Exceptions Element

HARP
Solar Project

Planning Commission Final Findings of Fact
COMPREHENSIVE PLAN AMENDMENT REQUEST
AC-121-18
ASSOCIATED WITH
CONDITIONAL USE REQUEST
CUP-N-331

REQUEST: To effect a Goal 3 exception to allow development of a solar photovoltaic energy generation facility and associated equipment on land zoned Exclusive Farm Use.

APPLICANT:	OE Solar 1, LLC 2003 Western Avenue, Suite 225 Seattle, Washington 98121
OWNER:	Bill and Rena Marquardt LLC 67070 Marquardt Road Lexington, Oregon 97839
PROPERTY DESCRIPTION:	Tax Lot 3401 of Assessor's Map 1N 26
PROPERTY LOCATION:	North of Lexington on Baseline Lane, between Lloyd Road and Juniper Canyon Road

I **SUMMARY OF APPLICATION AND PROCESS:** The applicant participated in a pre-application meeting with Planning staff and other affected agencies in mid-January 2018. This was followed by a variety of phone and email correspondence eventually culminating in the application that is subject to this action, Comprehensive Plan Amendment AC-121-18, and the associated Conditional Use Permit CUP-N-331. Applicant's request is to develop a solar photovoltaic energy generation facility and these Findings of Fact will evaluate the requested Goal 3 Exception.

The associated Conditional Use Permit CUP-N-331 provides the initial analysis under the Morrow County Zoning Ordinance Article 3 Section 3.010 Exclusive Farm Use K. Commercial Facilities for Generating Power (a)(1) and (2). The applicant does conclude, and staff concur, that the applicant does need to obtain an Exception to Goal 3 Agricultural Lands as the facility will impact more than 20 acres of arable land and may likely impact more than 12 acres of high value land.

II **SUMMARY OF APPLICABLE CRITERIA:** Substantive criteria are found in the Comprehensive Plan at Review and Revision. The Substantive Criteria are found below in **bold,** with responses in regular type.

Applicant's narrative submitted as a part of its Goal 3 exception request, dated March 1, 2018, is hereby incorporated by reference. Applicant also submitted at the hearing Supplemental Findings that are also incorporated by reference and are attached. Applicant's narrative provides additional findings as well as supplemental findings to support removal of up to 99 acres from Goal 3 protection for the Harp Solar Project. Applicant's narrative also includes additional state and local applicable review criteria and supplements the list of Applicable Criteria listed here.

MORROW COUNTY COMPREHENSIVE PLAN: CRITERIA. The following criteria must be considered before approval of an amendment to the Comprehensive Plan is given:

1. **Address the Criteria found in the Morrow County Zoning Ordinance Article 8 Amendments; and**
2. **Show how the request complies with the relevant statewide land use planning Goals. Include evidence of coordination and compliance with State agencies regarding the statewide planning Goals. (MC OR-1-2013)**

The Morrow County Zoning Ordinance criteria follow with the necessary analysis. The Oregon Department of Agriculture, Department of Environmental Quality, Department of Aviation, Department of Energy, Department of Fish and Wildlife and the Department of Land Conservation and Development are all noticed of this action and will receive both the Conditional Use Permit CUP-N-331 and these findings. These Findings of Fact will also be provided to the Department of Navy and the Oregon Military Department relative to their operations at the Boardman Bombing Range. Members of the Department of Fish and Wildlife participated in the pre-application meeting.

During that pre-application meeting Planning staff identified several of the Statewide Planning Goals and associated Morrow County policies that should be reviewed for this request. The applicant has included in their narrative discussion of Goal 9 Economics, Goal 11 Public Services and Goal 13 Energy. These other Goals must be considered as part of the Goal 3 exception and the allowance of an energy generation project that would preclude agricultural production on up to 99 acres of agricultural land.

To better understand the position of Morrow County please consider that in 2016 an update to Goal 9 Economics was adopted and included a section devoted to the Energy Sector, identifying policies in support of energy generation and movement of energy in and through Morrow County. This energy generation request fits the model of the types of energy development that was anticipated when updating the Economic Element of the Comprehensive Plan.

The final decision related to this request needs to balance removing agricultural land from production and converting the use of that land to energy production. Both the Planning Commission and the Board of Commissioners need to balance both the economic needs under the Morrow County Comprehensive Plan and the need for agricultural land to determine if a Goal 3 exception is warranted. The applicant's narrative addresses these factors under the legal framework for an Exception to a Statewide Planning Goal (see attached applicant narrative).

MORROW COUNTY ZONING ORDINANCE: SECTION 8.040. The proponent of the application or permit has the burden of proving justification for its approval. The more drastic the request or the greater the impact of the application or permit on the neighborhood, area, or county, the greater is the burden on the applicant. The following criteria shall be considered by the Planning Commission in preparing a recommendation and by the County Court in reaching their decision.

A. **The local conditions have changed and would warrant a change in the zoning of the subject property(ies).**

No change in zoning is requested. The applicant has requested approval for a solar photovoltaic energy generation facility which is being reviewed as Conditional Use Permit CUP-N-331. A portion of this review and potential

approval is contingent upon impacts on either or both high value soils or arable soils. The Conditional Use Permit does review this requirement and determines that an Exception to Goal 3 is needed, hence these Findings of Fact and the included analysis.

B. The public services and facilities are sufficient to support a change in designation including, but not limited to, water availability relevant to both quantity and quality, waste and storm water management, other public services, and streets and roads.

1. Amendments to the zoning ordinance or zone changes which significantly affect a transportation facility shall assure that land uses are consistent with the function, capacity, and level of service of the facility identified in the Transportation System Plan. This shall be accomplished by one of the following:

a. Limiting allowed land uses to be consistent with the planned function of the transportation facility or roadway;

b. Amending the Transportation System Plan to ensure that existing, improved, or new transportation facilities are adequate to support the proposed land uses consistent with the requirement of the Transportation Planning Rule; or,

c. Altering land use designations, densities, or design requirements to reduce demand for automobile travel to meet needs through other modes.

No land use designations are changing nor are any transportation systems being affected at this time. The Conditional Use Permit CUP-N-331 does analyze transportation impacts and any needed development permits or review specific to the proposed solar photovoltaic energy generation facility would be evaluated and conditioned there. Planning staff would find these criteria not applicable or otherwise evaluated.

2. A plan or land use regulation amendment significantly affects a transportation facility if it:

a. Changes the functional classification of an existing or planned transportation facility;

b. Changes standards implementing a functional classification;

c. Allows types or levels of land use that would result in levels of travel or access that are inconsistent with the functional classification of a transportation facility; or

d. Would reduce the level of service of the facility below the minimal acceptable level identified in the Transportation System Plan. (MC-C-8-98)

Please see the analysis just above. Planning staff would find that no changes would occur, based on the proposed development, to the current functional classification or level of service of the adjacent or area roads. Planning staff would find these criteria to be not applicable based on the proposed development and its associated impacts. Additionally these types of impacts are addressed as part of Conditional Use Permit CUP-N-331.

C. That the proposed amendment is consistent with unamended portions of the Comprehensive Plan and supports goals and policies of the Comprehensive Plan, that there is a public need for the proposal, and that the need will be best served by allowing the request. If other areas in the

county are designated for a use as requested in the application, then a showing of the necessity for introducing that use into an area not now so zoned and why the owners there should bear the burden, if any, of introducing that zone into their area.

The applicant's narrative generally addresses this criterion and Planning staff can find no fault in their analysis. Planning staff would find that this amendment would be consistent with the Comprehensive Plan and is compatible and does support recent work within the Economic Element concerning the Energy Sector. Additionally the State of Oregon has adopted a Renewable Portfolio Standard and development of solar photovoltaic energy generation facilities does fit within those standards. Other renewable energy development within Morrow County has been asked to limit the impacts from associated transmission lines and this applicant has identified a location that allows direct connection to the Energy Grid by allowing for connection within or immediately adjacent to the project footprint to the in place Bonneville Power Administration 115 kV transmission line that serves the Columbia Basin Electric Cooperative.

When considering other locations that a use like this could be established or other use zones that would better serve or suit the need, Planning staff caution against looking at land zoned for Port Industrial use. The Port Industrial use zone is reserved for large scale industrial uses with significant impacts. This proposed solar photovoltaic energy generation facility has limited impacts and can be sited within the Exclusive Farm Use zone via a conditional use permit without creating conflict. The Airport Light Industrial use zone does allow for solar energy development when certain standards are met; there is currently an application for a project on property so zoned which will consume much of that available land.

The applicant has also completed an analysis of the environmental, economic, social and energy consequences and found that they favor the Goal 3 exception. Planning staff can find no concerns with their analysis and would concur.

D. **The request addresses issues concerned with public health and welfare, if any.**

Planning staff have not identified any concerns with public health or welfare. The associated Conditional Use Permit CUP-N-331 addresses various environmental concerns related to the proposed project. Planning staff would find that any environmental impacts are better reviewed, and conditioned if necessary, within that context.

III **DLCD 35 DAY NOTICE:** March 19, 2018

IV **PROPERTY OWNER NOTICE:** April 4, 2018

V **LEGAL NOTICE:** Heppner Gazette Times and East-Oregonian April 4, 2018

VI **AGENCIES NOTIFIED:** Linda Hayes-Gorman and Don Butcher, Department of Environmental Quality; Phil Stenbeck, Jon Jinnings and Tim Murphy, Department of Land Conservation and Development; Steve Cherry, Oregon Department of Fish and Wildlife; Max Woods, Oregon Department of Energy; Jeff Caines, Oregon Department of

Aviation; Roy Swafford, Oregon Military Department; Jim Johnson, Oregon Department of Agriculture; Kim Peacher, Department of the Navy; Janet Greenup, Morrow Soil and Water Conservation District; Mike Gorman, Morrow County Assessor's Office.

VII HEARING DATES:

Planning Commission
April 24, 2018
Morrow County Bartholomew Building
Heppner, Oregon

Board of Commissioners
May 30, 2018
Morrow County Bartholomew Building
Heppner, Oregon

IX RECOMMENDATION: The Planning Department recommends that the Planning Commission adopt the following Findings:

- The proposed solar photovoltaic energy generation facility by OE Solar 1, LLC, known as HARP, does require an exception to Goal 3 Agricultural Lands as it will impact over 20 acres of arable land and may impact over 12 acres of high value farm land.
- The Morrow County Comprehensive Plan Economic Element when updated in 2016 identified the Energy Sector and was written envisioning projects like this one and supports responsible renewable energy development that has limited impacts. The Energy Sector discussion ends as follows: "...and provide mechanisms to maintain and improve energy generation and movement in and through Morrow County." This application achieves that desire.
- Economic Element Goal 3 states, "To diversify local businesses, industries and commercial activities and to promote the economic growth and stability of the County." This activity creates a new energy facility which would achieve this stated Goal.
- Economic Element Policy 3A state, "To encourage local producers to new markets for local products and to seek out new products that are in demand in the market place and that can be produced locally." Clearly there is a market demand as well as state policy that supports this development. This is a new and emerging product in Morrow County and fits the vision around Policy 3A.
- Economic Element Goal 4 states, "To encourage the development of compatible land uses throughout the County and to protect areas suitable for industrial development from encroachment of incompatible land uses." This Economic Element goal can be interpreted to allow renewable energy development on land zoned Exclusive Farm Use where it is allowed conditionally when an applicant can meet the determined standards. The related Conditional Use Permit CUP-N-331 evaluates a variety of criteria and has determined that the application can be approved if an exception to Goal 3 Agricultural Lands is granted.
- Another interpretation of Economic Element Goal 4 would be that allowing this activity on land zoned for Exclusive Farm Use protects land zoned Port or General Industrial from uses that consume large amounts of acreage, but do not either create jobs or significant tax base. Placing the proposed solar photovoltaic energy generation facility on land zoned for Exclusive Farm Use preserved industrial land for higher density and impact uses.

The record offers exceptional reasons to warrant removal of up to 99 acres from Goal 3 protection for solar development. Section III of the Applicant's narrative provides the analysis for allowing the exception under both OAR 660-004-0022(1) and OAR 660-004-0022(3). In addition, the identified local comprehensive plan goals and policies (listed above) directly support the exception and provide strong support for encouraging renewable energy development in Morrow County. Neither Applicant nor planning staff relied heavily on Statewide Planning Goal 13 to support the exception; justification for the exception is based on the local comprehensive plan goals and policies that implement the Statewide Planning Goals related to economic development and responsible growth. There has been adequate consideration of alternative locations for the development and there is evidence in the record to demonstrate consistency with ORS 197.732(2)(c) as well as MCZO 8.040(C).

Based on these Findings the Planning Commission recommends that the Morrow County Comprehensive Plan Agricultural Lands Element is amended (see attached) to authorize a Goal 3 exception allowing the solar photovoltaic energy generation facility proposed by OE Solar 1, LLC, and known as HARP. Additionally the Planning Commission recommends establishing an Exceptions Element to capture this and future exceptions to the Comprehensive Plan and contain the necessary exceptions documents. The proposed Exceptions Element would contain the Planning Commission Final Findings of Fact, a map representing the area of the exception similar to the current vicinity map, the applicant or other project narrative concerned with the Goal 3 Agricultural Lands exception, and the Board of Commissioners adopting Ordinance and other documents deemed necessary at the time of final adoption.

The Morrow County Planning Commission recommends that the Morrow County Board of Commissioners adopt these Findings of Fact approving the Goal 3 Agricultural Lands element exception and thereby allowing development of the associated Conditional Use Permit CUP-N-331.

Jeff Wenholz, Chair 5/4/18 Date

Attachments:
Vicinity Map
Morrow County Comprehensive Plan Agricultural Lands Element - DRAFT
Plan Amendment Application and Applicant Narrative
Applicant - Supplemental Findings (these have been incorporated directly into the Findings)
April 20, 2018 Letter - Oregon Department of Energy
Applicant PowerPoint Presentation

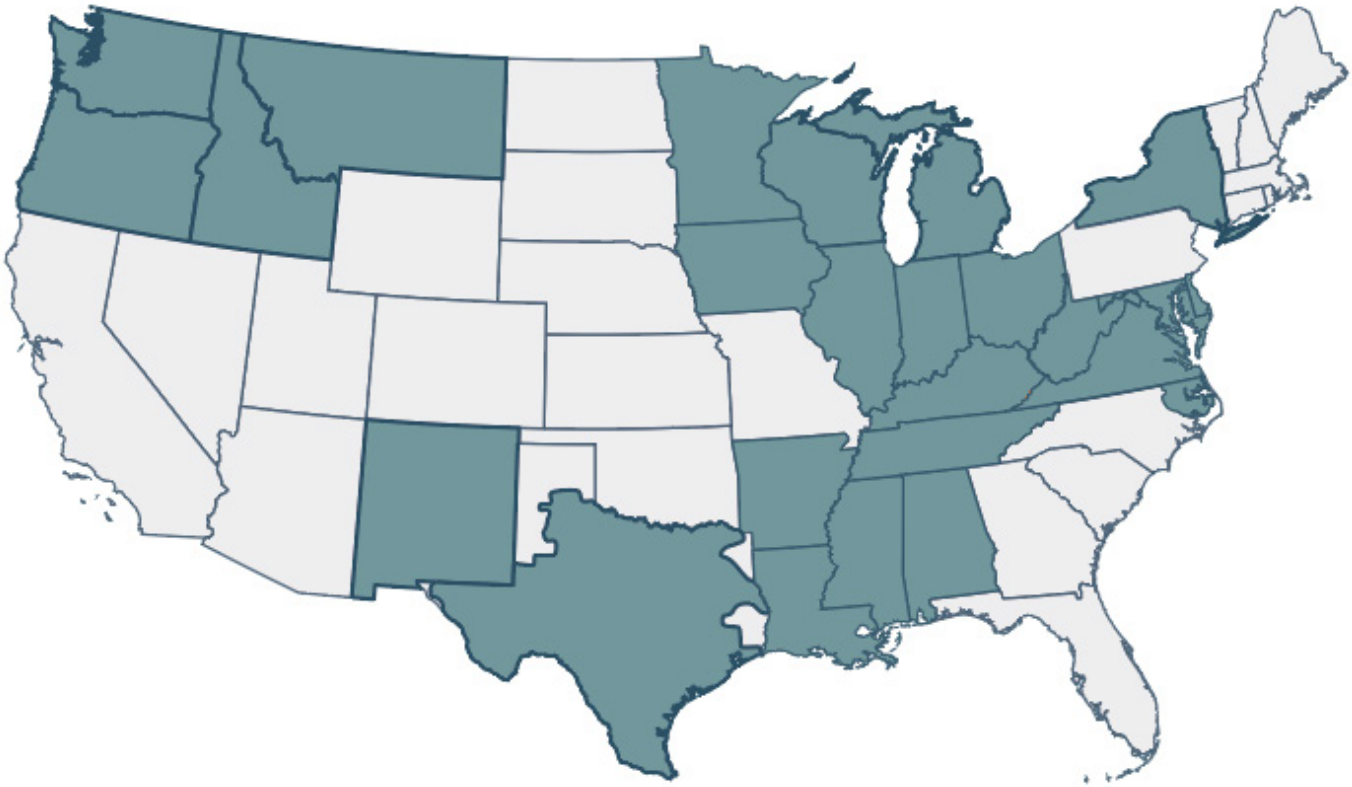
OneEnergy RENEWABLES

OneEnergy Renewables, founded in 2009, is a privately held company actively developing a significant pipeline of utility scale solar projects nationwide. Pioneers of the offsite solar project model, we specialize in pre-construction development of ground mounted solar PV projects.

