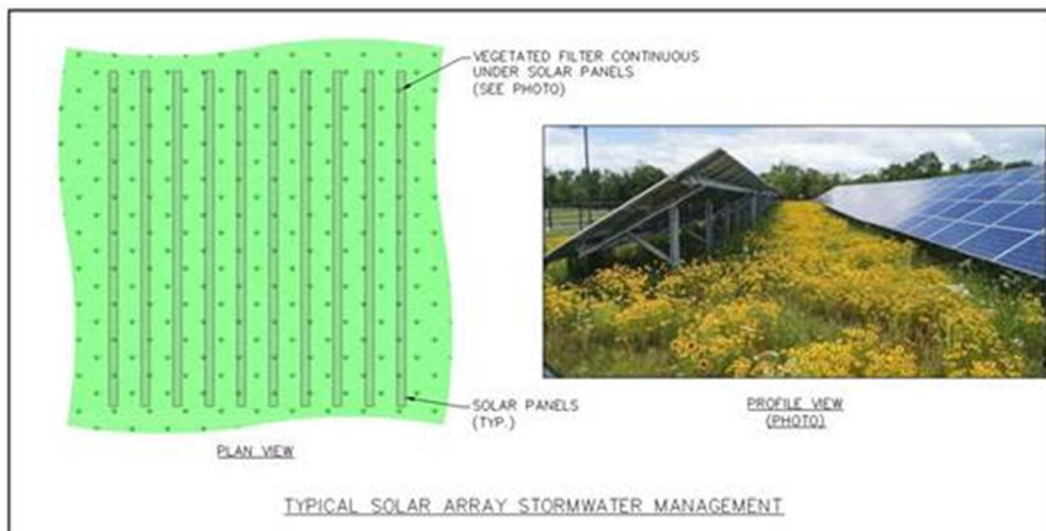
Cover	CN	Area [ac]
Grassland, HSG B	61	1,850.74
Grassland, HSG C	71	478.80
Roads/Inverters/Substation/Switchyard/BESS	96	72.76
Total		2,402.30

Proposed Stormwater Management

To meet the Wisconsin Administrative Code NR 151.121-151.128 post-construction performance standards for new development and redevelopment projects, a low impact development (LID) approach is proposed. The proposed management will consist of a vegetated filter under the proposed panels and throughout the Project with the addition of existing low areas to store runoff. Low areas within the Study Area meet the requirements for first-flush as shown in the below sections.

The proposed layout has minimized the proposed impervious surfaces and will consist of solar panels, gravel roads and other electrical equipment. Solar panels have a unique runoff characteristic, not like buildings or roads, but a fully disconnected impervious surface. The runoff generated from the solar panels will flow to the edge of the panels and will be allowed to drip onto the pervious surface below.

All areas below the panels will be seeded with a vegetated filter consisting of a low-maintenance grass seed mix. This vegetated filter acts as a permanent BMP and allows for runoff, sediment, and other pollutants to be infiltrated or captured by the vegetation. To further aid in the soils infiltration capacity, minimal grading is proposed.



In lieu of a typical stormwater management BMPs, the recommended approach for solar projects should include the following: limit the amount of impervious surfaces to reduce runoff,

minimize the amount of grading to promote sheet flow, and the planting of the meadow grass on the majority of the Study Area to provide both runoff reduction and treatment.

Per the runoff calculations summarized below, the use of the proposed vegetated filter will significantly reduce the runoff rate and volume from the Study Area.

Stormwater Management Requirements

Stormwater management for the Project falls under the jurisdiction of the Wisconsin Administrative Code, (https://docs.legis.wisconsin.gov/code/admin_code/nr/100/151/III/121). The Project also falls under the Dane County Erosion Control and Stormwater Management Chapter 14.51. The following requirements need to be met for the Project:

Total Suspended Solids

The Wisconsin Administrative Code NR 151.122 requires that new development reduce the total suspended solids (TSS) load by 80%. Per State requirements, the TSS removal from the Project overland flow was calculated for the Project using the P8 Urban Catchment Model program. For the existing conditions, a weighted curve number was used to represent the existing agricultural vegetation for each corresponding watershed and HSG. For the proposed condition, a weighted curve number was used to represent the proposed landcover for each corresponding watershed and HSG. This curve number was weighted to include the proposed meadow vegetation and disconnected impervious surfaces consisting of aggregate access roads, transformers, a substation, a battery energy storage system, and an O&M facility. The runoff generated from the solar panels will flow to the edge of the panels and be allowed to drip onto the pervious meadow vegetation below. The results of this analysis can be found in Appendix D and Table 4 below. This analysis includes the portion of the Project Area that will be developed as part of the solar facility, as well as all added impervious surfaces including aggregate access roads, transformers, a substation, a battery energy storage system, and an O&M facility (Study Area ~2,402.30 acres).

TABLE 4: TSS REMOVAL

Load In (lbs.)	Load Out (lbs.)	Load Reduction (%)
333,398.6	42,511.2	87.2

Peak Discharge

The Wisconsin Administrative Code NR 151.123 requires that pre-construction runoff rates are maintained or reduced in post-construction conditions for both the 1-year and 2-year 24-hour storm event. The existing and proposed runoff rates were calculated for the entire Study Area using HydroCAD software. The Atlas-14 1-year and 2-year 24-hour precipitation values for the Study Area are 2.46 inches and 2.81 inches, respectively (Appendix A). For the existing conditions, various curve numbers were used to represent the agricultural row crop and non-agricultural runoff conditions for each subwatershed within the Study Area. For the proposed conditions, a weighted curve number was used to represent meadow vegetation for each corresponding watershed and HSG. This curve number was weighted to include the proposed disconnected impervious surfaces consisting of aggregate access roads, transformers, a substation, a battery energy storage system, and an O&M facility. Table 5 below compares the

Study Area flows between the existing and proposed conditions for the 1-year and 2-year events, respectively. The full HydroCAD analysis can be found in Appendix B and C. This analysis includes the entire Study Area (2,402 acres).

TABLE 5: 1-YEAR & 2-YEAR RUNOFF RATE SUMMARY

Subwatershed #	1-year Runoff (cfs)		2-year Runoff (cfs)	
	Existing	Proposed	Existing	Proposed
1	127.67	45.03	200.30	83.79
2	28.38	12.03	42.93	21.09
3	133.30	63.51	202.93	108.62
4	39.69	13.55	62.62	26.14
5	3.21	1.19	5.31	2.34
6	58.76	23.25	87.93	40.05
7	5.70	2.13	8.80	3.92
8	18.34	6.10	29.29	11.97

Infiltration

The Wisconsin Administrative Code NR 151.124 requires that for a project less than 10% impervious, provided infiltration volume must equal at least 90% of the existing project infiltration. The existing and proposed infiltration rates were calculated for the entire Study Area using the P8 Urban Catchment Model program. For the existing conditions, various curve numbers were used to represent the runoff conditions for each subwatershed within the Study Area. For the proposed conditions, a weighted curve number was used to represent meadow vegetation for each corresponding watershed and HSG. This curve number was weighted to include the proposed disconnected impervious surfaces consisting of aggregate access roads, transformers, a substation, a battery energy storage system, and an O&M facility. Due to the HSG Type B and C soils present within the Study Area, infiltration rate of 0.13 inches/hour was input into the P8 model for both the existing and proposed conditions. Table 6 below compares the existing and proposed infiltration rates for the Study Area. The full P8 analysis can be found in Appendix D.

TABLE 6: INFILTRATION VOLUME

Pre-Construction Infiltration Volume (ac-ft)	Post-Construction Infiltration Volume (ac-ft)	Percent of Pre-Construction Infiltration (Δ %)
26,485.13	27,076.42	+2.2%

Dane County Stormwater Requirements

The Dane County Erosion Control and Stormwater Management Chapter 14.51 requires that the peak discharge rates not exceed the pre-developed rates for the 1-year, 2-year, 10-year, and 100-year 24-hour storm events. In addition to the 1-year and 2-year peak discharge rates listed in Table 5 above, Table 7 below compares discharge rates between the existing and proposed conditions for the 10-year and 100-year.

TABLE 7: 10-YEAR & 100-YEAR RUNOFF RATE SUMMARY

Subwatershed #	10-year Runoff (cfs)		100-year Runoff (cfs)	
	Existing	Proposed	Existing	Proposed
1	504.09	276.97	1203.30	807.08
2	100.86	62.26	226.20	164.09
3	483.54	313.25	1103.49	825.03
4	157.11	88.12	369.86	252.83
5	14.13	8.49	33.92	24.73
6	203.66	117.18	455.26	311.32
7	21.25	12.37	48.62	33.90
8	75.17	41.36	180.41	121.87

Consistent with the Wisconsin Administrative Code NR 151.122, Dane County requires the new development reduce the total suspended solids (TSS) load by 80%. See Table 4 for TSS removal loads.

Consistent with the Wisconsin Administrative Code NR 151.124, Dane County requires that new developments have design practices to infiltrate sufficient runoff volume so that post-development infiltration volume shall be at least 90% of the pre-development infiltration volume. See Table 6 for pre- and post-development infiltration totals.

Koshkonong Solar Energy Center LLC will submit a Final Stormwater Management Report to Dane County upon final design.

Construction Conditions

During construction conditions, runoff rates and volumes can be expected to be higher than the fully vegetated final condition. Due to the shallow excavation depths on the Project, significant dewatering is not expected during construction. If dewatering is required due to intrusion of rainwater, surface runoff, or groundwater into trenches or other excavations, dewatering will use small pumps and discharge locally applying sediment control as outlined in the Erosion Control and Storm Water Management Plan. Using temporary seed/mulch at the onset of construction can greatly reduce the amount of erosion and rework on solar projects.

Temporary construction sedimentation basins will be necessary where greater than 10 acres of disturbed area discharges to a common point. Based on permit requirements and the current design, no temporary sediment basins are currently proposed. Portions of the Project will seed prior to and during construction to minimize disturbed soils with the intent to maintain under 10 acres of disturbance at any given time draining to a common discharge point during construction.

Conclusion

This drainage report has been prepared and the Project is in compliance with the Wisconsin Administrative Code. Based on experience on similar projects, the Project is suitable for the planned development and all hydrologic concerns can be addressed through detailed engineering design. Runoff from the inverters and gravel access roads will be allowed to sheet flow across the newly established perennial vegetation. The proposed Project discharges in a manner similar to the existing flow pattern in all modeled storm events and does not alter drainage patterns. The proposed Project also increases the Study Area infiltration volume and reduces the TSS load, nutrient losses, and peak discharge rates.

If changes to the proposed array and facilities design are made, the analysis should be reviewed to ensure that all assumptions are still valid. Based on experience on other similar projects, the overall Project is suitable for the planned development.

References Cited

National Engineering Handbook, Part 630 Hydrology. Chapter 9 Hydrologic Soil-Cover Complexes. USDA. NRCS. 210-VI-NEH, July 2004

Wisconsin View. 1-ft and 2-ft Elevation data, Accessed January 2020, <https://wisconsinview.org/>

Web soil survey. Retrieved January 2021, from <https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>

NOAA, & Service, N. W. AHPS Precipitation analysis. Retrieved January 2021, from <http://water.weather.gov/precip/download.php>

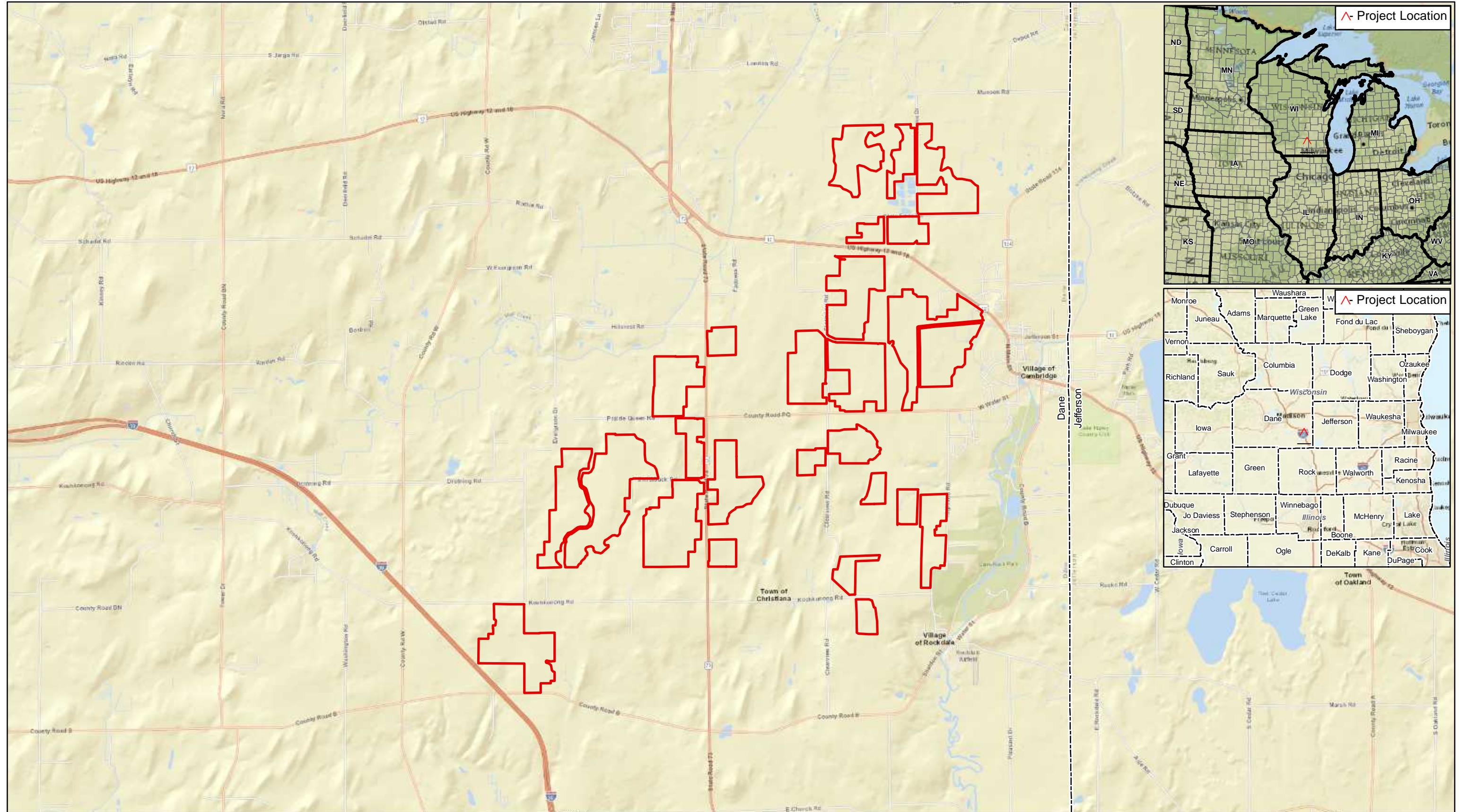
USGS. USGS water resources: About USGS water resources. Retrieved January 2021, from <https://water.usgs.gov/GIS/huc.html>