AS A CERTIFIED B-CORP, ONEENERGY ENTHUSIASTICALLY EMBRACES AND MEETS RIGOROUS STANDARDS OF BUSINESS, SOCIAL, AND ENVIRONMENTAL PERFORMANCE, ACCOUNTABILITY, AND TRANSPARENCY. IT'S HOW WE DO BUSINESS, PLAIN AND SIMPLE.

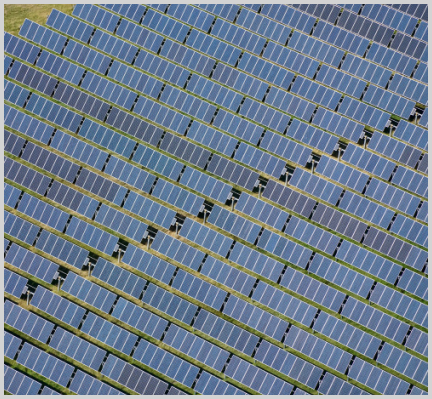
Our experienced team of renewable energy professionals pair de-risked projects with advanced energy procurement and financial solutions to deliver construction-ready and operational solar assets.

ACTIVE MARKETS + PROJECT HIGHLIGHTS



WYE MILLS SOLAR

LOCATION
QUEEN ANNE'S COUNTY, MD
SIZE
13.6 MW
OPERATIONAL
FALL 2016
CUSTOMER
JOHNS HOPKINS MEDICINE
OWNER
SOLAR CITY



CAMBRIDGE SOLAR

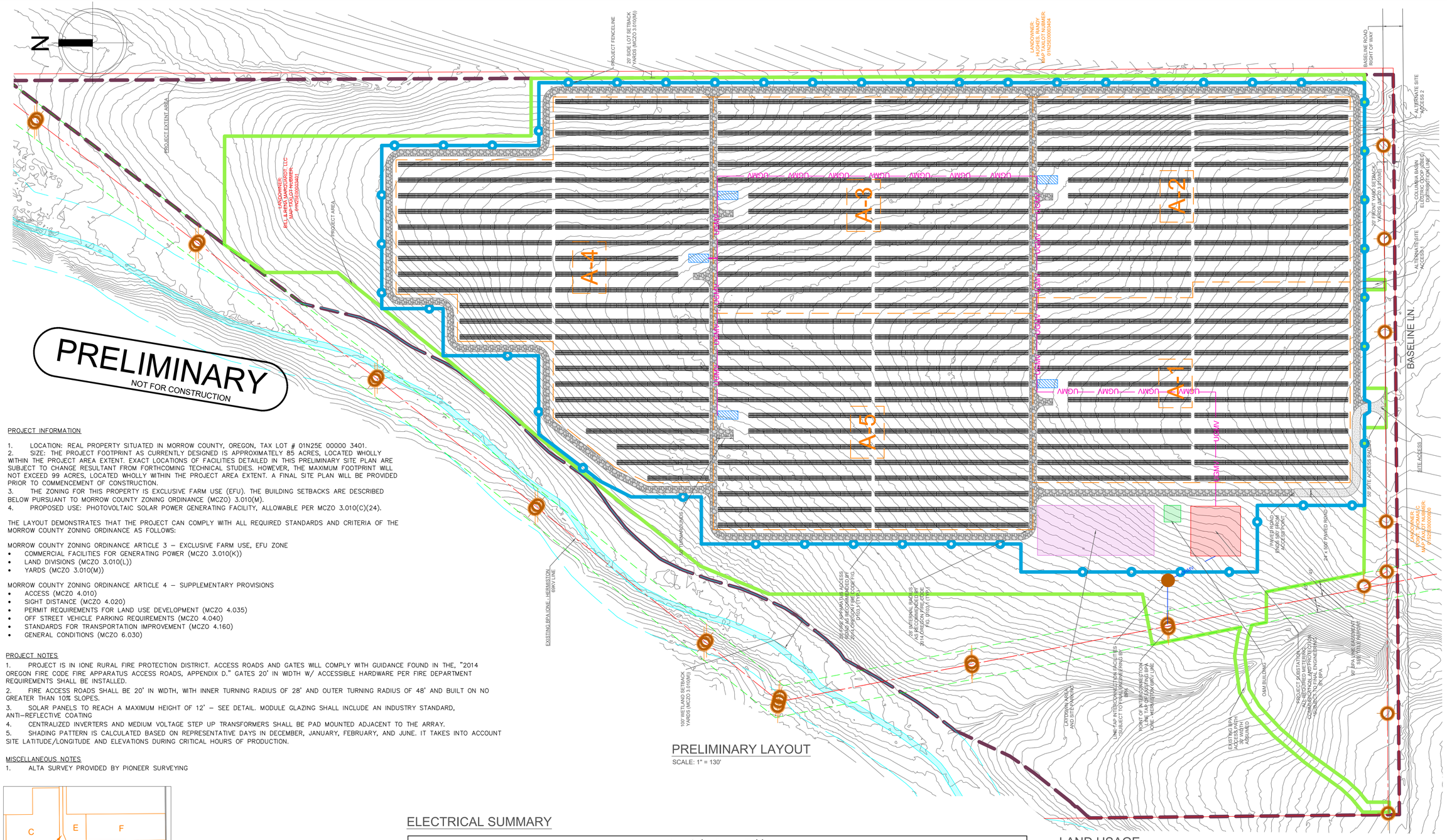
LOCATION
DORCHETER COUNTY, MD
SIZE
4.3 MW
OPERATIONAL
SPRING 2015
CUSTOMER
NATIONAL AQUARIUM
OWNER
CONSTELLATION

BLUE BASIN POWER

LOCATION
KLAMATH COUNTY, OR
SIZE
4 MW
OPERATIONAL
FALL 2016
CUSTOMER
PACIFIC POWER
OWNER
SOLAR CITY

STEEL BRIDGE SOLAR

LOCATION
POLK COUNTY, OR
SIZE
3 MW
OPERATIONAL
SPRING 2016
CUSTOMER
PORTLAND GEN. ELECTRIC
OWNER
NRG



PRELIMINARY LAYOUT

SCALE: 1" = 130'

PROJECT INFORMATION

1. LOCATION: REAL PROPERTY SITUATED IN MORROW COUNTY, OREGON, TAX LOT # 01N25E 00000 3401.
2. SIZE: THE PROJECT FOOTPRINT AS CURRENTLY DESIGNED IS APPROXIMATELY 85 ACRES, LOCATED WHOLLY WITHIN THE PROJECT AREA EXTENT. EXACT LOCATIONS OF FACILITIES DETAILED IN THIS PRELIMINARY SITE PLAN ARE SUBJECT TO CHANGE RESULTANT FROM FORTHCOMING TECHNICAL STUDIES. HOWEVER, THE MAXIMUM FOOTPRINT WILL NOT EXCEED 99 ACRES, LOCATED WHOLLY WITHIN THE PROJECT AREA EXTENT. A FINAL SITE PLAN WILL BE PROVIDED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. THE ZONING FOR THIS PROPERTY IS EXCLUSIVE FARM USE (EFU). THE BUILDING SETBACKS ARE DESCRIBED BELOW PURSUANT TO MORROW COUNTY ZONING ORDINANCE (MCZO) 3.010(M).
4. PROPOSED USE: PHOTOVOLTAIC SOLAR POWER GENERATING FACILITY, ALLOWABLE PER MCZO 3.010(C)(24).

THE LAYOUT DEMONSTRATES THAT THE PROJECT CAN COMPLY WITH ALL REQUIRED STANDARDS AND CRITERIA OF THE MORROW COUNTY ZONING ORDINANCE AS FOLLOWS:

MORROW COUNTY ZONING ORDINANCE ARTICLE 3 – EXCLUSIVE FARM USE, EFU ZONE
- COMMERCIAL FACILITIES FOR GENERATING POWER (MCZO 3.010(K))
- LAND DIVISIONS (MCZO 3.010(L))
- YARDS (MCZO 3.010(M))

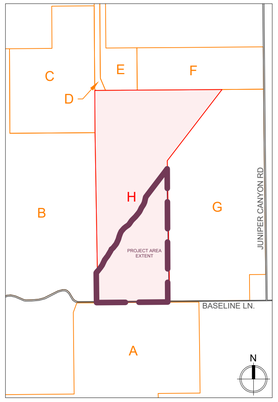
MORROW COUNTY ZONING ORDINANCE ARTICLE 4 – SUPPLEMENTARY PROVISIONS
- ACCESS (MCZO 4.010)
- SIGHT DISTANCE (MCZO 4.020)
- PERMIT REQUIREMENTS FOR LAND USE DEVELOPMENT (MCZO 4.035)
- OFF STREET VEHICLE PARKING REQUIREMENTS (MCZO 4.040)
- STANDARDS FOR TRANSPORTATION IMPROVEMENT (MCZO 4.160)
- GENERAL CONDITIONS (MCZO 6.030)

PROJECT NOTES

1. PROJECT IS IN IONE RURAL FIRE PROTECTION DISTRICT. ACCESS ROADS AND GATES WILL COMPLY WITH GUIDANCE FOUND IN THE, "2014 OREGON FIRE CODE FIRE APPARATUS ACCESS ROADS, APPENDIX D." GATES 20' IN WIDTH W/ ACCESSIBLE HARDWARE PER FIRE DEPARTMENT REQUIREMENTS SHALL BE INSTALLED.
2. FIRE ACCESS ROADS SHALL BE 20' IN WIDTH, WITH INNER TURNING RADIUS OF 28' AND OUTER TURNING RADIUS OF 48' AND BUILT ON NO GREATER THAN 10% SLOPES.
3. SOLAR PANELS TO REACH A MAXIMUM HEIGHT OF 12' – SEE DETAIL. MODULE GLAZING SHALL INCLUDE AN INDUSTRY STANDARD, ANTI–REFLECTIVE COATING
4. CENTRALIZED INVERTERS AND MEDIUM VOLTAGE STEP UP TRANSFORMERS SHALL BE PAD MOUNTED ADJACENT TO THE ARRAY.
5. SHADING PATTERN IS CALCULATED BASED ON REPRESENTATIVE DAYS IN DECEMBER, JANUARY, FEBRUARY, AND JUNE. IT TAKES INTO ACCOUNT SITE LATITUDE/LONGITUDE AND ELEVATIONS DURING CRITICAL HOURS OF PRODUCTION.

MISCELLANEOUS NOTES

1. ALTA SURVEY PROVIDED BY PIONEER SURVEYING



VICINITY MAP

PARCEL INFORMATION		
PARCEL	LAND OWNER	MAP TAXLOT #
A	POINTER, THOMAS C	01S2E000000800
B	NELSON, KENNETH E	01N2E000003600
C	MORGAN, VIRGIL & DEBBIE A	01N2E000003500
D	BILL & RENA MARQUARDT, LLC	01N2E000002801
E	HUGHES, RANDY	01N2E000002802
F	HUGHES, RANDY	01N2E000003400
G	HUGHES, RANDY	01N2E000003404
H	BILL & RENA MARQUARDT, LLC	01N2E000003401

ELECTRICAL SUMMARY

Harp Solar Power Table

SubArray	Module Power (W)	Modules / Table	Tables	Inverter (MVA)	Inverter @ PF 0.89	Inverter Count	MWdc	MWac	DC/AC
A1	355	54	123	0.125	0.111	16	2.36	1.78	1.326
A2	355	54	123	0.125	0.111	16	2.36	1.78	1.326
A3	355	54	138	0.125	0.111	18	2.65	2.00	1.323
A4	355	54	169	0.125	0.111	22	3.24	2.44	1.325
A5	355	54	138	0.125	0.111	18	2.65	2.00	1.323
Total	-	-	**691**	-	-	**90**	**13.25**	**10.00**	-

Harp Collection System Design

Run	Linear Distance (ft)	Feeder (MVA)	Feeder Volatage (kV)	Conductor Type
A5 - A4	499.56	2.00	34.5	Underground
A4 - A3	214.62	4.45	34.5	Underground
A3 - A2	1030.77	6.45	34.5	Underground
A2-A1	615.03	8.22	34.5	Underground
A-1 - MPT	905.96	10.00	34.5	Underground
MPT - POI	**293.21**	**10.00**	**69**	**Overhead**

LAND USAGE

Harp Solar Land Use		*High Value Farm Land*	*Soil Types*		
Major Area Names	*Total Area (ac)*	*Impacted Area (ac)*	*45B, Ritzville Silt Loam (ac)*	*45C, Ritzville Silt Loam (ac)*	*75C, Willis Silt Loam (ac)*
Project Area Extent	131.5	20.0	76.3	43.7	11.5
Project Area	98.9	14.1	70.6	20.1	8.2
Project Fence	83.6	11.9	63.0	13.5	7.1

Minor Areas	*Total Area (SF)*	*Total Area (ac)*
Impermeable Surfaces:		
Paved Road	13,336	0.3
Gravel Road	210,470	4.8
Substation	22,500	0.5
O&M Building	2,500	0.1
Inverter/XFMR Pads	8,750	0.2
Piles	3,960	0.1
Total Impermeable	261,516	6.0
Other:		
Laydown Area	52,500	1.2

PROJECT

HARP SOLAR
OE SOLAR 1, LLC

ADDRESS

LEXINGTON, OR 97839

DRAWING

TITLE:
SITE PLAN - LAYOUT

SHEET NUMBER:
A-001

SCALE:
1" = 130'

DRAWN BY:
AA

CHECKED BY:
MD

DATE:
02/09/2018

REVISIONS:

DESCRIPTION

THIS PROJECT CONSISTS OF THE DESIGN AND INSTALLATION OF A 10 MW AC SOLAR PHOTOVOLTAIC PLANT TO BE LOCATED IN MORROW COUNTY, OR. THE PV SYSTEM WILL CONSIST OF MODULES INSTALLED INTO ARRAYS WHICH WILL TRACK THE SUN AROUND A SINGLE AXIS. THE ARRAY WILL BE CONNECTED THROUGH (5) INVERTER / STEP UP TRANSFORMER STATIONS AND REQUIRED GRID PROTECTION EQUIPMENT, TO THE BONNEVILLE POWER ADMINISTRATION 69KV LINE LOCATED ON THE WEST SIDE OF THE PARCEL.

LEGEND

- INVERTER / TRANSFORMER PAD
- COMPACTED GRAVEL INTERIOR ROAD
- PAVED SITE ACCESS ROAD
- PROJECT SUBSTATION
- NWI WETLAND
- LAY DOWN AREA
- OPERATIONS AND MAINTENANCE BUILDING
- PROJECT EXTENT AREA
- PROJECT AREA (NTE 99 ACRES)
- PROJECT FENCELINE
- OVERHEAD MEDIUM VOLTAGE GEN TIE
- UNDERGROUND MEDIUM VOLTAGE COLLECTION
- SUB-ARRAY SEPARATION
- NEW RISER
- EXISTING RISER

OneEnergy RENEWABLES

Rena Marquardt
Bill & Rena Marquardt, LLC
67070 Marquardt Rd
Lexington, OR 97839

February 15, 2018

Carla McLane
Director
Morrow County Planning Department
205 Third Street NE
Irrigon, OR 97844

RE: Harp Solar Project

Dear Ms. McLane,

The Harp Solar project is a proposed photovoltaic solar power generation facility in Morrow County on land owned by our family on tax lot 3401 in Township 1 North, Range 25 East. As the landowner, we support the project and provide the following information in support of OE Solar 1 LLC's request for a Conditional Use Permit and Goal 3 exception.