USDA 2013 Crop Data Layer, Landcover data, retrieved January 2021, from https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php

FEMA Flood Insurance Rate Maps, retrieved January 2020 from <https://msc.fema.gov/portal/advanceSearch#searchresultsanchor>

The background of the page is a dark red topographic map with intricate contour lines. A dashed red line runs vertically through the center, starting from the top and ending near a solid red dot in the lower-left quadrant. A red 'x' is located on the dashed line, slightly above the solid red dot. The word "Exhibits" is printed in white, sans-serif font, centered horizontally and partially overlapping the dashed line.



Exhibits



Data Sources: Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

Westwood
Toll Free (888) 937-5150 westwoodps.com
Westwood Professional Services, Inc.

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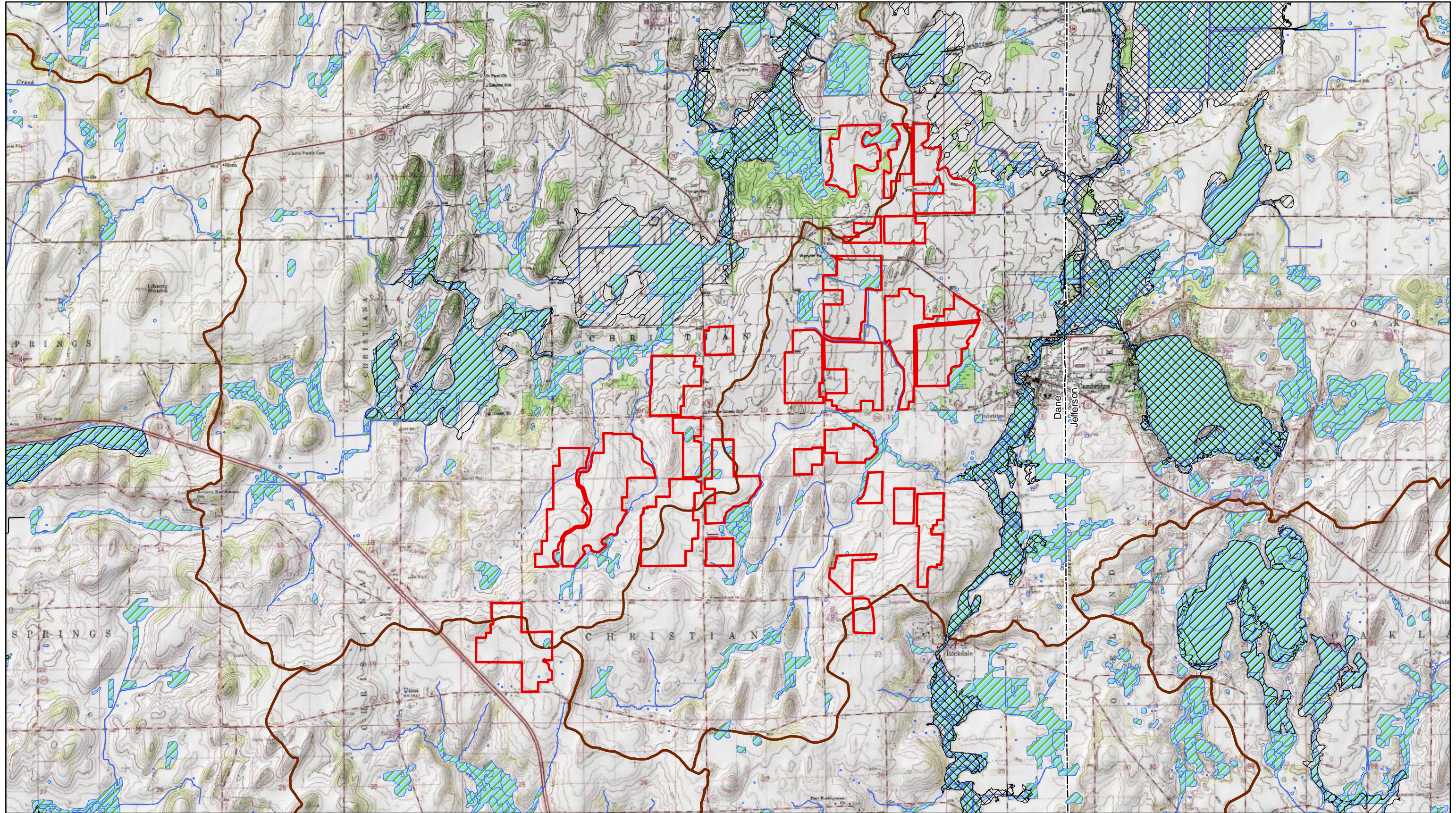
-  County Boundary
-  Project Area



Koshkonong Solar Energy Center
Dane County, WI

Exhibit 1: Location Map

April 12, 2021



Data Sources: Westwood (2021); Esri WMS
 Basemap Imagery (Accessed 2021); USGS
 (2021); FEMA (2021); USDA (2021)

Legend

- County Boundary
- HUC-12 Boundary
- NWI Wetlands
- Project Area
- NHD Flowline
- FEMA Zone A
- FEMA Zone AE

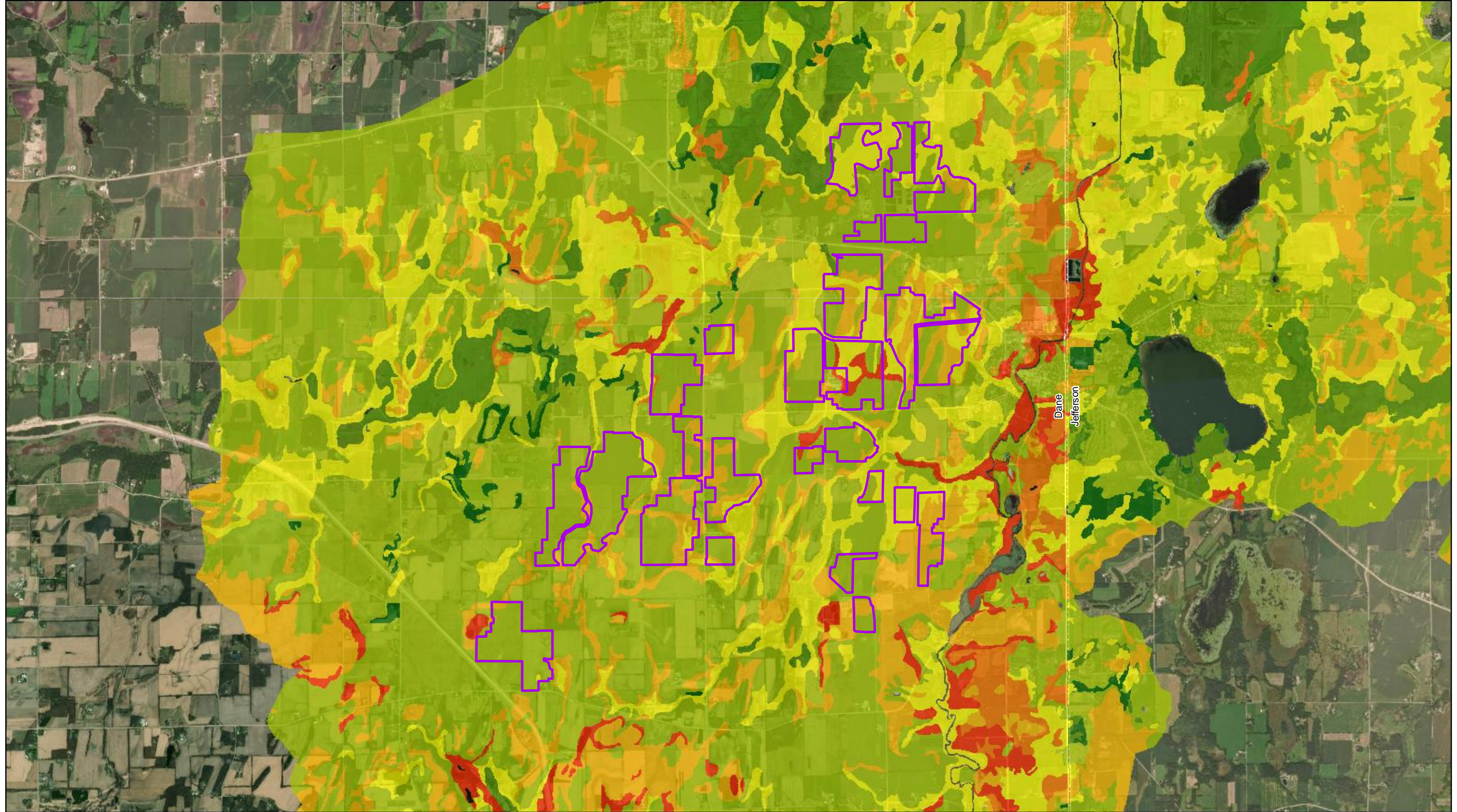
Koshkonong Solar Energy Center

Dane County, WI





Exhibit 2: Base Map

April 12, 2021




Data Sources: Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

Legend

-  County Boundary
-  Project Area

Hydrologic Soils Group

- | | | | |
|---|-----|---|-----|
|  | A |  | B/D |
|  | A/D |  | C |
|  | B |  | C/D |
| | |  | D |

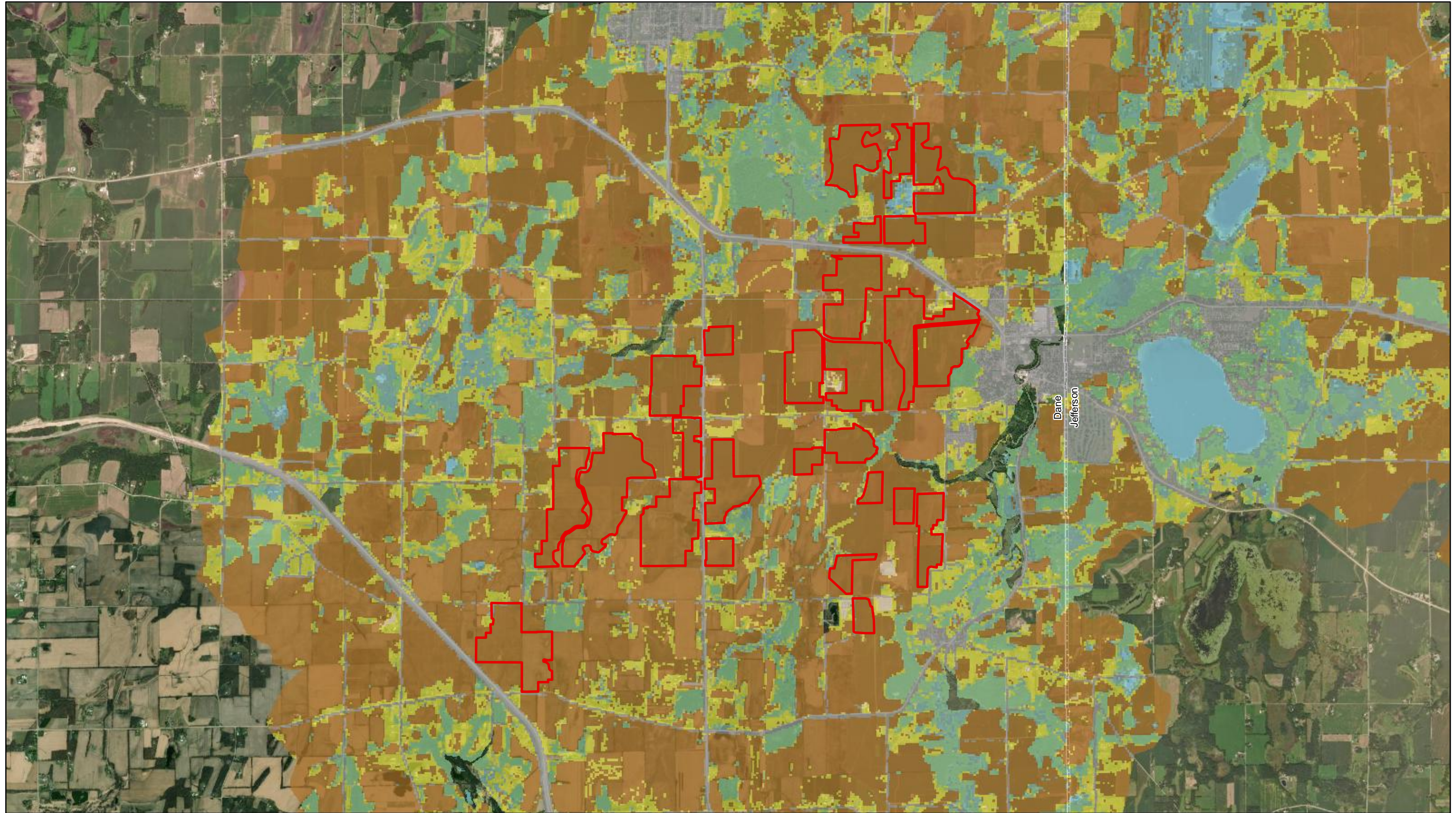
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 Dane County, WI





Exhibit 3: Soils Map

April 12, 2021




Data Sources: Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

Legend

-  County Boundary
-  Project Area

Landcover

- | | | |
|--|---|---|
|  Barren |  Fallow |  Shrubland |
|  Cultivated |  Forested |  Water |
|  Developed |  Prairie/Pasture |  Wetland |