The proposed site for the project has been owned by the family for more than 70 years and has been historically cultivated for dryland wheat. The fields on which the project is proposed are among the least productive of our 1,959 acres in Morrow County. The shallow soils are subject to wind erosion which leaves a gravelly unproductive soil behind. Consistently these fields have biannual wheat yields that are significantly lower than that of other fields we farm. Additionally, this site has never been irrigated and our family does not have any water rights or the intention of acquiring new water rights for this part of our property.

Because the site has limited productivity and is not irrigated, we have chosen to lease our land to construct the Harp Solar project at the proposed site, which will be a higher and better use of this portion of our land while we continue to farm our more productive farmland. The annual lease payments from the project will provide long-term, predictable revenue while broadening the income generated by our landholdings to more than just farming. Moreover, the project will not adversely impact or increase the cost of farming practices near the project. We do not anticipate any changes to our ongoing wheat farming operations nor those of our neighbors resulting from the construction or operation of the proposed project.

Sincerely,

Rena Marquardt

Rena Marquardt
Representative,
Bill & Rena Marquardt, LLC

HARP SOLAR

SOILS ANALYSIS

MARCH 1, 2018

OneEnergy Renewables
2003 Western Ave, Suite 225
Seattle, Washington 98121

oneenergy
renewables
.com

HARP SOLAR

SOILS ANALYSIS

I. DEFINITIONS

Project Area: Harp Solar is a proposed 10 megawatt ("MW") photovoltaic ("PV") solar generation facility in Morrow County, Oregon, approximately 6 miles east of Ione (the "Project"). The Project will consist of PV panels, inverters, mounting infrastructure, an electrical collection system, operation and maintenance ("O&M") building, private access roads, interior roads, security fencing, a new collector substation and electrical interconnection infrastructure including a line tap to the existing 69 kilovolt ("kV") Bonneville Power Administration ("BPA") transmission line located on-site. The Project's maximum permanent footprint, including all Project components, shall not exceed 99 acres ("Project Area"). This Project Area will be wholly located within the Project Area Extent (defined below).

Project Area Extent: The Project Area will be within the defined micrositing boundary encompassing approximately 132 acres ("Project Area Extent").

Project Parcel: The 382-acre parcel on which the Project will be built ("Project Parcel"). The parcel is known as Morrow County tax lot 3401 in Township 1 North, Range 25 East.

Permitting Approach: OE Solar 1, LLC ("Applicant") requests that the conditional use permit ("CUP") and the Goal 3 exception, give the Applicant flexibility to microsite the precise location of Project components within the Project Area Extent based on a final design layout. The design layout included in Applicant's permit package is preliminary but demonstrates that the Project does, or can subject to conditions, satisfy the applicable Morrow County approval criteria and development standards. The permitting approach allows Applicant the ability to refine the spacing of solar modules and the location for the associated access roads, location of the O&M building, collector lines, staging areas, and other above-ground facilities within the Project Area Extent when finalizing the construction design. It also allows Applicant the ability to further minimize potential impacts and deliver the most effective and efficient Project consistent with landowner needs.

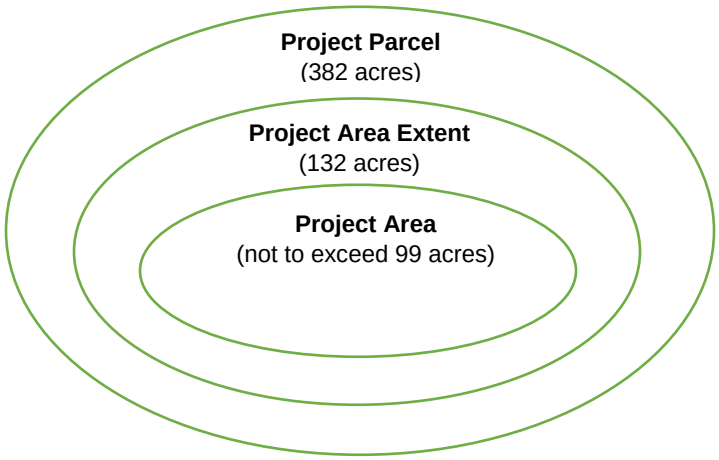


Figure 1: Area Definitions

II. SOIL TYPES

The Project Area Extent, totaling 131.5 acres, is comprised of 120.0 acres of Ritzville silt loam (45B and 45C) and 11.5 acres of Willis silt loam (75C). (See ***Attachment E***, NRCS Soils Report.) The entire Project Parcel is not irrigated and does not have water rights for agricultural irrigation (see ***Attachment P***, Water Rights Map and ***Attachment C***, Landowner Letter of Support). When not irrigated, the soil types found within the Project Area Extent are considered by the Natural Resources Conservation Service ("NRCS") to have a "land capability classification" of Class 3e. NRCS states that "Class 3 soils have severe limitations that reduce the choice of plants or require special conservation practices, or both." The "e" component of the classification is a subclass which refers to erosion as being the limitation involved. Further, both soil types are not considered "Prime Farmland" when not irrigated by the US Department of Agriculture. (See ***Attachment F***, Prime Farmland List for Oregon.)

Soil Map Unit Name (Map Unit Symbol)	Land Capability Class	Acres	% of Total Acres
Ritzville silt loam, 2-7% slopes (45B)	3e	76.3	58%
Ritzville silt loam, 7-12% slopes (45C)	3e	43.7	33.2%
Willis silt loam, 5-12% slopes (75C)	3e	11.5	8.8%
Totals		131.5	100%

Table 1: Soil Types at Project Area Extent

Within the Project Area Extent, the Project Area will occupy a maximum of 99 acres. (See ***Attachment B***, Preliminary Layout.) Because the Project Area Extent is comprised entirely of Class 3 soils, Applicant assumes for purposes of the impacts analysis that the final Project Area will impact up to 99 acres of Class 3 soils.

III. ARABLE LAND V. HIGH-VALUE FARMLAND

As outlined in Oregon Administrative Rule ("OAR") 660 Division 33, a photovoltaic solar power generation facility must abide by different rules depending on the number of acres precluded by 1) high-value farmland and 2) arable land. OAR 660-033-0130(38)(f) and (g) provide:

> *(f) For high-value farmland described at ORS 195.300(10), a photovoltaic solar power generation facility shall not preclude more than 12 acres from use as a commercial agricultural enterprise unless an exception is taken pursuant to ORS197.732 and OAR chapter 660, division 4.*
>
> *(g) For arable lands a photovoltaic solar power generation facility shall not preclude more than 20 acres from use as a commercial agricultural enterprise unless an exception is taken pursuant to ORS197.732 and OAR chapter 660, division 4.*

Simply, if more than 12 acres of high-value farmland are precluded then a Goal 3 Exception is required by OAR 660-033-0130(38)(f). If fewer than 12 acres of high-value farmland, but more than 20 acres of arable land are precluded, then a Goal 3 Exception is required by OAR 660-033-0130(38)(g).

A. ARABLE LAND

As stated above, the Project Area Extent is comprised of Class 3 soils and is predominately used for dryland wheat farming. Therefore, under OAR 660-033-0130(38)(a) and (b), the Project Area Extent is comprised of arable land and arable soils using the NRCS soils classifications system. The Project's permanent footprint (*e.g*. the Project Ara) will impact up to 99 acres of arable land, thus triggering a Goal 3 exception under OAR 660-033-0130(38)(f). However, because the Project Area Extent is located within the mapped Columbia Valley American Viticulture Area ("AVA"), the Applicant must further evaluate the

Project Area Extent to determine if, (1) if the Project Area Extent also contains high-value farmland as defined ORS 195.300(10), and (2) whether the Project's permanent footprint would impact more than 12 acres of high-value farmland thus triggering a Goal 3 exception under OAR 660-033-0130(38)(f).

B. HIGH-VALUE FARMLAND

The solar siting rule cross-references ORS 195.300(10) for purposes of defining high-value farmland. ORS chapter 195.300 to 195.336 contains the statutory provisions governing "Just Compensation for Land Use Regulations," which implement Oregon Measure 37 and Measure 49. ORS 195.300(10) broadly defines "high-value farmland" and establishes six categories of high-value farmland:

ORS 195.300(10) *"High-value farmland" means:*

> ***ORS 195.300(10)(a)*** *High-value farmland as described in ORS 215.710 (High-value farmland description for ORS 215.705) that is land in an exclusive farm use zone or a mixed farm and forest zone, except that the dates specified in ORS 215.710 (High-value farmland description for ORS 215.705) (2), (4) and (6) are December 6, 2007.*
>
> Response: This section refers to a separate statute, ORS 215.710, which further defines high-value farmland in four subsections, (1) through (4). As demonstrated below, the land within the Project Area Extent does not meet the definition of high-value farmland by these criteria:
>
> > ***ORS 215.710(1)*** *For purposes of ORS 215.705 (Dwellings in farm or forest zone), high-value farmland is land in a tract composed predominantly of soils that, at the time the siting of a dwelling is approved for the tract, are:*
> >
> > *(a)Irrigated and classified prime, unique, Class I or Class II; or*
> >
> > *(b)Not irrigated and classified prime, unique, Class I or Class II.*
> >
> > Response: The Project Area Extent is not irrigated and all the soils are classified as Class III. Therefore, the Project Area Extent is not considered high-value farmland by this criterion, which indicates that it is not high-value farmland based on its soil type.
>
> > ***ORS 215.710(2)*** *In addition to that land described in subsection (1) of this section, for purposes of ORS 215.705 (Dwellings in farm or forest zone), high-value farmland, if outside the Willamette Valley, includes tracts growing specified perennials as demonstrated by the most recent aerial photography of the Agricultural Stabilization and Conservation Service of the United States Department of Agriculture taken prior to November 4, 1993. For purposes of this subsection, specified perennials means perennials grown for market or research purposes including, but not limited to, nursery stock, berries, fruits, nuts, Christmas trees or vineyards but not including seed crops, hay, pasture or alfalfa.*
> >
> > Response: The Project Area Extent is used to for dryland wheat farming, which is specifically not included as a perennial and the land is therefore not considered high-value farmland by this criterion.
>
> > ***ORS 215.710(3)*** *In addition to that land described in subsection (1) of this section, for purposes of ORS 215.705 (Dwellings in farm or forest zone), high-value farmland, if in the Willamette Valley, includes tracts composed predominantly of the following soils in Class III or IV or composed predominantly of a combination of soils described in subsection (1) of this section and the following soils:*

(a)Subclassification IIIe, specifically, Bellpine, Bornstedt, Burlington, Briedwell, Carlton, Cascade, Chehalem, Cornelius, Cornelius Variant, Cornelius and Kinton, Helvetia, Hillsboro, Hullt, Jory, Kinton, Latourell, Laurelwood, Melbourne, Multnomah, Nekia, Powell, Price, Quatama, Salkum, Santiam, Saum, Sawtell, Silverton, Veneta, Willakenzie, Woodburn and Yamhill;
(b)Subclassification IIIw, specifically, Concord, Conser, Cornelius Variant, Dayton (thick surface) and Sifton (occasionally flooded);
(c)Subclassification IVe, specifically, Bellpine Silty Clay Loam, Carlton, Cornelius, Jory, Kinton, Latourell, Laurelwood, Powell, Quatama, Springwater, Willakenzie and Yamhill; and
(d)Subclassification IVw, specifically, Awbrig, Bashaw, Courtney, Dayton, Natroy, Noti and Whiteson.

Response: The Project Area Extent is located outside of the Willamette Valley and is therefore not considered high-value farmland by this criterion.

ORS 215.710(4) *In addition to that land described in subsection (1) of this section, for purposes of ORS 215.705 (Dwellings in farm or forest zone), high-value farmland, if west of the summit of the Coast Range and used in conjunction with a dairy operation on January 1, 1993, includes tracts composed predominantly of the following soils in Class III or IV or composed predominantly of a combination of soils described in subsection (1) of this section and the following soils:*

(a)Subclassification IIIe, specifically, Astoria, Hembre, Knappa, Meda, Quillayutte and Winema;
(b)Subclassification IIIw, specifically, Brenner and Chitwoo(c)Subclassification IVe, specifically, Astoria, Hembre, Meda, Nehalan, Neskowin and Winema; and
(d)Subclassification IVw, specifically, Coquille.

Response: The Project Area Extent site is not located west of the summit of the Coast Range and is therefore not considered high-value farmland by this criterion.

ORS 195.300(10)(b) *Land west of U.S. Highway 101 that is composed predominantly of the following soils in Class III or IV or composed predominantly of a combination of the soils described in ORS 215.710 (High-value farmland description for ORS 215.705) (1) and the following soils:*

(A)Subclassification IIIw, specifically Ettersburg Silt Loam and Croftland Silty Clay Loam;
(B)Subclassification IIIe, specifically Klooqueth Silty Clay Loam and Winchuck Silt Loam©nd
(C)Subclassification IVw, specifically Huffling Silty Clay Loam.

Response: The Project Area Extent is not located west of Highway 101 and is therefore not considered high-value farmland by this criterion.

ORS 195.300(10)(c) *Land that is in an exclusive farm use zone or a mixed farm and forest zone and that on June 28, 2007, is:*

(A) Within the place of use for a permit, certificate or decree for the use of water for irrigation issued by the Water Resources Department;

(B) Within the boundaries of a district, as defined in ORS 540.505 (Definitions); or
(C) Within the boundaries of a diking district formed under ORS chapter 551.

Response: The Project Area Extent is not irrigated, has no history of irrigation and does not have water rights. (See ***Attachment P***, Water Rights Map and ***Attachment C***, Landowner Support Letter.) The Project Area Extent is not within the boundaries of a district as defined in ORS 540.505 or within the boundaries of a diking district per a conversation with the Assistant Watermaster on February 15, 2018.

As shown, the Project Area Extent does not meet any of the criteria for subsection (c) and is therefore not considered high-value farmland by this criterion.

ORS 195.300(10)(d) *Land that contains not less than five acres planted in wine grapes.*

Response: The Project Area Extent is used for dryland wheat farming and does not have any wine grapes and is therefore not considered high-value farmland by this criterion.

ORS 195.300(10)(e) *Land that is in an exclusive farm use zone and that is at an elevation between 200 and 1,000 feet above mean sea level, with an aspect between 67.5 and 292.5 degrees and a slope between zero and 15 percent, and that is located within:*

(A) The Southern Oregon viticultural area as described in 27 C.F.R. 9.179;
(B) The Umpqua Valley viticultural area as described in 27 C.F.R. 9.89; or
(C) The Willamette Valley viticultural area as described in 27 C.F.R. 9.90.

Response: The Project Area Extent is not located within any of these viticultural areas and is therefore not considered high-value farmland by this criterion.

ORS 195.300(10)(f) *Land that is in an exclusive farm use zone and that is no more than 3,000 feet above mean sea level, with an aspect between 67.5 and 292.5 degrees and a slope between zero and 15 percent, and that is located within:*

(A) The portion of the Columbia Gorge viticultural area as described in 27 C.F.R. 9.178 that is within the State of Oregon;
(B) The Rogue Valley viticultural area as described in 27 C.F.R. 9.132*;*
(C) The portion of the Columbia Valley viticultural area as described in 27 C.F.R. 9.74 that is within the State of Oregon;
(D) The portion of the Walla Walla Valley viticultural area as described in 27 C.F.R. 9.91 that is within the State of Oregon; or
(E) The portion of the Snake River Valley viticultural area as described in 27 C.F.R. 9.208 that is within the State of Oregon.

Response: The Project Area Extent is located within the Exclusive Farm Use ("EFU") zone, is below 3,000 feet above mean sea level, has a slope between 0 and 15 percent and is located within the Columbia Valley AVA. (See ***Attachment G***, Columbia Valley AVA Map.) The critical criterion for the land within the Project Area Extent is the aspect[1]. To evaluate whether the land meets this criterion, the Applicant utilized a dataset created by the Oregon Ocean-Coastal

[1] Aspect refers to the compass direction that a slope faces.

Management Program - Department of Land Conservation and Development (titled sde.gis.pln_or_viticultural_areas_2007), which identifies land that meets these conditions. As shown in Figure 2, that dataset shows that some portions of the Project Area Extent are considered high-value farmland because the land has an aspect that is between 67.5 and 292.5 degrees. As depicted, 20.00 acres of the Project Area Extent are considered high-value farmland; the remaining 111.5 acres do not meet the criteria and are not considered high-value farmland by this criterion.