Koshkonong Solar Energy Center
Dane County, WI



Exhibit 4: Landcover Map

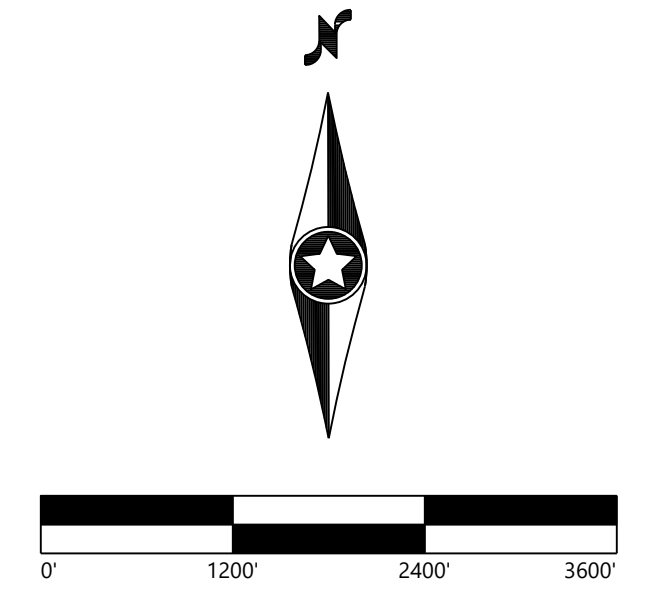
April 12, 2021

PREPARED FOR:

**Koshkonong Solar
 Energy Center, LLC**

REVISIONS:

#	DATE	COMMENT



**Koshkonong Solar
 Energy Center**
 Dane County, Wisconsin

Existing Drainage Map
 Overall

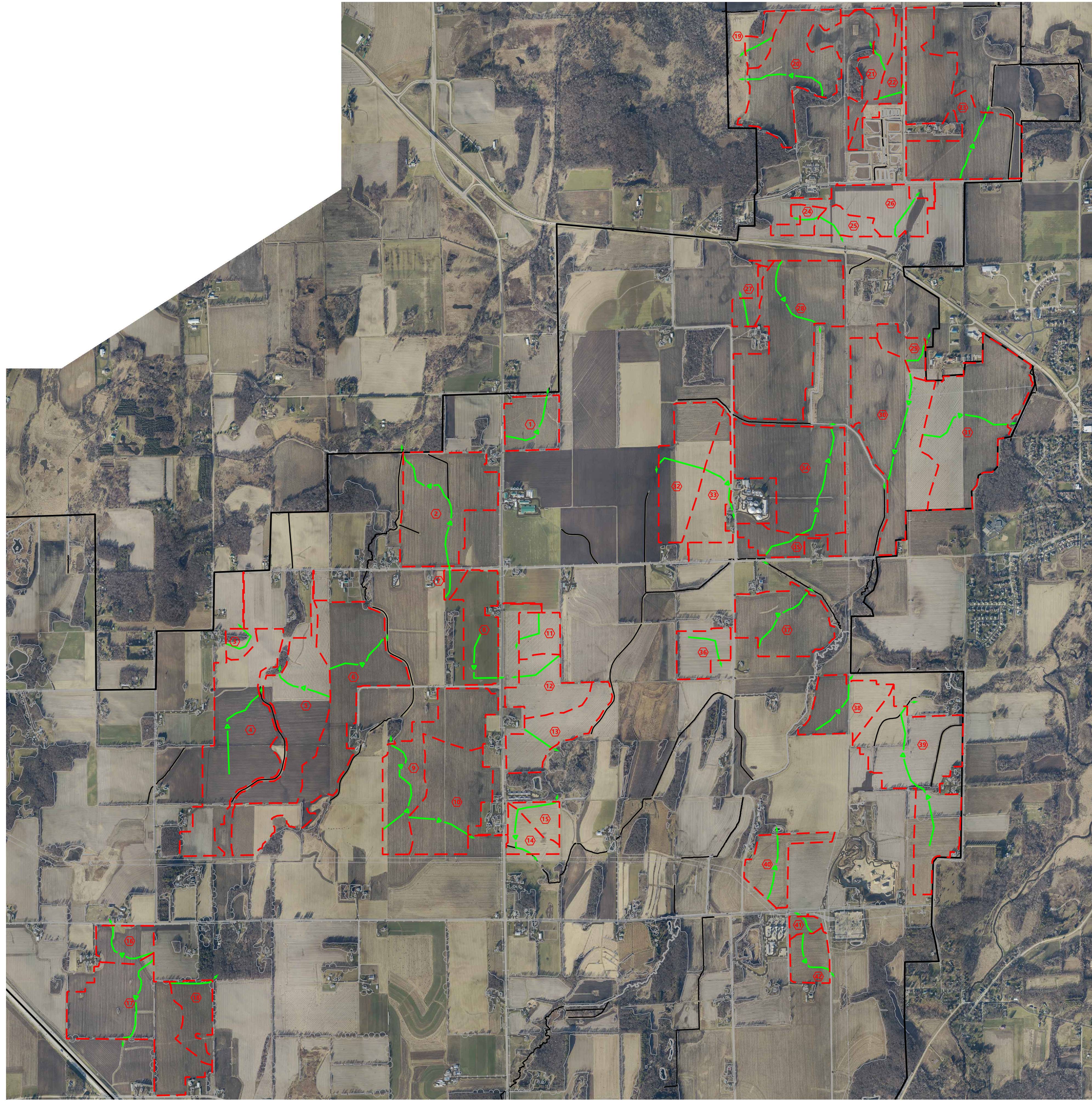
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DATE: 04/12/2021

SHEET: 5

LEGEND:

- PROJECT AREA
- EX. INDEX CONTOUR
- EX. INTERVAL CONTOUR
- EX. TREELINE
- EX. PAVED ROAD
- EX. GRAVEL ROAD
- EX. CULVERT
- EX. STREAM CHANNEL
- EX. WETLAND
- FEMA FLOOD HAZARD ZONE
- EX. ONSITE DRAINAGE AREA BOUNDARY
- EX. TIME OF CONCENTRATION LINE
- DISCHARGE LOCATION
- DRAINAGE AREA LABEL



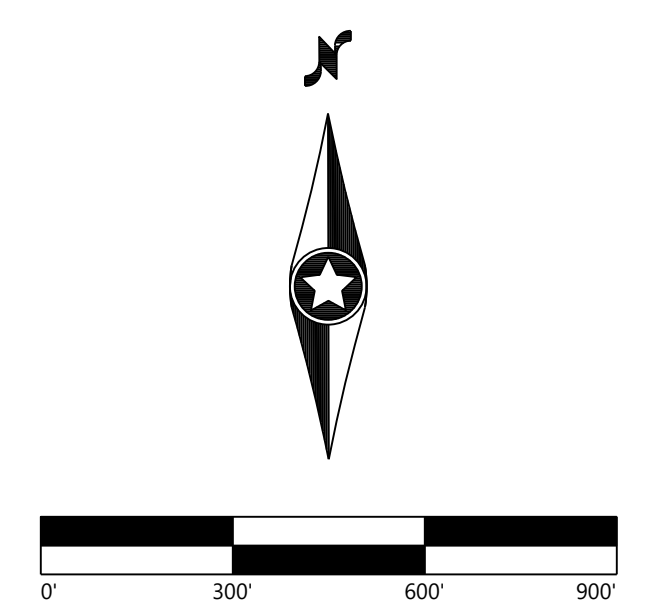
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Koshkonong Solar Energy Center, LLC