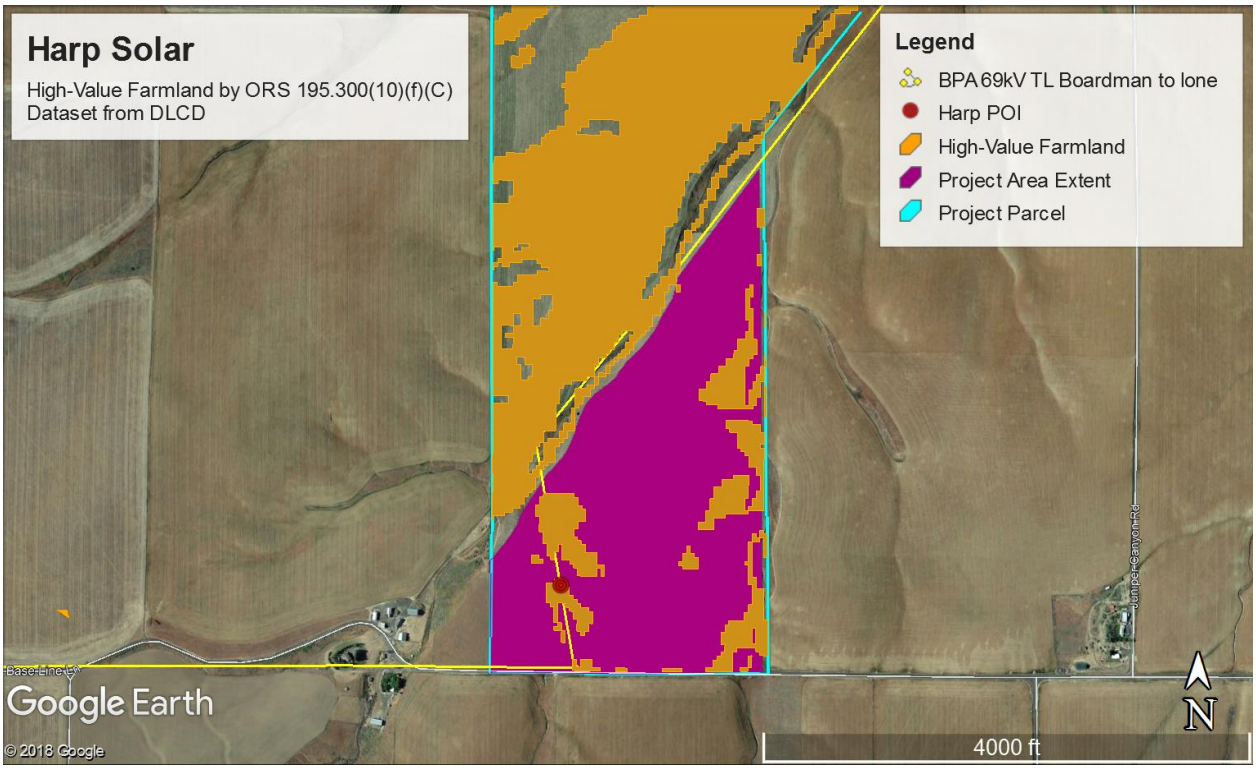


Figure 2: High-Value Farmland Map

IV. CONCLUSIONS

The Applicant proposes to construct the Project on up to 99 acres. This 99-acre permanent footprint is defined as the Project Area, which will be located within the 132-acre Project Area Extent. For purposes of this soils analysis, the Applicant analyzes the entire Project Area Extent to preserve the ability to microsite the final project layout within the Project Area Extent.

The Project Area Extent is comprised of Ritzville Silt Loam (45B and 45C) and Willis Silt Loam (75C), which are considered Class III when not irrigated. As predominately cultivated land, the Project Area Extent is comprised entirely of arable land. However, by operation of ORS 195.300(10)(f)(C), 20 acres (15%) of the Project Area Extent is considered high-value farmland.

A conservative analysis demonstrates that the Project *may* impact more than 12 acres of high-value farmland soils as defined by law, and *will* impact more than 20 acres of arable soils as defined by the NRCS soil classification system. Therefore, to preserve micrositing flexibility within the Project Area Extent, the Applicant analyzes the Project under both OAR 660-033-0130(38)(f) for high-value farmland and OAR 660-033-0130(38)(g) for arable land.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Morrow County, Oregon

Executive Summary

November 29, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

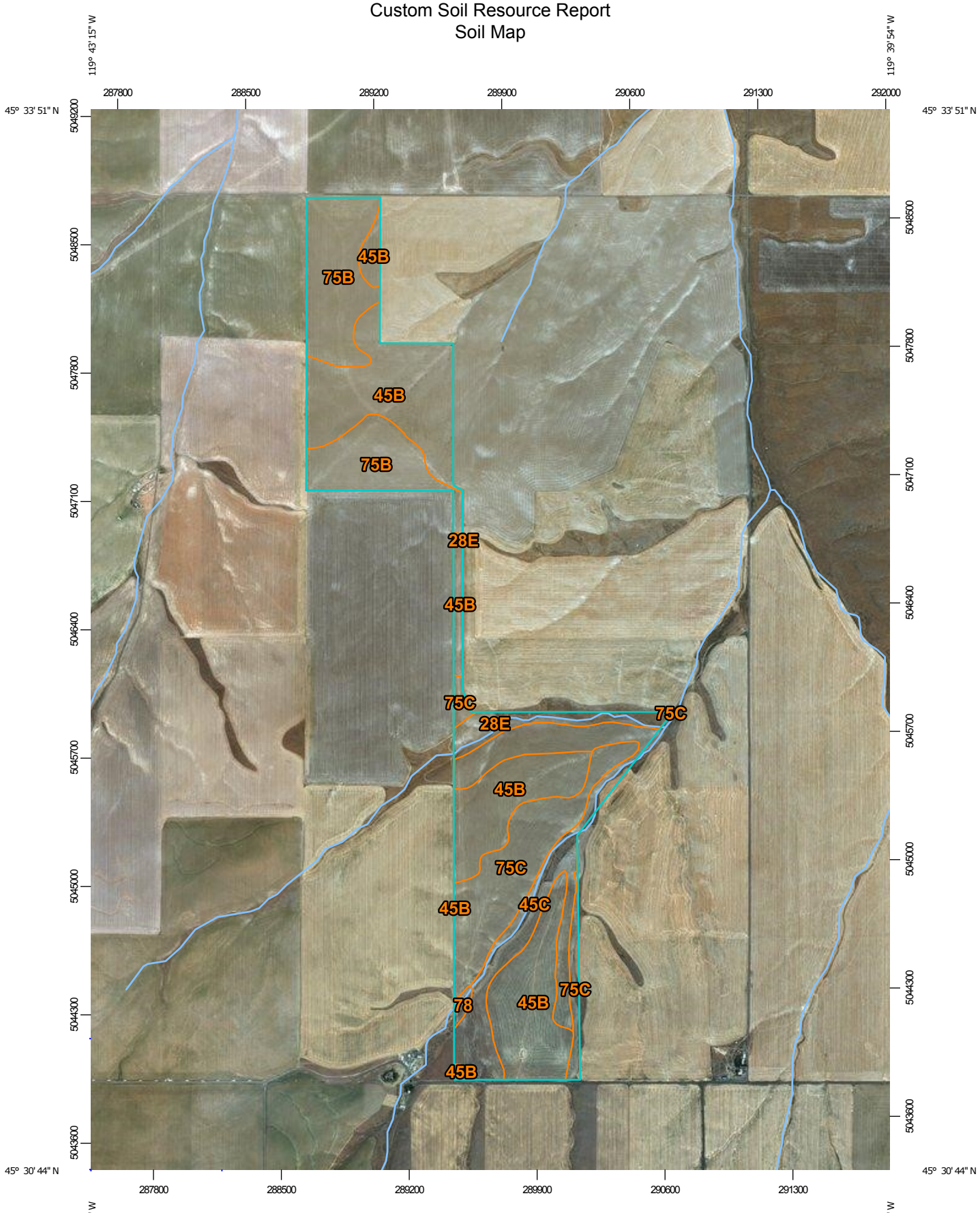
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 400 800 1600 2400

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	103.8	16.3%
78	Xeric Torriorthents, nearly level	3.1	0.5%
Totals for Area of Interest		**637.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Morrow County, Oregon

28E—Lickskillet very stony loam, 7 to 40 percent slopes

Map Unit Setting

National map unit symbol: 21sm
Elevation: 800 to 3,500 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 47 to 51 degrees F
Frost-free period: 100 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Lickskillet and similar soils: 70 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lickskillet

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Nose slope, interfluve, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with colluvium from basalt

Typical profile

H1 - 0 to 2 inches: very stony loam
H2 - 2 to 17 inches: extremely cobbly loam
H3 - 17 to 27 inches: unweathered bedrock

Properties and qualities

Slope: 7 to 40 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: SHALLOW SOUTH 10-14 PZ (R008XY210OR)
Hydric soil rating: No

45B—Ritzville silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 21tn
Elevation: 1,000 to 2,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 130 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ritzville and similar soils: 77 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritzville

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with small amounts of volcanic ash

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 33 inches: silt loam
H3 - 33 to 70 inches: silt loam

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: LOAMY 10-12 PZ (R008XY110OR)
Hydric soil rating: No

45C—Ritzville silt loam, 7 to 12 percent slopes

Map Unit Setting

National map unit symbol: 21tp
Elevation: 1,000 to 2,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 130 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ritzville and similar soils: 70 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritzville

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with small amounts of volcanic ash

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 33 inches: silt loam
H3 - 33 to 70 inches: silt loam

Properties and qualities

Slope: 7 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: LOAMY 10-12 PZ (R008XY110OR)
Hydric soil rating: No

75B—Willis silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 21wf
Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 9 to 11 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Willis and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Willis

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over cemented alluvium

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 27 inches: silt loam
H3 - 27 to 35 inches: silt loam
H4 - 35 to 39 inches: cemented material

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 20 to 40 inches to duripan
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: LOAMY 8-10 PZ (R007XY014OR)
Hydric soil rating: No

75C—Willis silt loam, 5 to 12 percent slopes

Map Unit Setting

National map unit symbol: 21wg
Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 9 to 11 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Willis and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Willis

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over cemented alluvium

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 27 inches: silt loam
H3 - 27 to 35 inches: silt loam
H4 - 35 to 39 inches: cemented material

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: 20 to 40 inches to duripan
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: LOAMY 8-10 PZ (R007XY014OR)
Hydric soil rating: No

78—Xeric Torriorthents, nearly level

Map Unit Setting

National map unit symbol: 21wl
Elevation: 300 to 800 feet
Mean annual precipitation: 8 to 9 inches
Mean annual air temperature: 49 to 54 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Xeric torriorthents and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xeric Torriorthents

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands and alluvium

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 15 inches: fine sandy loam
H3 - 15 to 30 inches: gravelly sandy loam
H4 - 30 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: SANDY 8-10 PZ (R007XY012OR)
Hydric soil rating: No

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Building Site Development

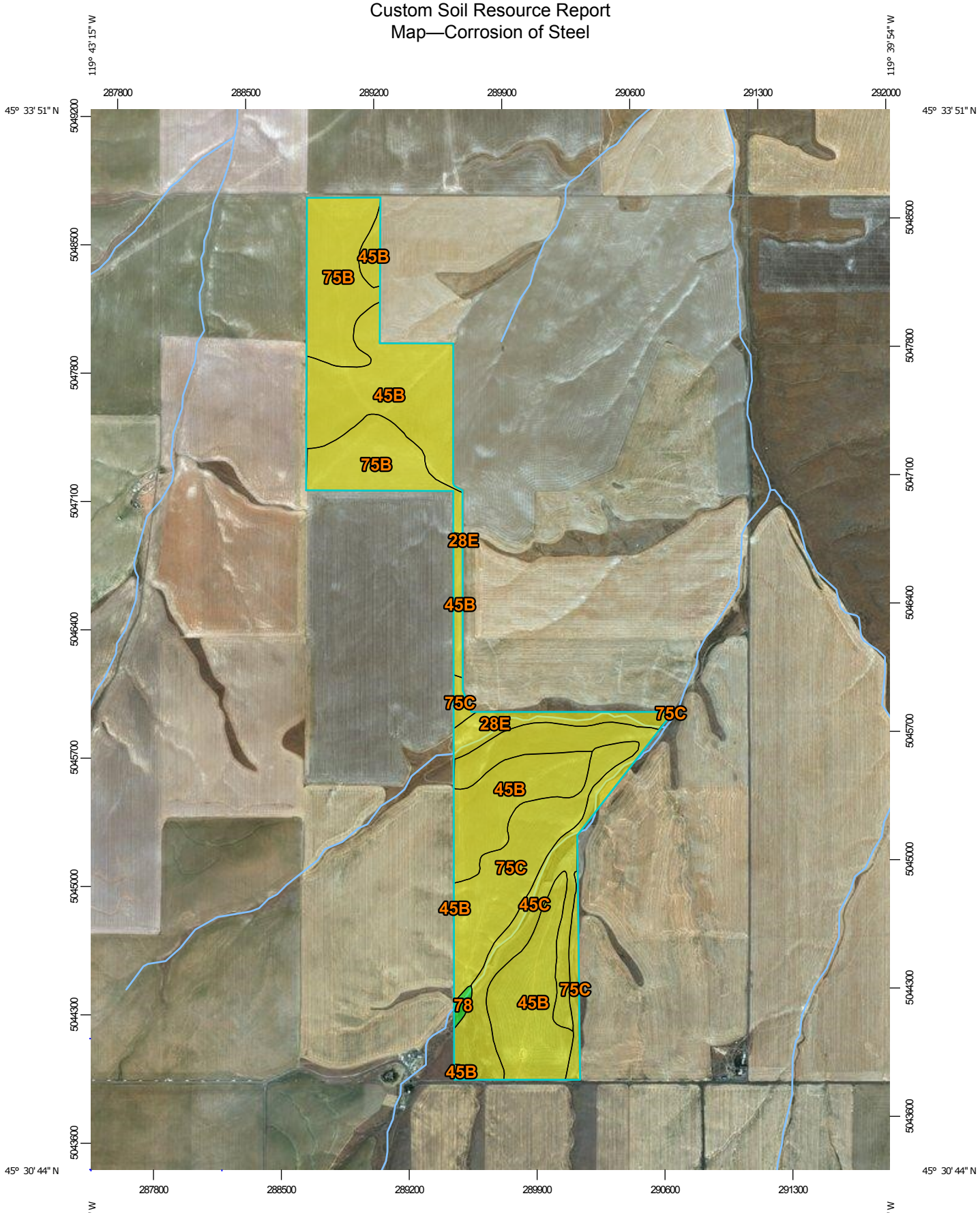
Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Corrosion of Steel

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Custom Soil Resource Report
Map—Corrosion of Steel



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Steel

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	Moderate	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	Moderate	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	Moderate	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	Moderate	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	Moderate	103.8	16.3%
78	Xeric Torriorthents, nearly level	Low	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Corrosion of Steel

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

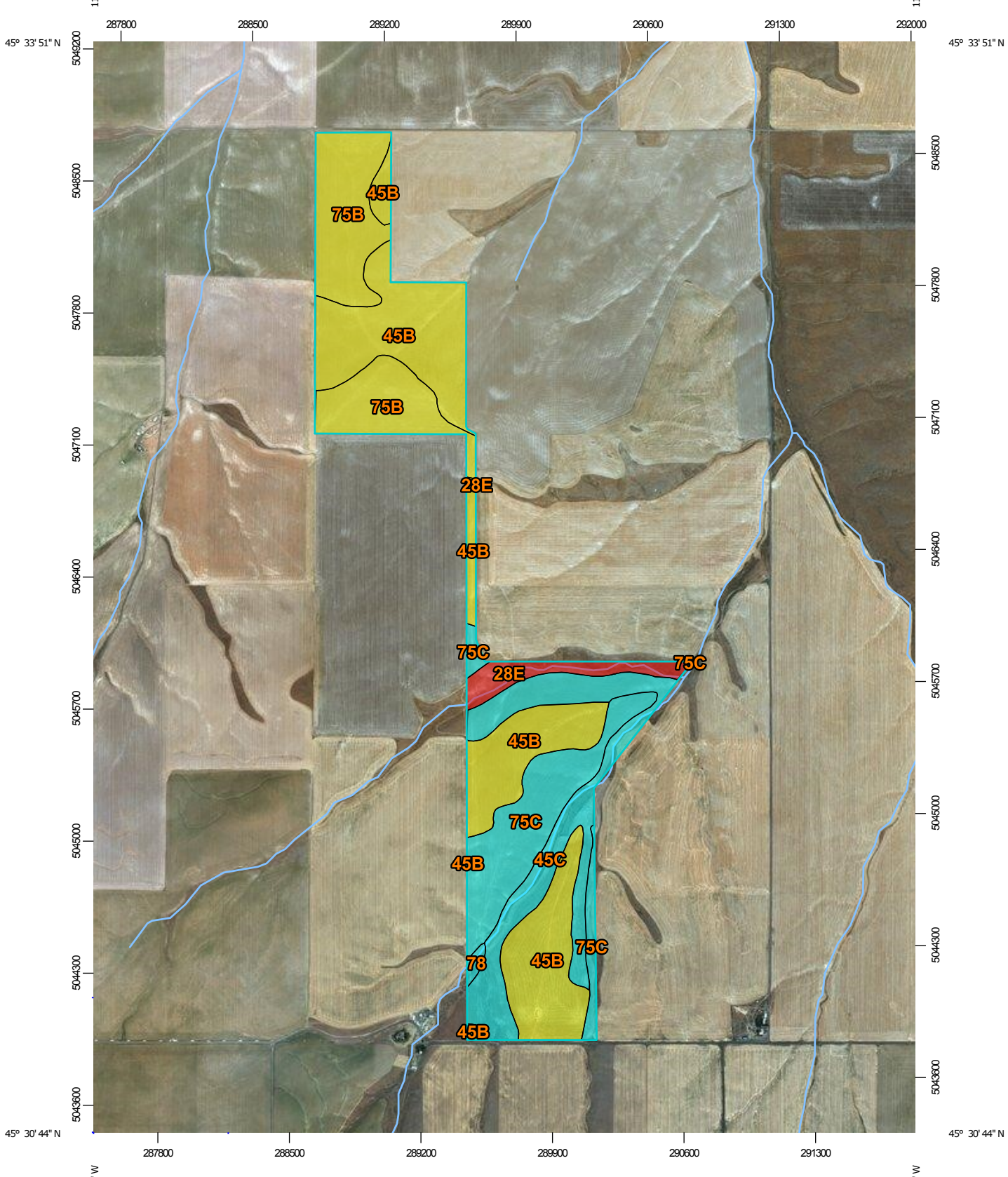
Tie-break Rule: Higher

Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 400 800 1600 2400

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Lines

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Points

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Water Features

MAP INFORMATION

Streams and Canals

Transportation


Rails


Interstate Highways


US Routes

Major Roads

Local Roads

Background


Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	Not prime farmland	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	Prime farmland if irrigated	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	Farmland of statewide importance	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	Prime farmland if irrigated	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	Farmland of statewide importance	103.8	16.3%
78	Xeric Torriorthents, nearly level	Farmland of statewide importance	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Farmland Classification

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Hydric Rating by Map Unit

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the

upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Custom Soil Resource Report
Map—Hydric Rating by Map Unit

Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines

- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points

- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	0	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	0	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	0	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	0	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	0	103.8	16.3%
78	Xeric Torriorthents, nearly level	0	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Hydric Rating by Map Unit

Aggregation Method: Percent Present

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Nonirrigated Capability Class

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

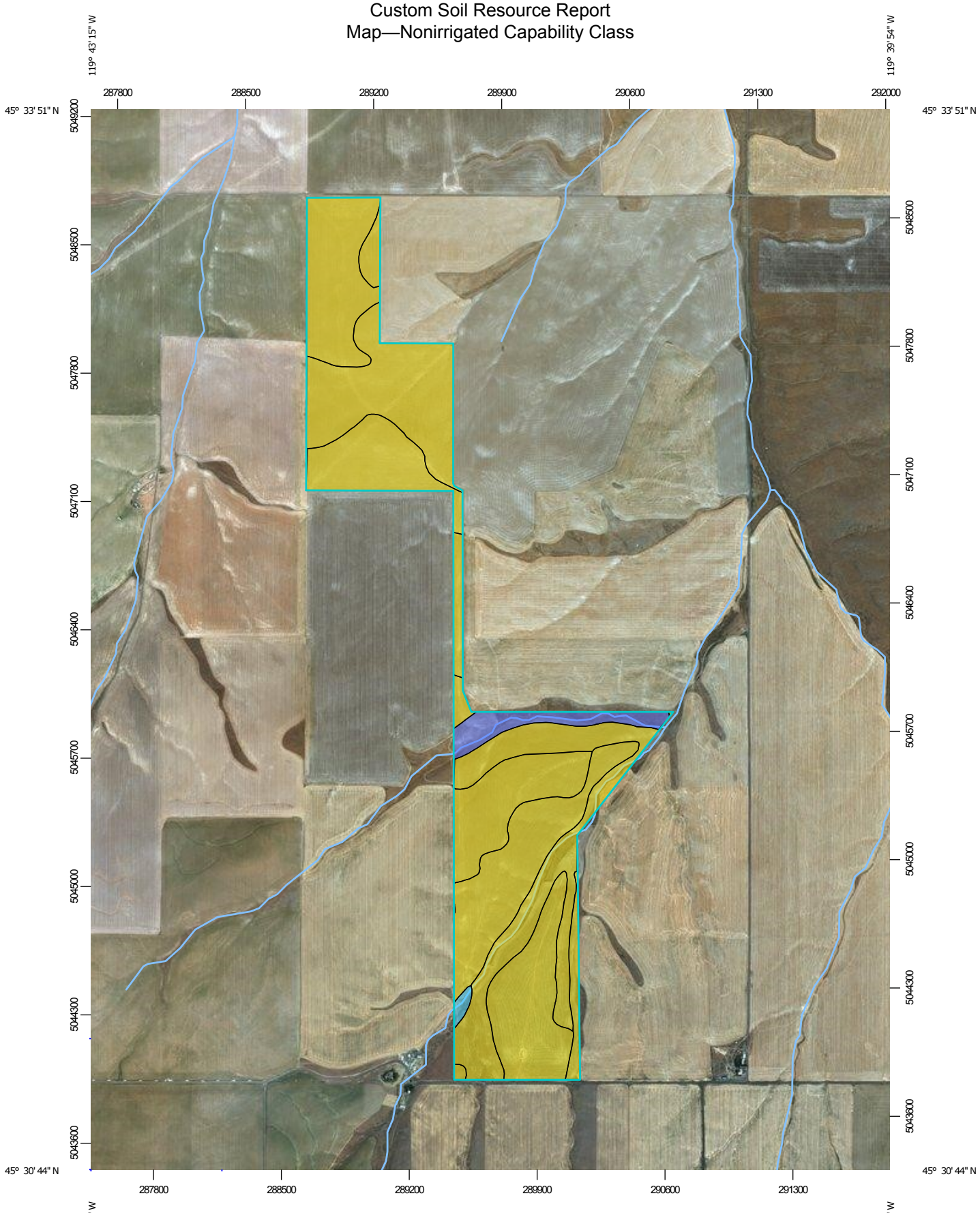
Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Custom Soil Resource Report
Map—Nonirrigated Capability Class



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Capability Class - I
- Capability Class - II
- Capability Class - III
- Capability Class - IV
- Capability Class - V
- Capability Class - VI
- Capability Class - VII
- Capability Class - VIII
- Not rated or not available

Soil Rating Lines

- Capability Class - I
- Capability Class - II
- Capability Class - III
- Capability Class - IV
- Capability Class - V
- Capability Class - VI
- Capability Class - VII
- Capability Class - VIII
- Not rated or not available

Soil Rating Points

- Capability Class - I
- Capability Class - II
- Capability Class - III
- Capability Class - IV
- Capability Class - V
- Capability Class - VI
- Capability Class - VII
- Capability Class - VIII
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Nonirrigated Capability Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	7	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	3	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	3	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	3	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	3	103.8	16.3%
78	Xeric Torriorthents, nearly level	6	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Nonirrigated Capability Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Nonirrigated Capability Subclass

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

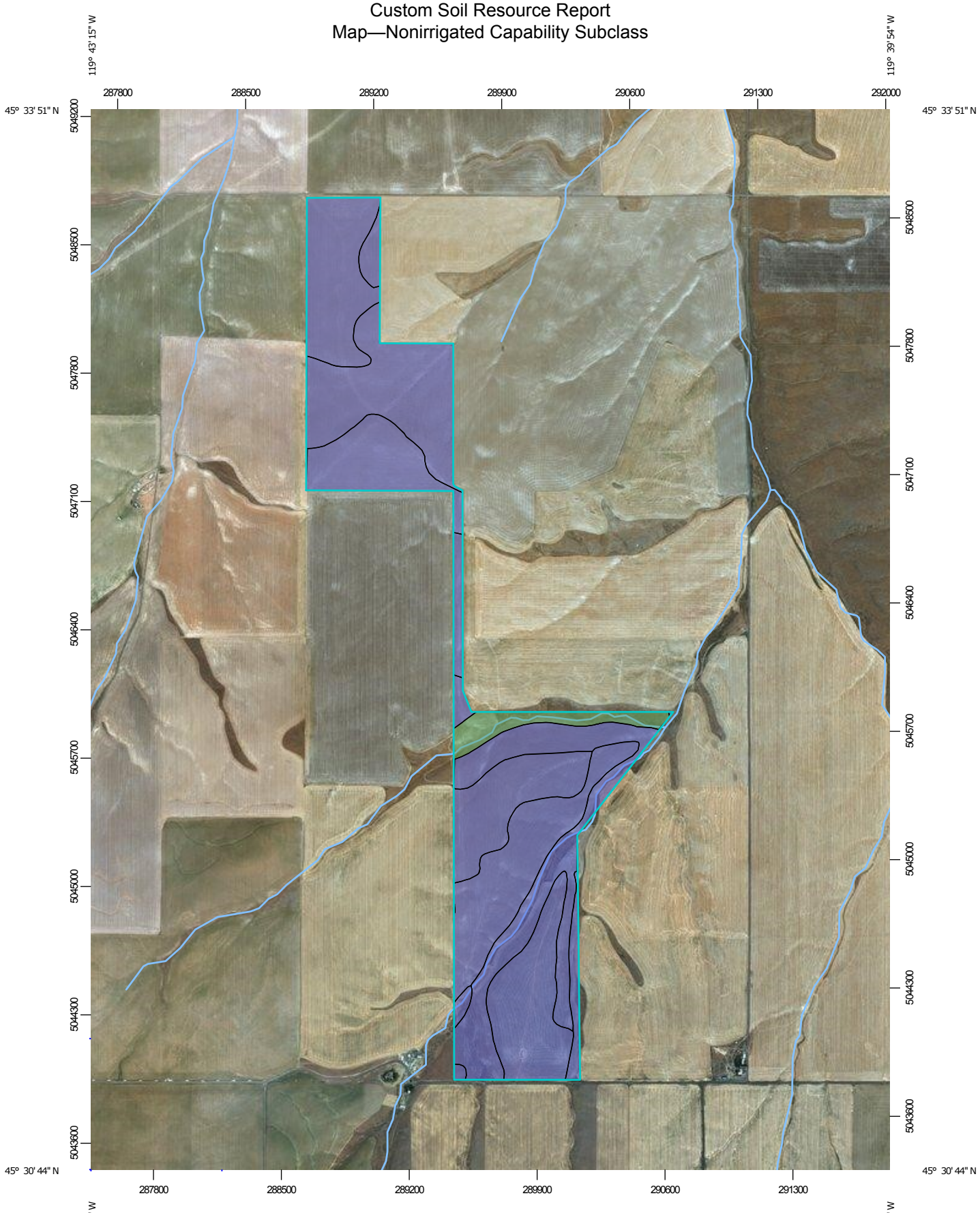
In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.

Capability subclasses are soil groups within one capability class. They are designated by adding a small letter, "e," "w," "s," or "c," to the class numeral, for example, 2e. The letter "e" shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; "w" shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); "s" shows that the soil is limited mainly because it is

shallow, droughty, or stony; and "c," used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by "w," "s," or "c" because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, forestland, or wildlife habitat.

Custom Soil Resource Report
Map—Nonirrigated Capability Subclass



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Erosion
- Soil limitation within the rooting zone
- Excess water
- Climate condition
- Not rated or not available

Soil Rating Lines

- Erosion
- Soil limitation within the rooting zone
- Excess water
- Climate condition
- Not rated or not available

Soil Rating Points

- Erosion
- Soil limitation within the rooting zone
- Excess water
- Climate condition
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Survey Area Data: Version 13, Sep 25, 2017

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Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

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Table—Nonirrigated Capability Subclass

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	s	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	e	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	e	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	e	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	e	103.8	16.3%
78	Xeric Torriorthents, nearly level	e	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Nonirrigated Capability Subclass

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Soil Taxonomy Classification

This rating presents the taxonomic classification based on Soil Taxonomy.

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999 and 2003). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. This table shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in sol. An example is Alfisols.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalfs (Ud, meaning humid, plus alfs, from Alfisols).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (Hapl, meaning minimal horizonation, plus udalfs, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective Typic identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineralogy class, cation-exchange activity class, soil temperature regime, soil depth, and reaction class. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, active, mesic Typic Hapludalfs.

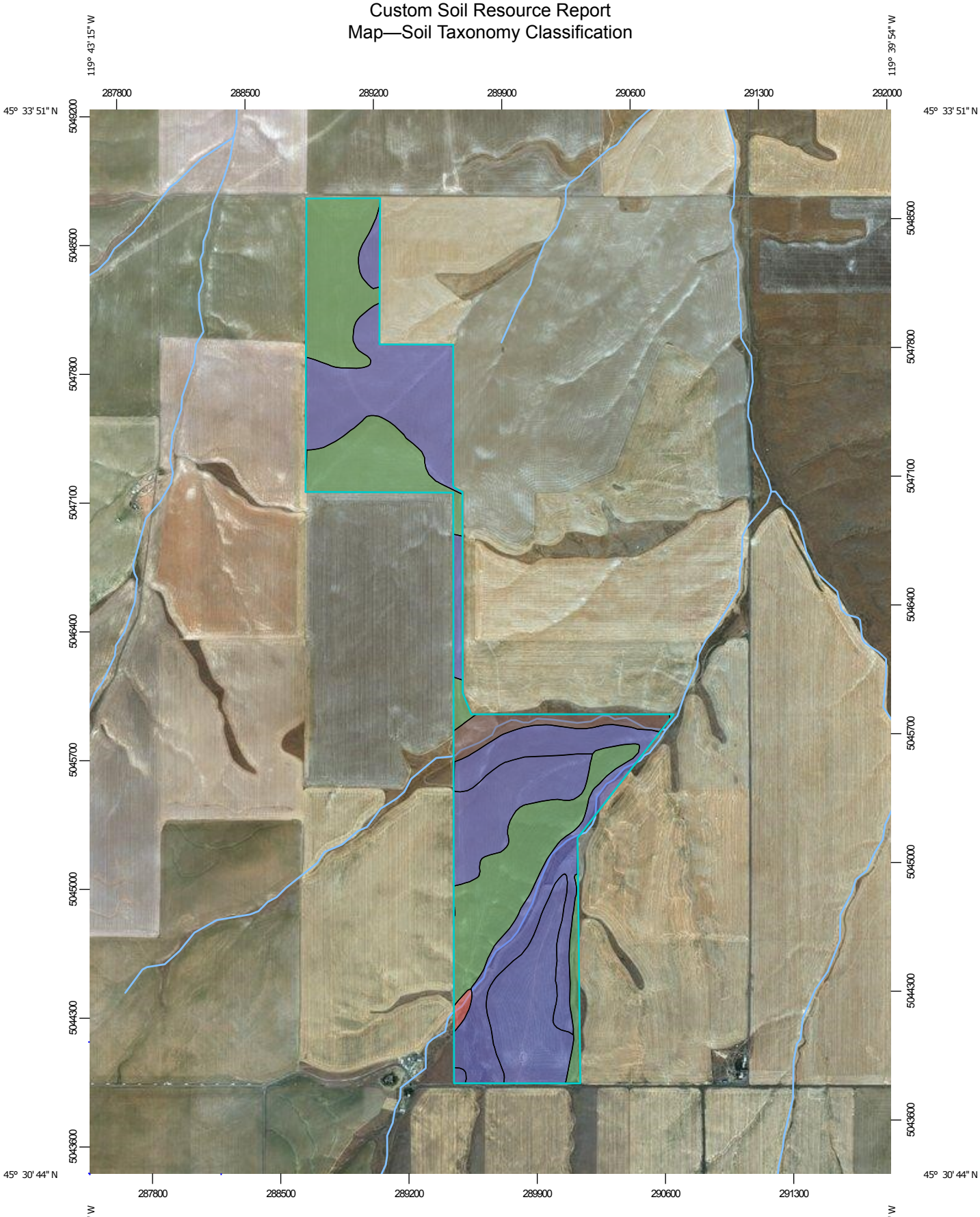
SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

References:

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. (The soils in a given survey area may have been classified according to earlier editions of this publication.)