REVISIONS:

#	DATE	COMMENT



Koshkonong Solar Energy Center
Dane County, Wisconsin

Existing Drainage Map

NOT FOR CONSTRUCTION

DATE: 04/12/2021

SHEET: 5A

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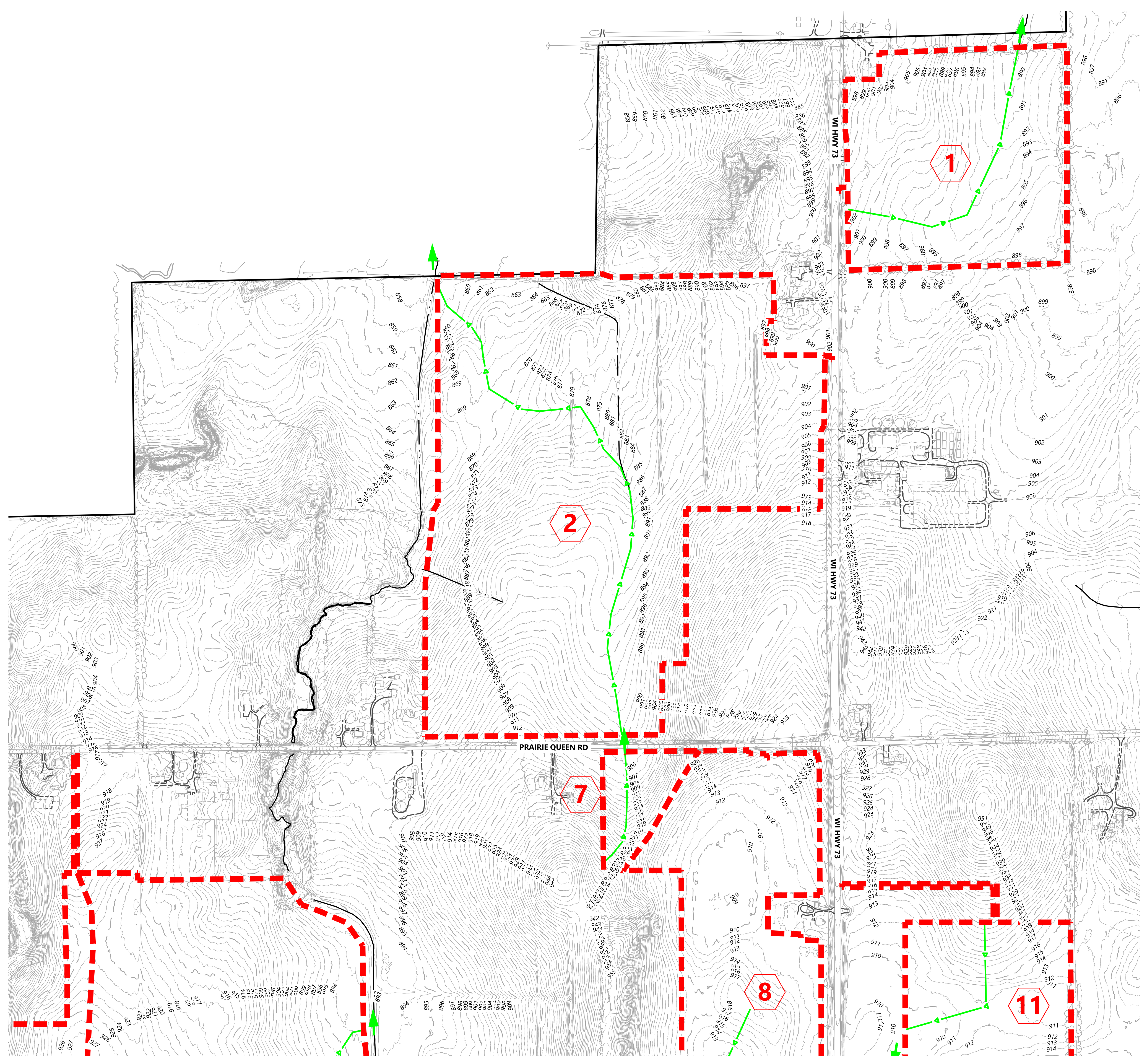
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- EX. INDEX CONTOUR
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- EX. TREELINE
- EX. PAVED ROAD
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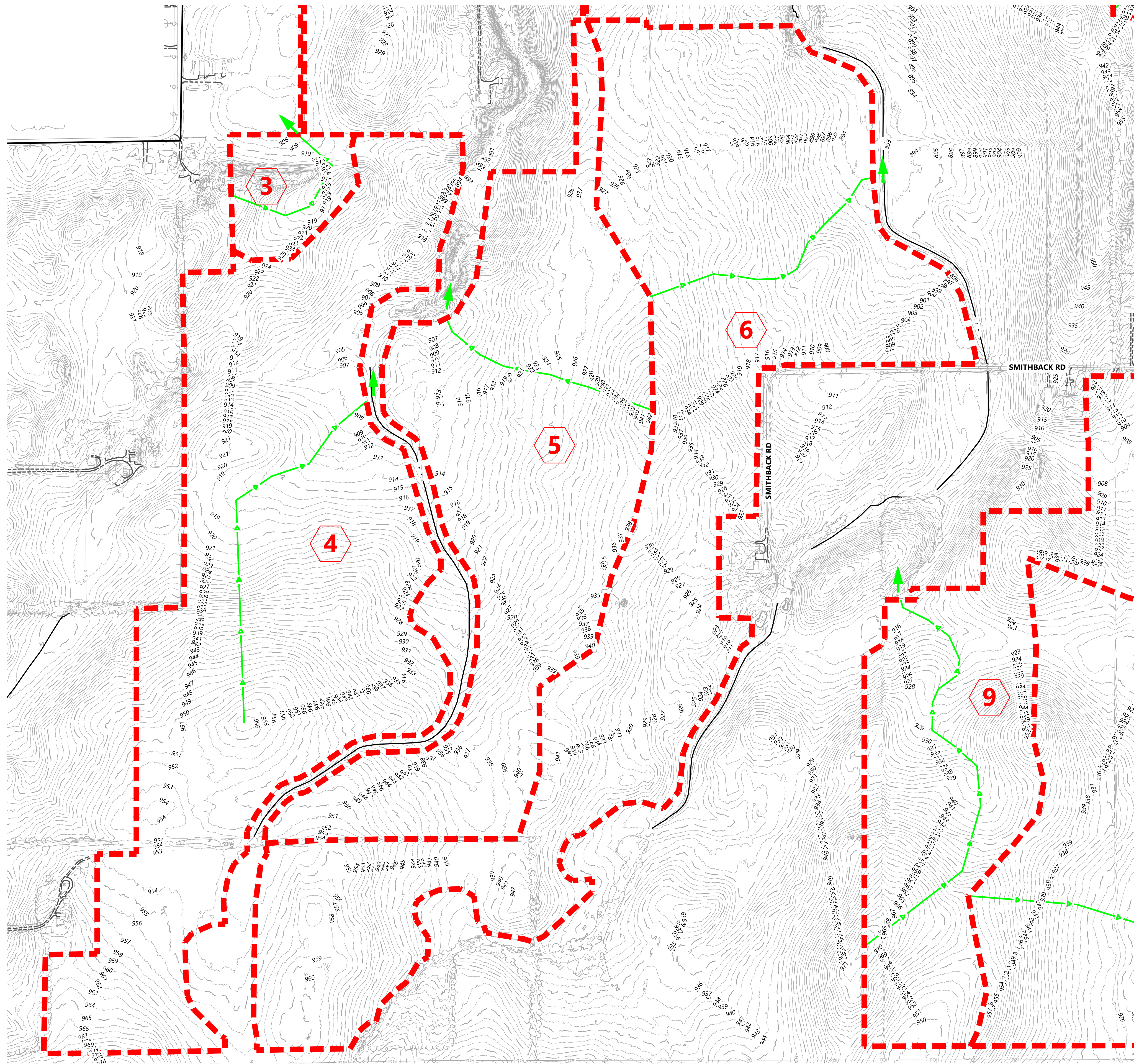
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SEE SHEET 5D