Custom Soil Resource Report
Map—Soil Taxonomy Classification



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls
- Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls
- Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls
- Xeric Torriorthents
- Not rated or not available

Soil Rating Lines

- Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls
- Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls
- Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls
- Xeric Torriorthents
- Not rated or not available

Soil Rating Points

- Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls
- Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls
- Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls
- Xeric Torriorthents
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Soil Taxonomy Classification

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
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75C	Willis silt loam, 5 to 12 percent slopes	Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls	103.8	16.3%
78	Xeric Torriorthents, nearly level	Xeric Torriorthents	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Soil Taxonomy Classification

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Soil Taxonomy Classification

This rating presents the taxonomic classification based on Soil Taxonomy.

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999 and 2003). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. This table shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (Hapl, meaning minimal horizonation, plus udalfs, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective Typic identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineralogy class, cation-exchange activity class, soil temperature regime, soil depth, and reaction class. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, active, mesic Typic Hapludalfs.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

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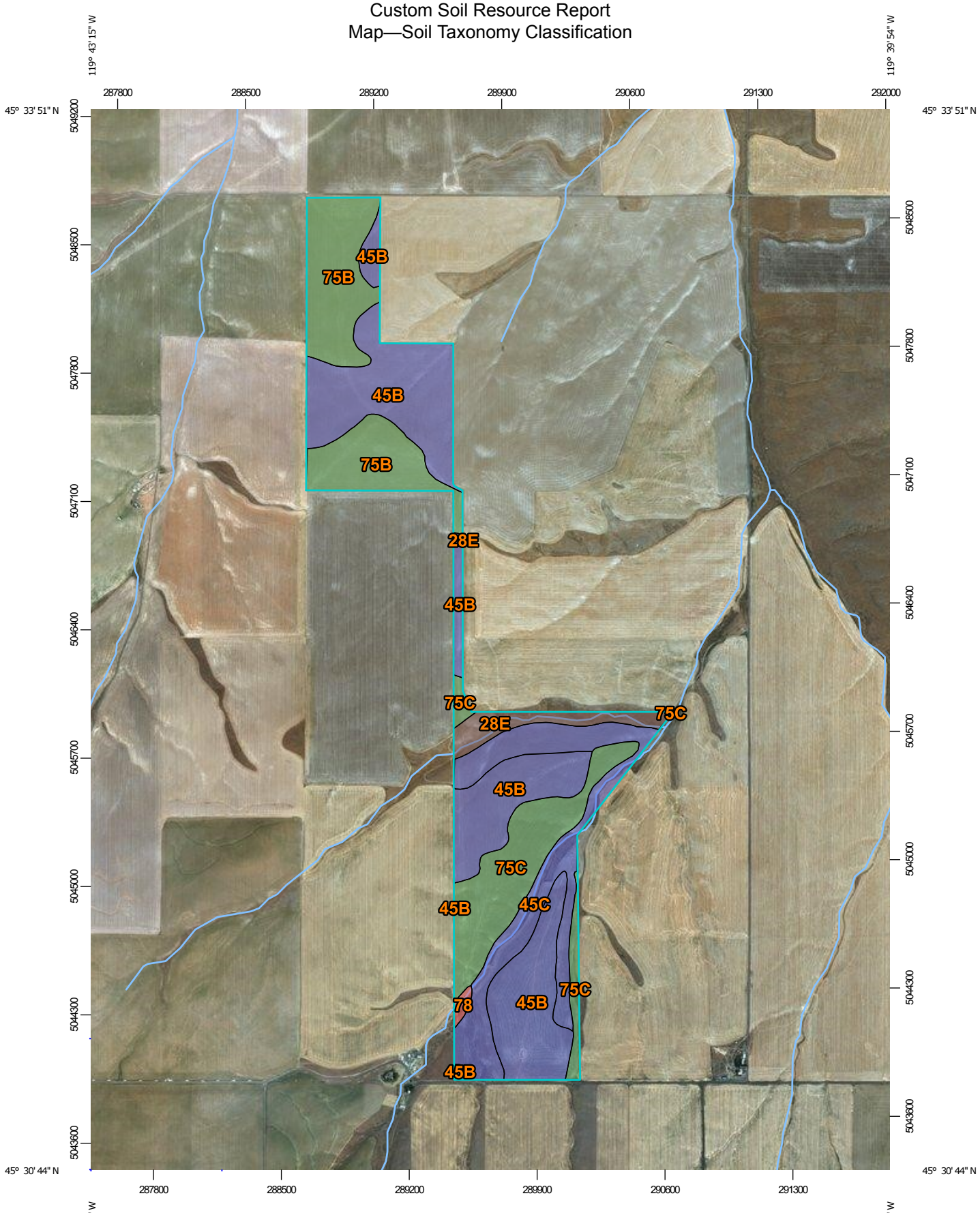
Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. (The soils in a given survey area may have been classified according to earlier editions of this publication.)

Custom Soil Resource Report
Map—Soil Taxonomy Classification



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls
- Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls
- Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls
- Xeric Torriorthents
- Not rated or not available

Soil Rating Lines

- Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls
- Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls
- Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls
- Xeric Torriorthents
- Not rated or not available

Soil Rating Points

- Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls
- Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls
- Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls
- Xeric Torriorthents
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Soil Taxonomy Classification

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	Loamy-skeletal, mixed, superactive, mesic Lithic Haploxerolls	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	Coarse-silty, mixed, superactive, mesic Haploduridic Durixerolls	103.8	16.3%
78	Xeric Torriorthents, nearly level	Xeric Torriorthents	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Soil Taxonomy Classification

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

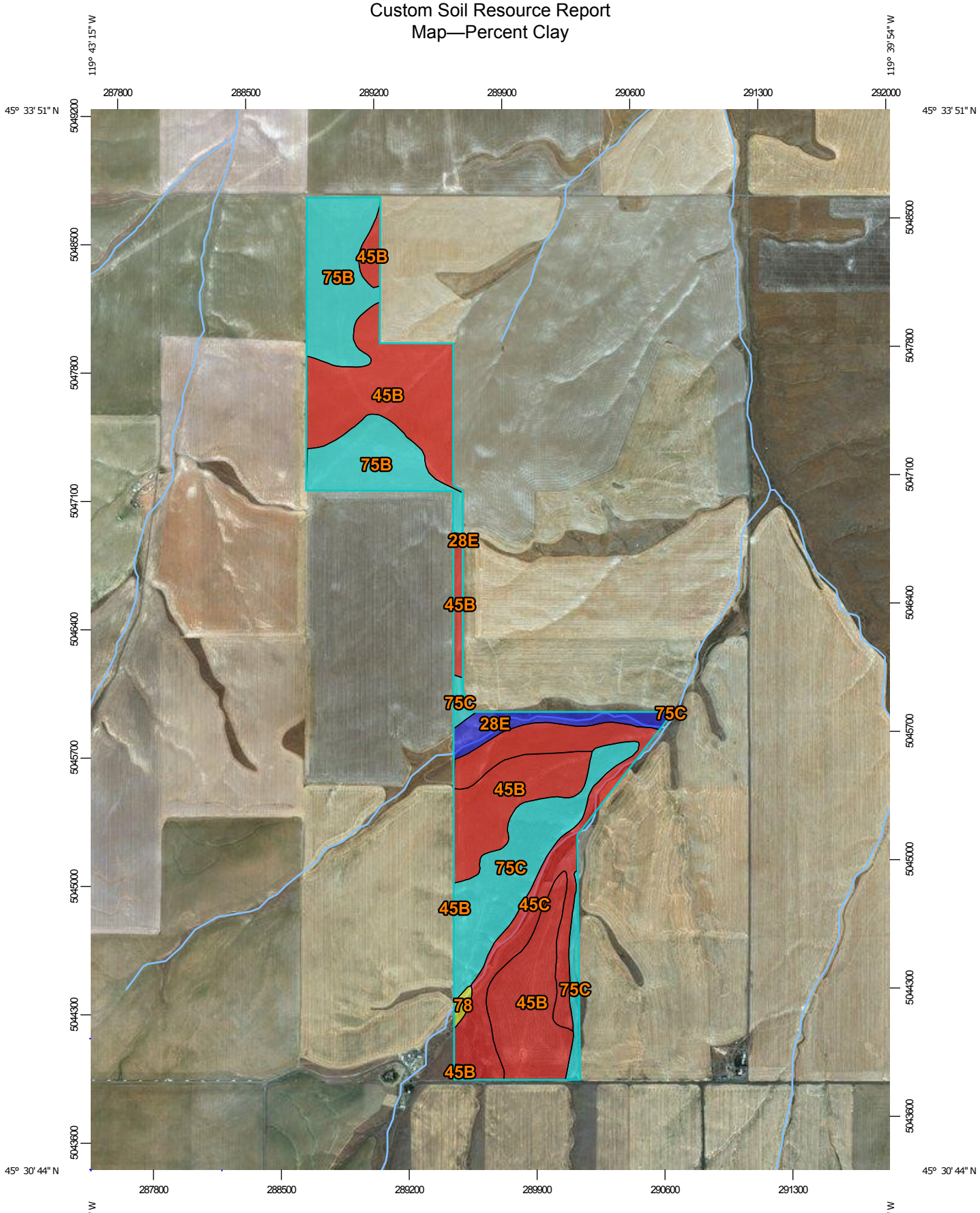
Percent Clay

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Most of the material is in one of three groups of clay minerals or a mixture of these clay minerals. The groups are kaolinite, smectite, and hydrous mica, the best known member of which is illite.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Percent Clay



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- <= 7.5
- > 7.5 and <= 8.8
- > 8.8 and <= 10.8
- > 10.8 and <= 25.3
- Not rated or not available

Soil Rating Lines
- <= 7.5
- > 7.5 and <= 8.8
- > 8.8 and <= 10.8
- > 10.8 and <= 25.3
- Not rated or not available

Soil Rating Points
- <= 7.5
- > 7.5 and <= 8.8
- > 8.8 and <= 10.8
- > 10.8 and <= 25.3
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Percent Clay

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	25.3	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	7.5	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	7.5	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	10.8	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	10.8	103.8	16.3%
78	Xeric Torriorthents, nearly level	8.8	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Percent Clay

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

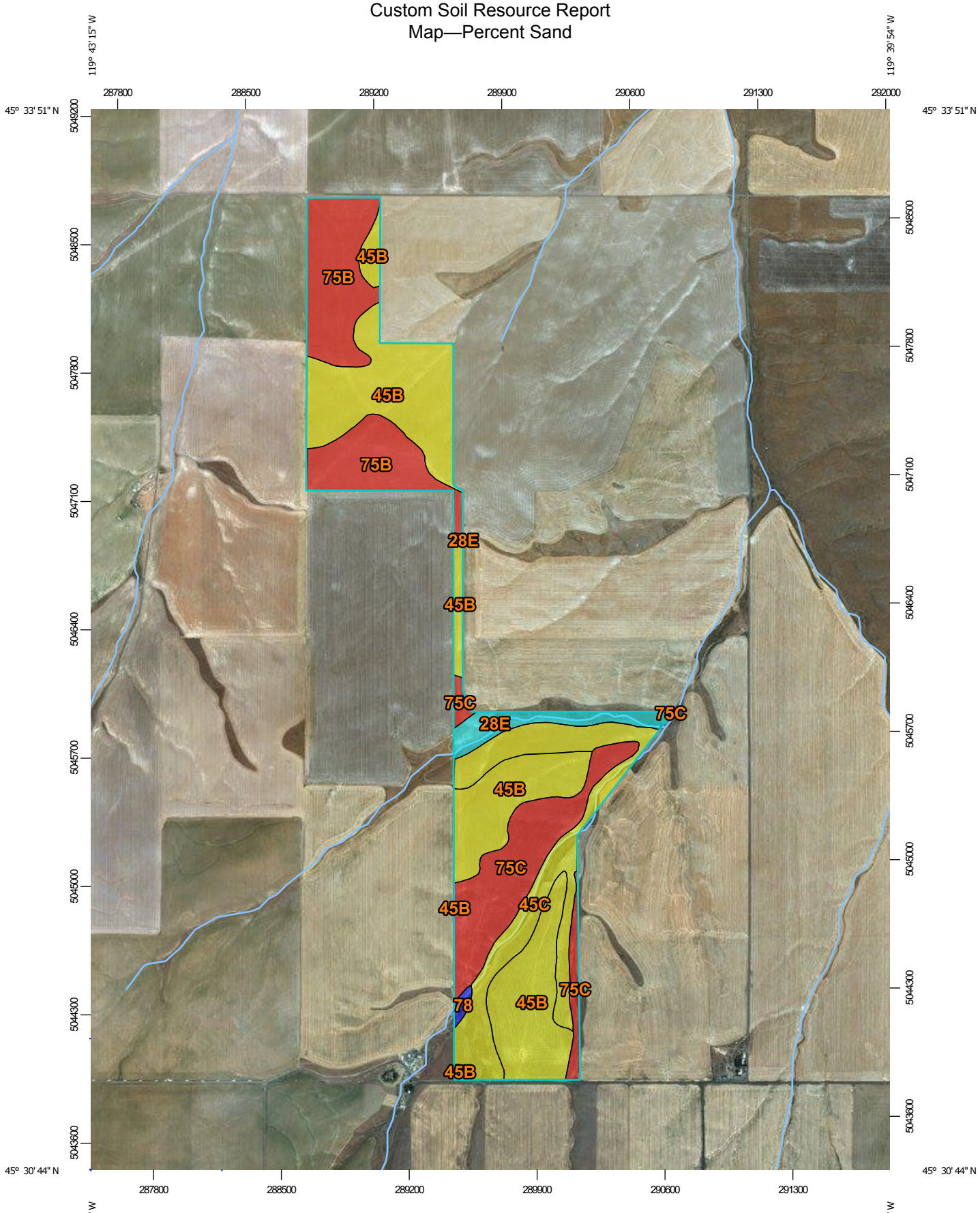
Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Percent Sand

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In the database, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Percent Sand



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- <= 16.8
- > 16.8 and <= 23.7
- > 23.7 and <= 37.6
- > 37.6 and <= 74.6
- Not rated or not available

Soil Rating Lines
- <= 16.8
- > 16.8 and <= 23.7
- > 23.7 and <= 37.6
- > 37.6 and <= 74.6
- Not rated or not available

Soil Rating Points
- <= 16.8
- > 16.8 and <= 23.7
- > 23.7 and <= 37.6
- > 37.6 and <= 74.6
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Percent Sand

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	37.6	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	23.7	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	23.7	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	16.8	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	16.8	103.8	16.3%
78	Xeric Torriorthents, nearly level	74.6	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Percent Sand

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

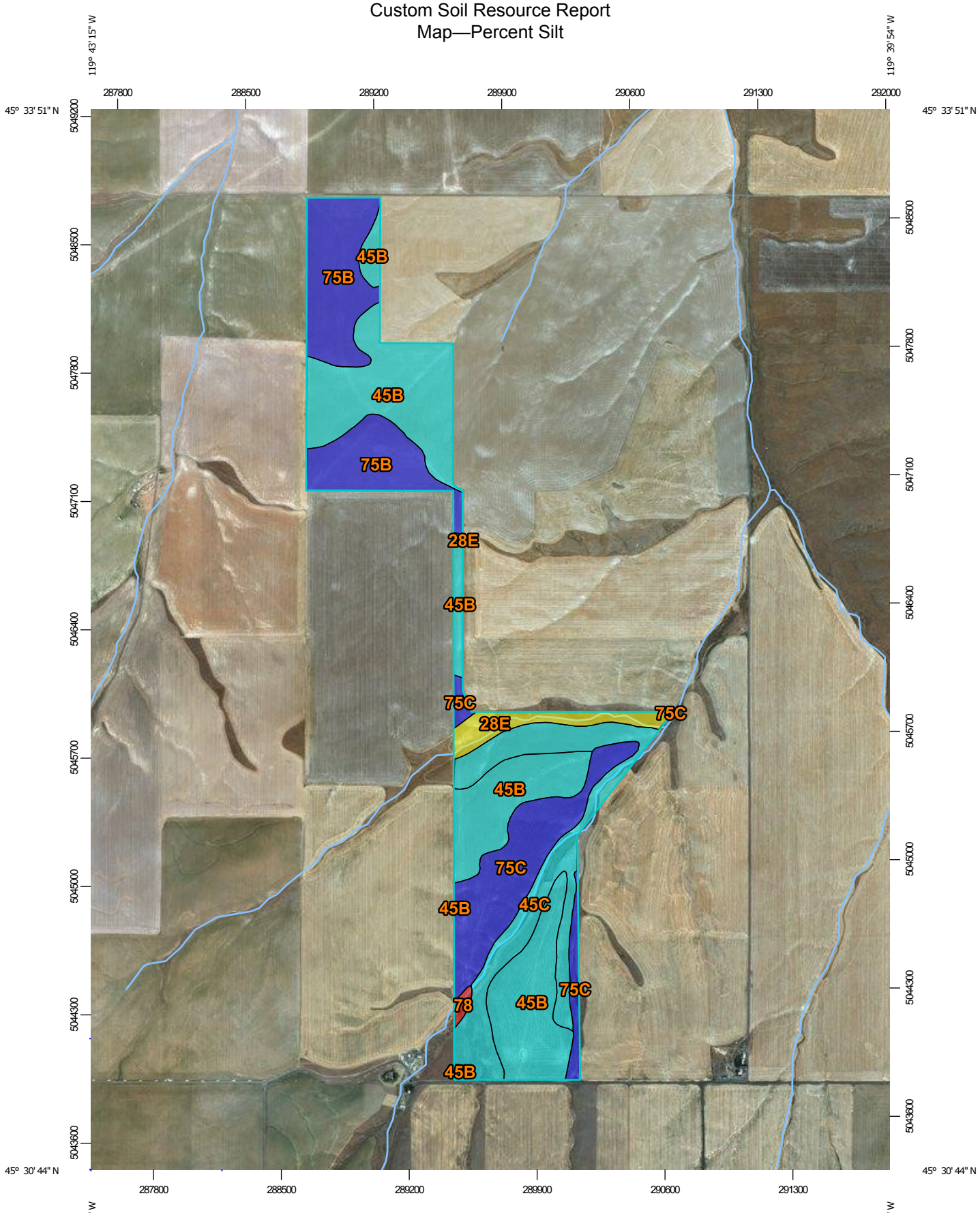
Percent Silt

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In the database, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Percent Silt



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- <= 16.7
- > 16.7 and <= 37.1
- > 37.1 and <= 68.8
- > 68.8 and <= 72.4
- Not rated or not available

Soil Rating Lines
- <= 16.7
- > 16.7 and <= 37.1
- > 37.1 and <= 68.8
- > 68.8 and <= 72.4
- Not rated or not available

Soil Rating Points
- <= 16.7
- > 16.7 and <= 37.1
- > 37.1 and <= 68.8
- > 68.8 and <= 72.4
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Percent Silt

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	37.1	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	68.8	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	68.8	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	72.4	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	72.4	103.8	16.3%
78	Xeric Torriorthents, nearly level	16.7	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Percent Silt

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Plasticity Index

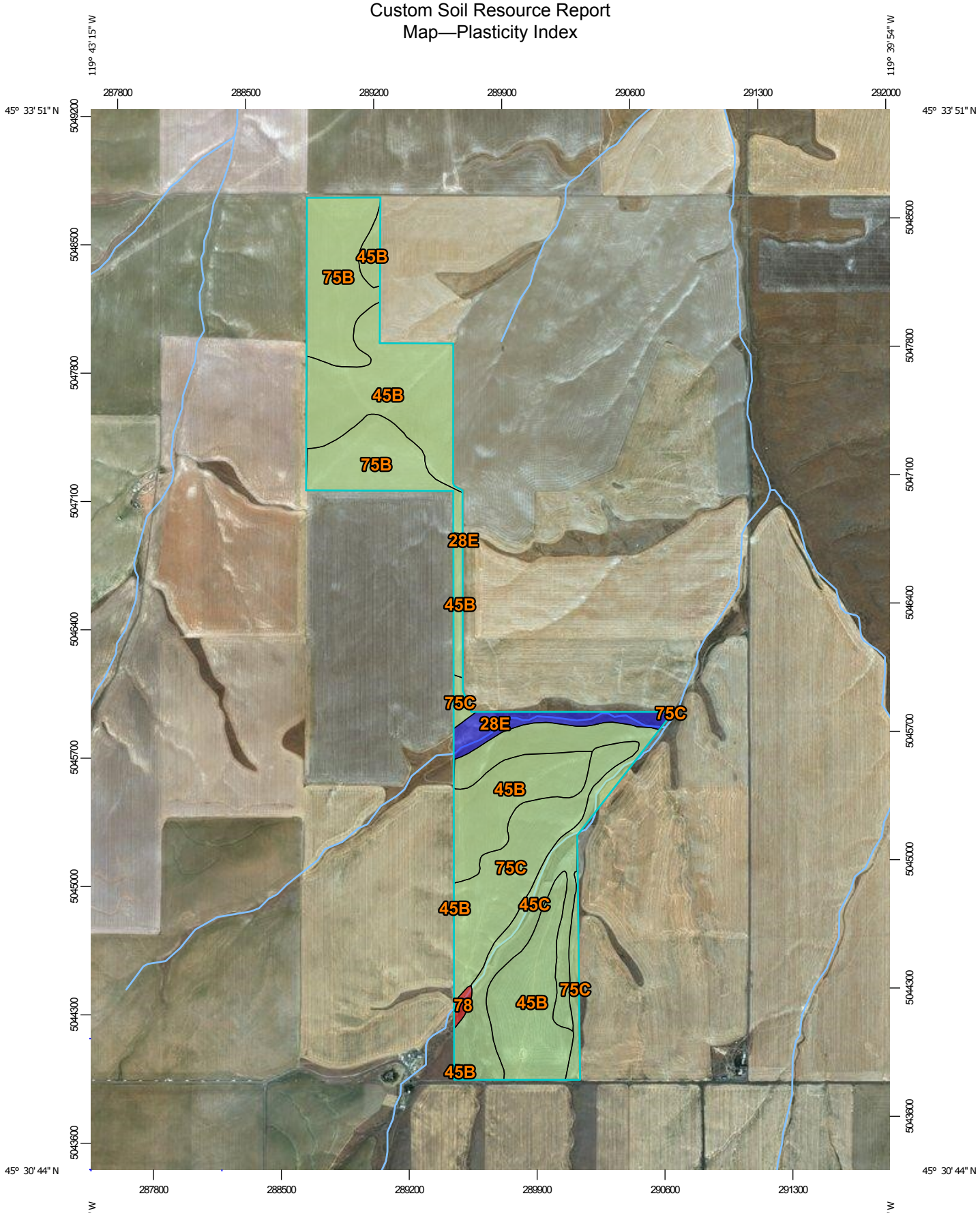
Plasticity index (PI) is one of the standard Atterberg limits used to indicate the plasticity characteristics of a soil. It is defined as the numerical difference between the liquid limit and plastic limit of the soil. It is the range of water content in which a soil exhibits the characteristics of a plastic solid.

The plastic limit is the water content that corresponds to an arbitrary limit between the plastic and semisolid states of a soil. The liquid limit is the water content, on a percent by weight basis, of the soil (passing #40 sieve) at which the soil changes from a plastic to a liquid state.

Soils that have a high plasticity index have a wide range of moisture content in which the soil performs as a plastic material. Highly and moderately plastic clays have large PI values. Plasticity index is used in classifying soils in the Unified and AASHTO classification systems.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Plasticity Index



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 1.3

> 1.3 and <= 2.5

> 2.5 and <= 14.1

Not rated or not available

Soil Rating Lines

<= 1.3

> 1.3 and <= 2.5

> 2.5 and <= 14.1

Not rated or not available

Soil Rating Points

<= 1.3

> 1.3 and <= 2.5

> 2.5 and <= 14.1

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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Table—Plasticity Index

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	14.1	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	2.5	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	2.5	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	2.5	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	2.5	103.8	16.3%
78	Xeric Torriorthents, nearly level	1.3	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Plasticity Index

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

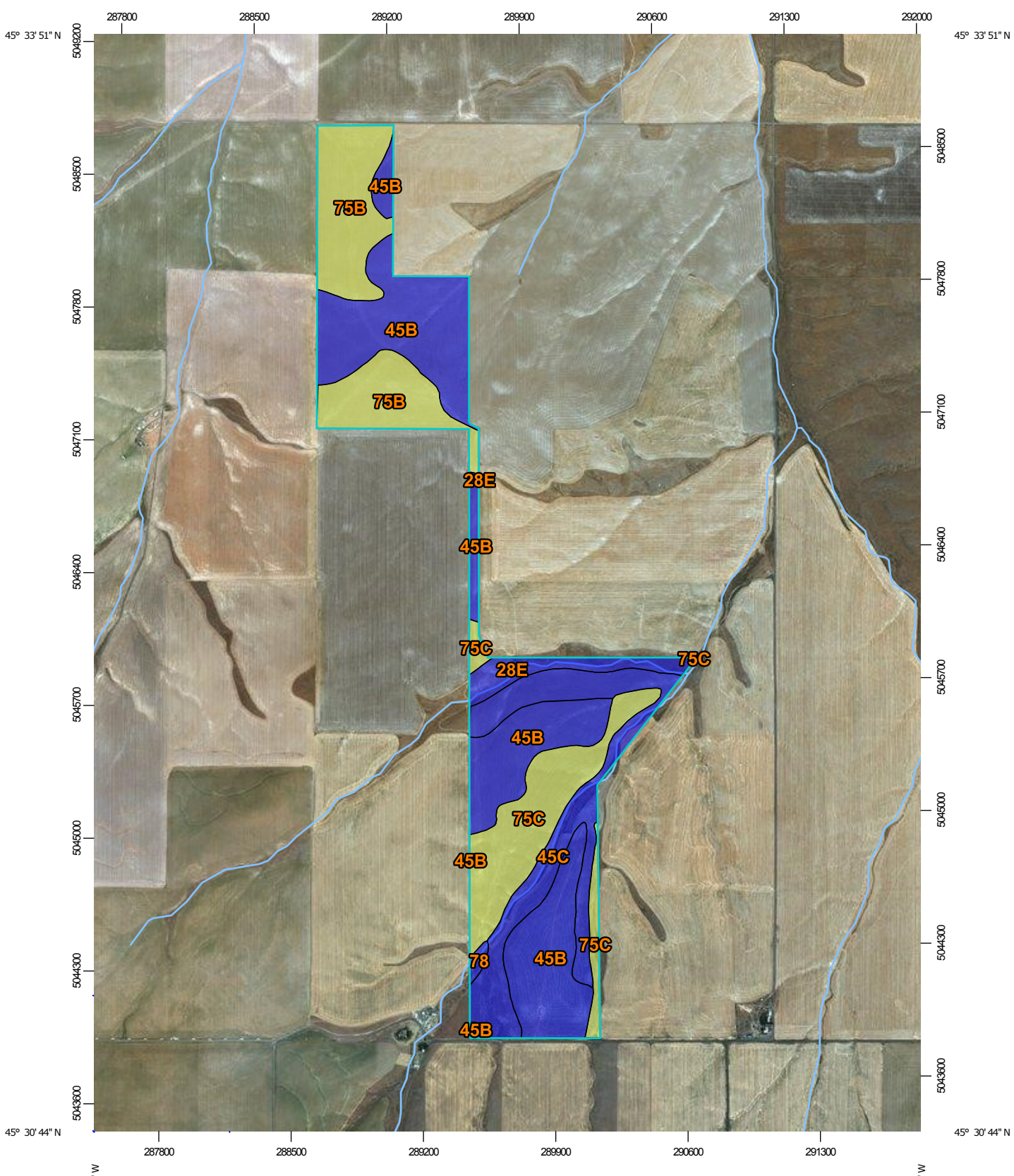
Depth to a Selected Soil Restrictive Layer: Duripan

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to the user selected type of restrictive layer as described in for each map unit. If no restrictive layer is described in a map unit, it is represented by the "> 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Depth to a Selected Soil Restrictive Layer: Duripan



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Depth to a Selected Soil Restrictive Layer: Duripan

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	>200	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	>200	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	>200	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	89	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	89	103.8	16.3%
78	Xeric Torriorthents, nearly level	>200	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Depth to a Selected Soil Restrictive Layer: Duripan

Units of Measure: centimeters

Restriction Kind: Duripan

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Depth to Any Soil Restrictive Layer

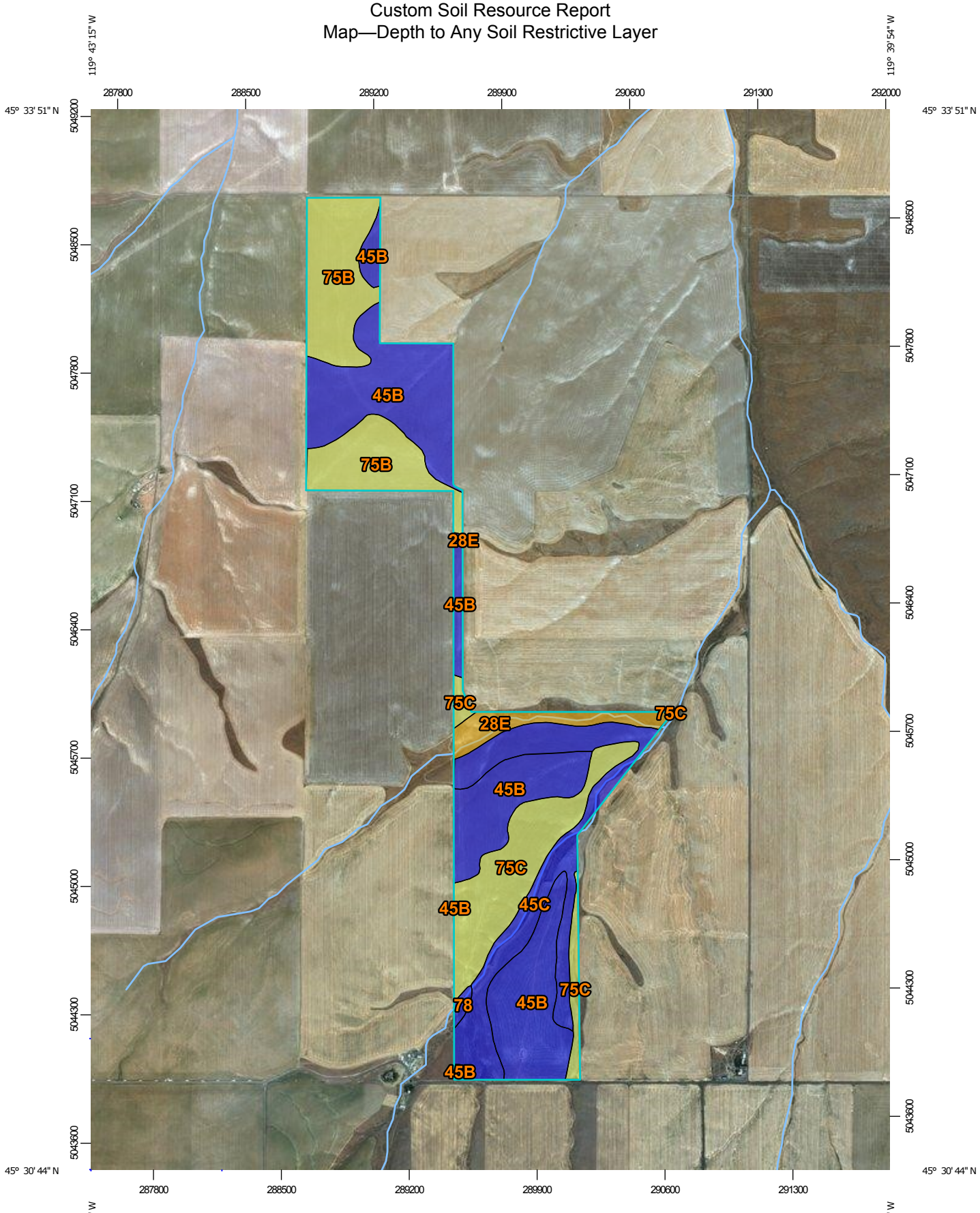
A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to any type of restrictive layer that is described for each map unit. If more than one type of restrictive layer is described for an individual soil type, the depth to the shallowest one is presented. If no restrictive layer is described in a map unit, it is represented by the "> 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A

"representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Depth to Any Soil Restrictive Layer



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Depth to Any Soil Restrictive Layer

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	43	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	>200	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	>200	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	89	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	89	103.8	16.3%
78	Xeric Torriorthents, nearly level	>200	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Depth to Any Soil Restrictive Layer