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- EX. PAVED ROAD
- EX. GRAVEL ROAD
- S10 — EX. CULVERT
- EX. STREAM CHANNEL
- EX. WETLAND
- FEMA FLOOD HAZARD ZONE
- - - - - EX. ONSITE DRAINAGE AREA BOUNDARY
- EX. TIME OF CONCENTRATION LINE
- EX. DISCHARGE LOCATION
- ① DRAINAGE AREA LABEL

SEE SHEET 5A

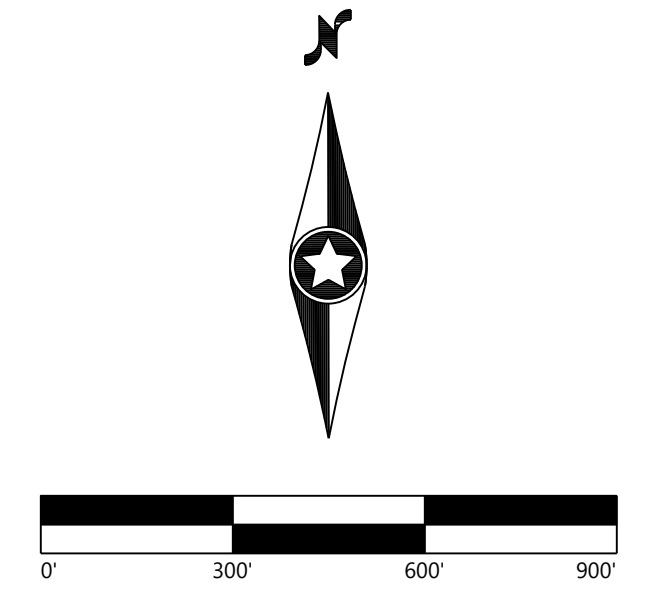
SEE SHEET 5D

SEE SHEET 5C

PREPARED FOR:
Koshkonong Solar Energy Center, LLC

REVISIONS:

#	DATE	COMMENT



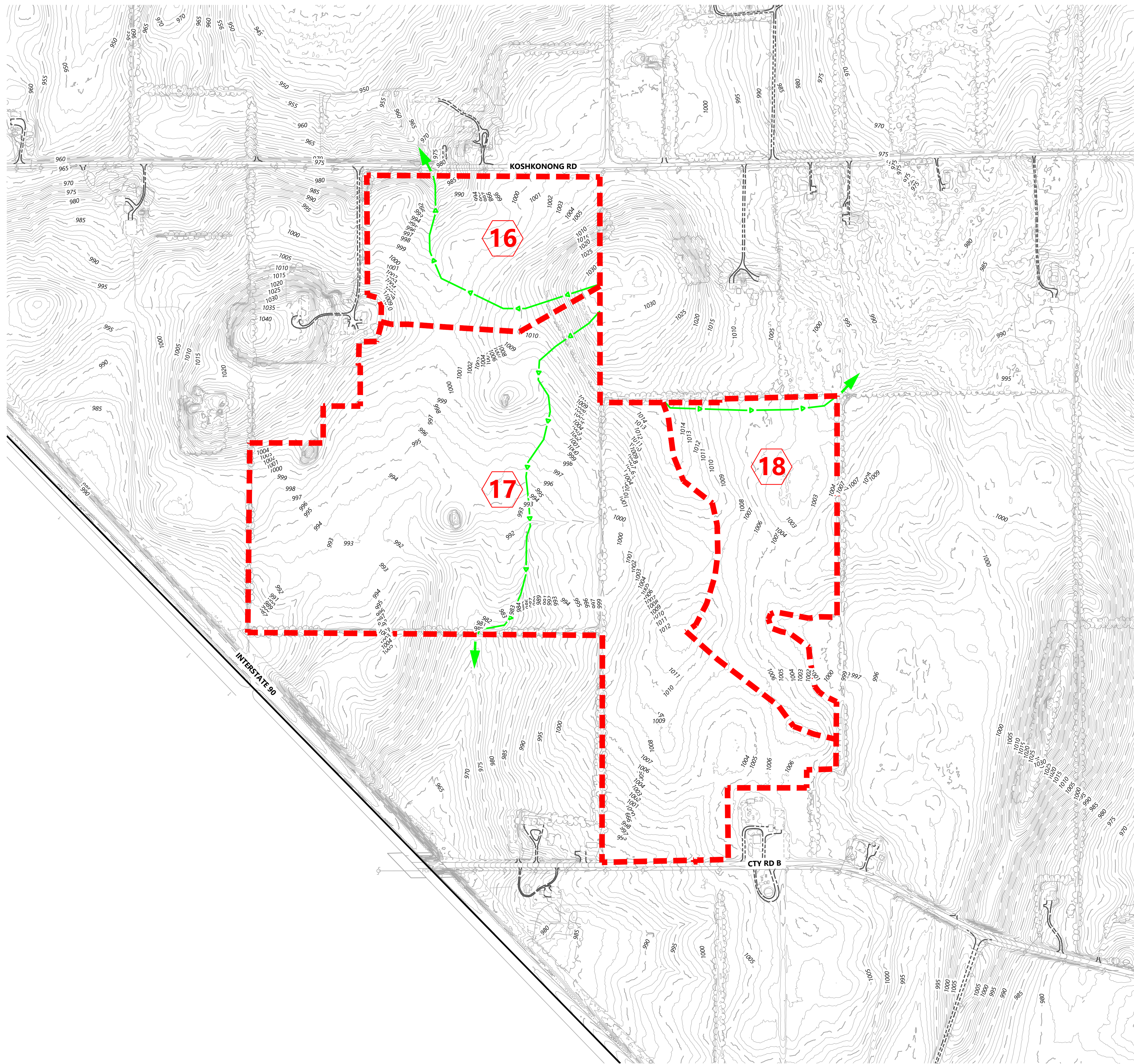
Koshkonong Solar Energy Center
 Dane County, Wisconsin

Existing Drainage Map

NOT FOR CONSTRUCTION
 DATE: 04/12/2021
 SHEET: 5B

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SEE SHEET 5B



LEGEND:

- PROJECT AREA
- EX. INDEX CONTOUR
- EX. INTERVAL CONTOUR
- EX. TREELINE
- EX. PAVED ROAD
- EX. GRAVEL ROAD
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- DRAINAGE AREA LABEL

Westwood

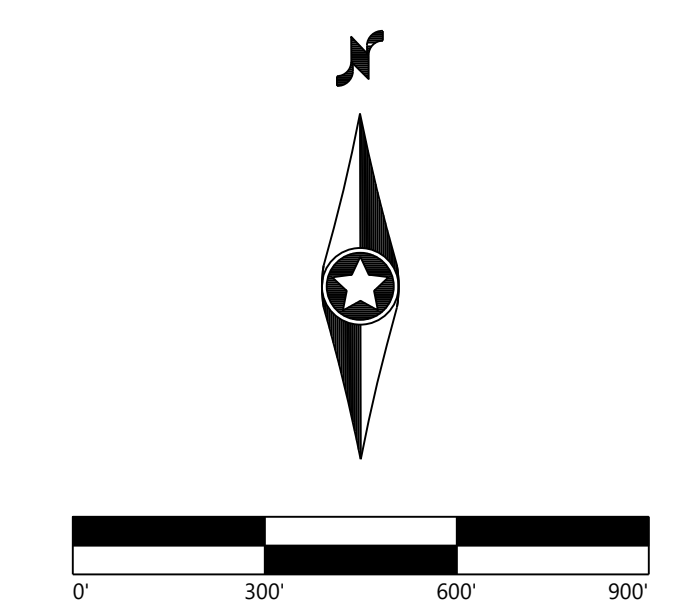
Phone (320) 253-9495 3701 12th Street North, Suite 206
 Fax (320) 358-2001 St. Cloud, MN 56303
 TollFree (800) 270-9495 westwoodsps.com
 Westwood Professional Services, Inc.

PREPARED FOR:

Koshkonong Solar Energy Center, LLC

REVISIONS:

#	DATE	COMMENT



Koshkonong Solar Energy Center
 Dane County, Wisconsin

Existing Drainage Map

NOT FOR CONSTRUCTION

DATE: 04/12/2021
 SHEET: 5C

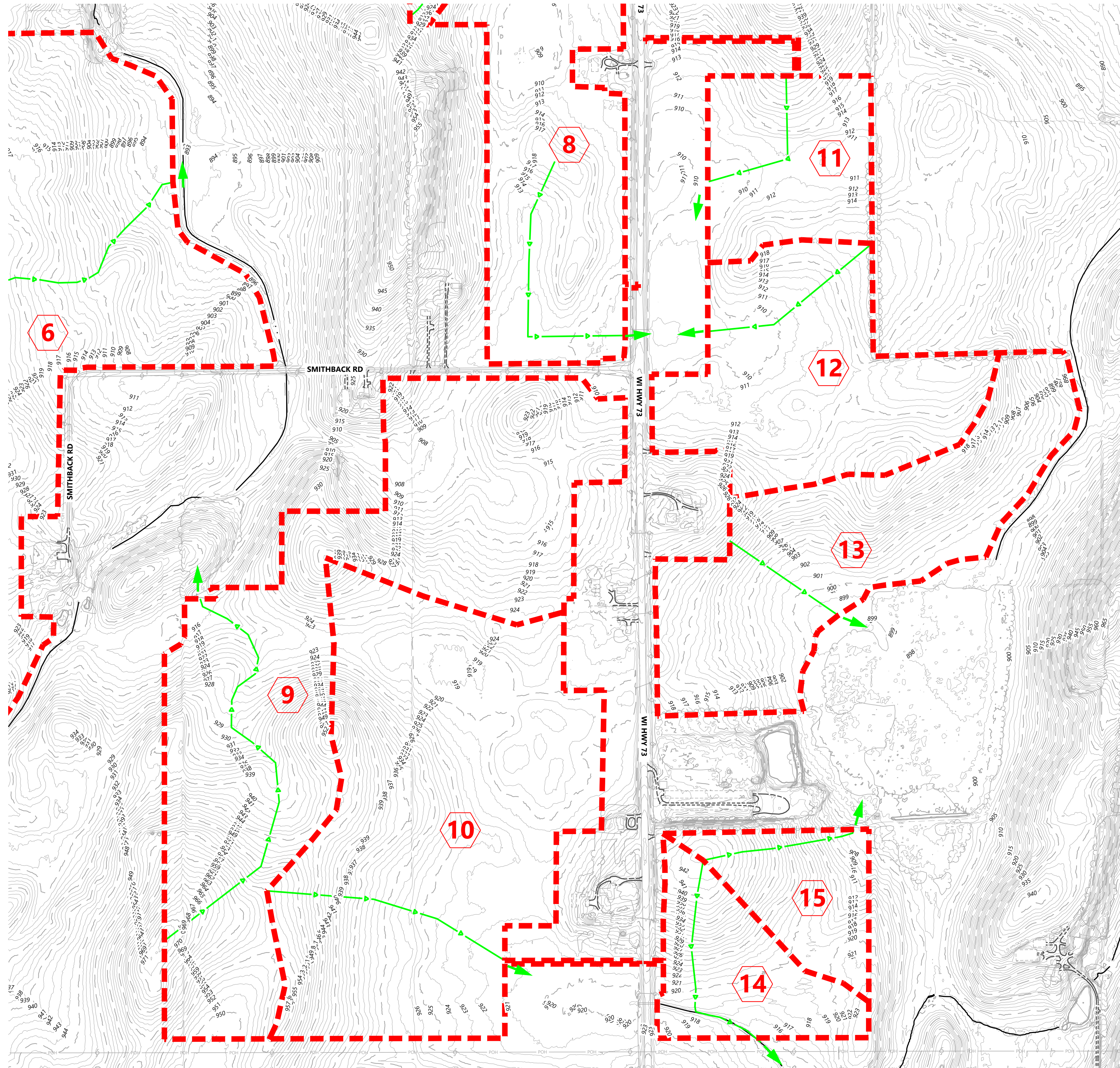
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SEE SHEET 5A

SEE SHEET 5H

SEE SHEET 5I

SEE SHEET 5B



LEGEND:

- PROJECT AREA
- EX. INDEX CONTOUR
- EX. INTERVAL CONTOUR
- EX. TREELINE
- EX. PAVED ROAD
- EX. GRAVEL ROAD
- EX. CULVERT
- EX. STREAM CHANNEL
- EX. WETLAND
- FEMA FLOOD HAZARD ZONE
- EX. ONSITE DRAINAGE AREA BOUNDARY
- EX. TIME OF CONCENTRATION LINE
- DISCHARGE LOCATION
- DRAINAGE AREA LABEL

Westwood

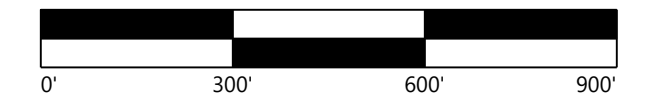
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**Koshkonong Solar
 Energy Center**
 Dane County, Wisconsin

Existing Drainage Map

NOT FOR CONSTRUCTION

DATE: 04/12/2021

SHEET: 5D

4/12/2021 2:52 PM
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 jwheeler