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Water Features

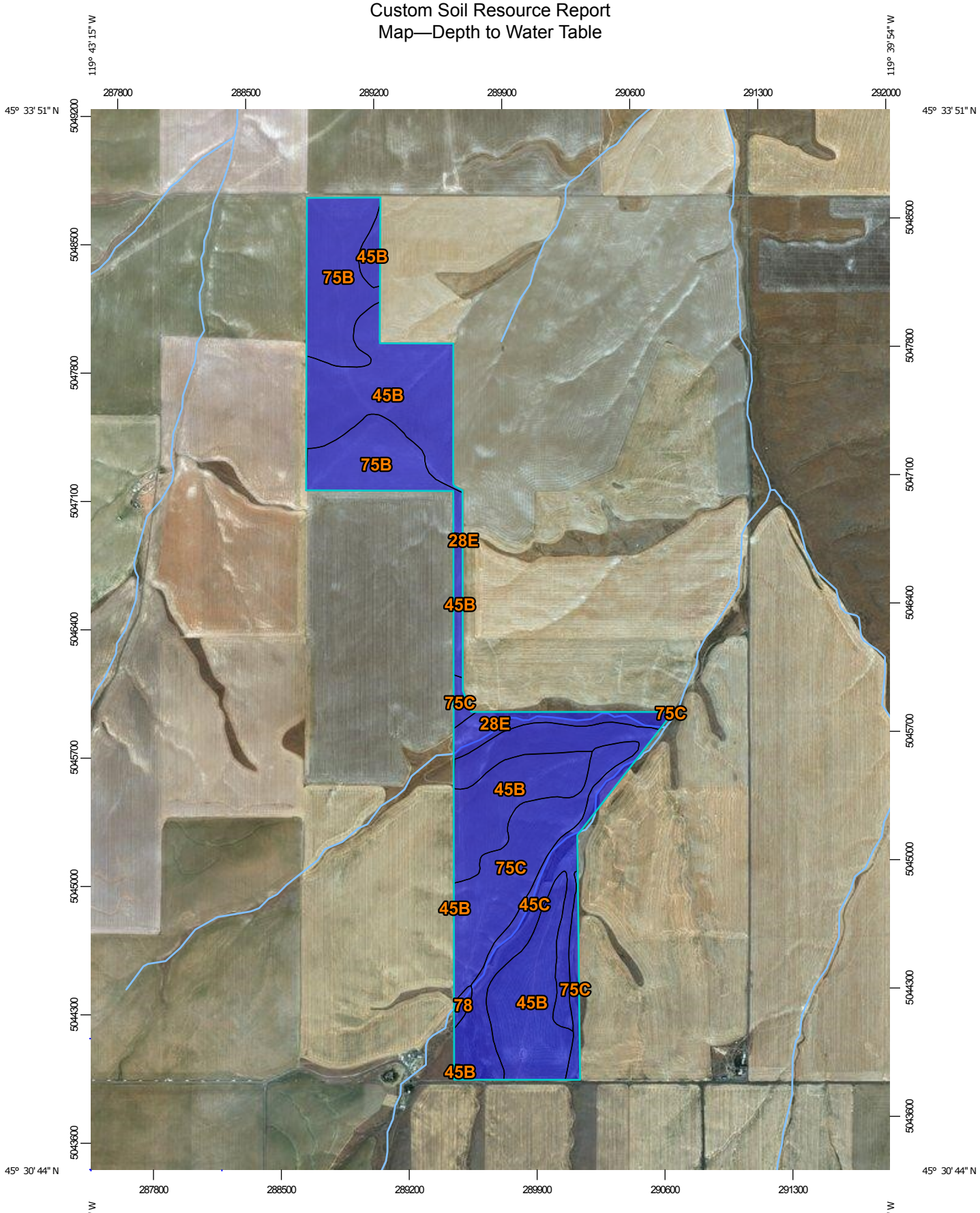
Water Features include ponding frequency, flooding frequency, and depth to water table.

Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Depth to Water Table



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
28E	Lickskillet very stony loam, 7 to 40 percent slopes	>200	27.4	4.3%
45B	Ritzville silt loam, 2 to 7 percent slopes	>200	260.6	40.9%
45C	Ritzville silt loam, 7 to 12 percent slopes	>200	113.2	17.7%
75B	Willis silt loam, 2 to 5 percent slopes	>200	129.6	20.3%
75C	Willis silt loam, 5 to 12 percent slopes	>200	103.8	16.3%
78	Xeric Torriorthents, nearly level	>200	3.1	0.5%
Totals for Area of Interest			**637.7**	**100.0%**

Rating Options—Depth to Water Table

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Morrow County, Oregon

Executive Summary

February 22, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	11.5	8.8%
Totals for Area of Interest		**131.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Morrow County, Oregon

45B—Ritzville silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 21tn
Elevation: 1,000 to 2,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 130 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ritzville and similar soils: 77 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritzville

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with small amounts of volcanic ash

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 33 inches: silt loam
H3 - 33 to 70 inches: silt loam

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: LOAMY 10-12 PZ (R008XY110OR)
Hydric soil rating: No

45C—Ritzville silt loam, 7 to 12 percent slopes

Map Unit Setting

National map unit symbol: 21tp
Elevation: 1,000 to 2,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 130 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ritzville and similar soils: 70 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritzville

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with small amounts of volcanic ash

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 33 inches: silt loam
H3 - 33 to 70 inches: silt loam

Properties and qualities

Slope: 7 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: LOAMY 10-12 PZ (R008XY110OR)
Hydric soil rating: No

75C—Willis silt loam, 5 to 12 percent slopes

Map Unit Setting

National map unit symbol: 21wg
Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 9 to 11 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Willis and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Willis

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over cemented alluvium

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 27 inches: silt loam
H3 - 27 to 35 inches: silt loam
H4 - 35 to 39 inches: cemented material

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: 20 to 40 inches to duripan
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: LOAMY 8-10 PZ (R007XY014OR)
Hydric soil rating: No

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Building Site Development

Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Corrosion of Steel

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Steel

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	Moderate	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	Moderate	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	Moderate	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Corrosion of Steel

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Hydric Rating by Map Unit

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Custom Soil Resource Report
Map—Hydric Rating by Map Unit

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 350, 700, 1400, 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	0	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	0	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	0	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Hydric Rating by Map Unit

Aggregation Method: Percent Present

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Percent Clay

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Most of the material is in one of three groups of clay minerals or a mixture of these clay minerals. The groups are kaolinite, smectite, and hydrous mica, the best known member of which is illite.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Percent Clay

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 7.5

> 7.5 and <= 10.8

Not rated or not available

Soil Rating Lines

<= 7.5

> 7.5 and <= 10.8

Not rated or not available

Soil Rating Points

<= 7.5

> 7.5 and <= 10.8

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Percent Clay

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	7.5	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	7.5	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	10.8	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Percent Clay

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Percent Sand

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In the database, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Percent Sand

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- <= 16.8
- > 16.8 and <= 23.7
- Not rated or not available

Soil Rating Lines

- <= 16.8
- > 16.8 and <= 23.7
- Not rated or not available

Soil Rating Points

- <= 16.8
- > 16.8 and <= 23.7
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

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Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Percent Sand

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	23.7	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	23.7	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	16.8	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Percent Sand

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Percent Silt

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In the database, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Percent Silt

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- <= 68.8
- > 68.8 and <= 72.4
- Not rated or not available

Soil Rating Lines

- <= 68.8
- > 68.8 and <= 72.4
- Not rated or not available

Soil Rating Points

- <= 68.8
- > 68.8 and <= 72.4
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

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Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

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Table—Percent Silt

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	68.8	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	68.8	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	72.4	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Percent Silt

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Plasticity Index

Plasticity index (PI) is one of the standard Atterberg limits used to indicate the plasticity characteristics of a soil. It is defined as the numerical difference between the liquid limit and plastic limit of the soil. It is the range of water content in which a soil exhibits the characteristics of a plastic solid.

The plastic limit is the water content that corresponds to an arbitrary limit between the plastic and semisolid states of a soil. The liquid limit is the water content, on a percent by weight basis, of the soil (passing #40 sieve) at which the soil changes from a plastic to a liquid state.

Soils that have a high plasticity index have a wide range of moisture content in which the soil performs as a plastic material. Highly and moderately plastic clays have large PI values. Plasticity index is used in classifying soils in the Unified and AASHTO classification systems.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Plasticity Index

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

= 2.5

Not rated or not available

Soil Rating Lines

= 2.5

Not rated or not available

Soil Rating Points

= 2.5

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Plasticity Index

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	2.5	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	2.5	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	2.5	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Plasticity Index

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Depth to a Selected Soil Restrictive Layer: Duripan

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to the user selected type of restrictive layer as described in for each map unit. If no restrictive layer is described in a map unit, it is represented by the "> 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Map—Depth to a Selected Soil Restrictive Layer: Duripan

Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
Survey Area Data: Version 13, Sep 25, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Depth to a Selected Soil Restrictive Layer: Duripan

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	>200	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	>200	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	89	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Depth to a Selected Soil Restrictive Layer: Duripan

Units of Measure: centimeters

Restriction Kind: Duripan

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

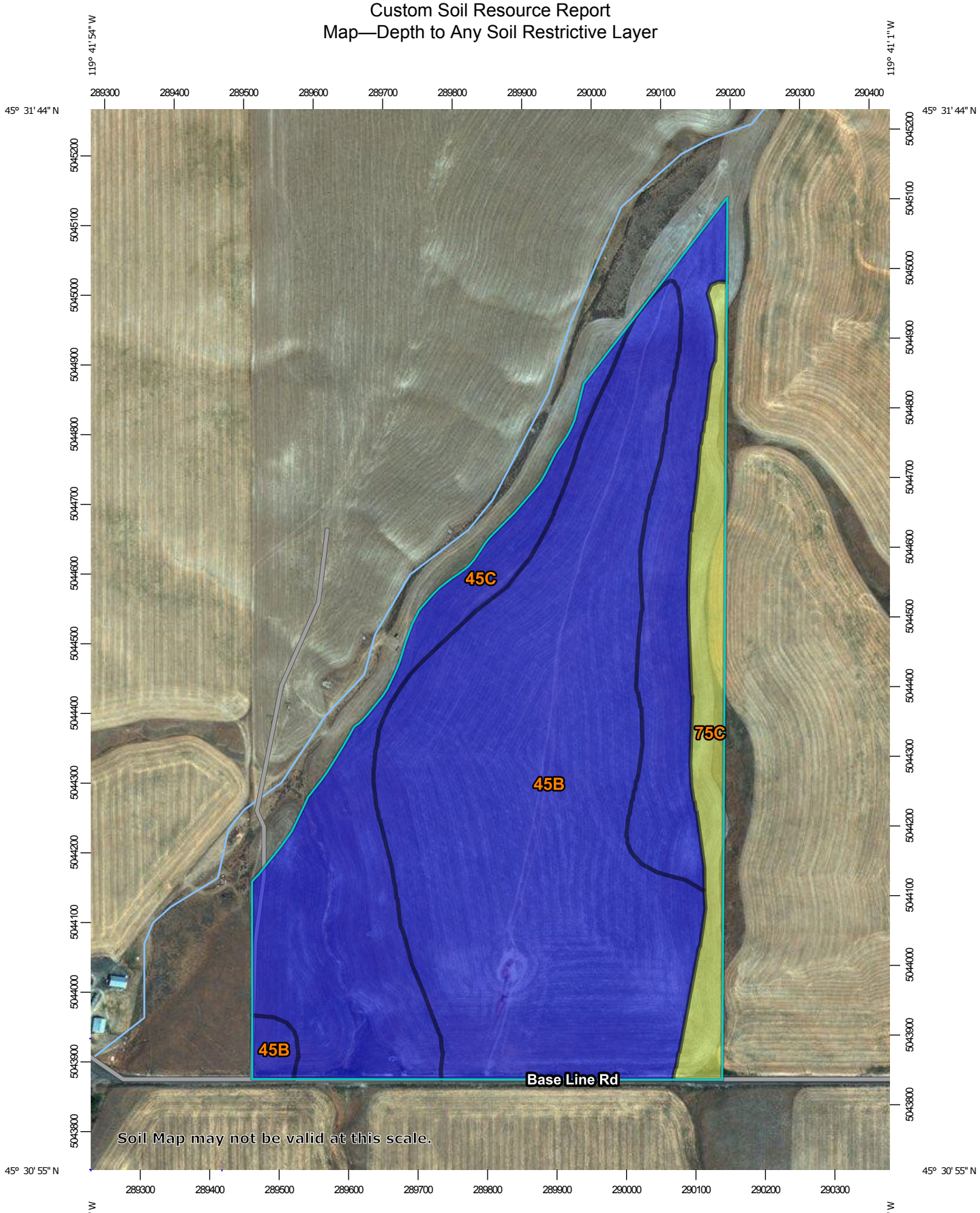
Depth to Any Soil Restrictive Layer

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to any type of restrictive layer that is described for each map unit. If more than one type of restrictive layer is described for an individual soil type, the depth to the shallowest one is presented. If no restrictive layer is described in a map unit, it is represented by the "> 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Depth to Any Soil Restrictive Layer



Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morrow County, Oregon
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Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

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Table—Depth to Any Soil Restrictive Layer

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	>200	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	>200	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	89	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Depth to Any Soil Restrictive Layer

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

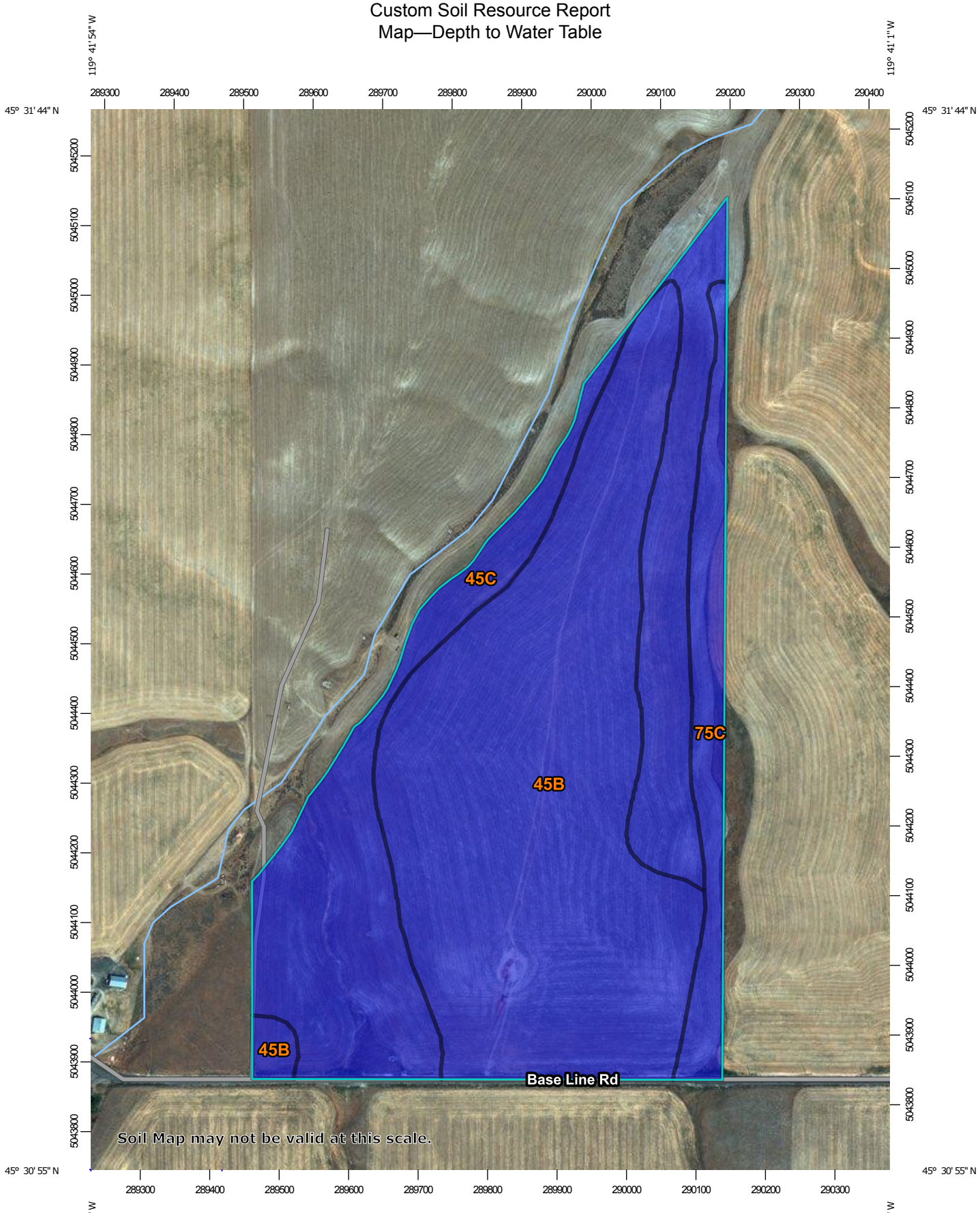
Water Features

Water Features include ponding frequency, flooding frequency, and depth to water table.

Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.



Map Scale: 1:7,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Date(s) aerial images were photographed: May 30, 2013—Nov 10, 2016

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Table—Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
45B	Ritzville silt loam, 2 to 7 percent slopes	>200	76.3	58.0%
45C	Ritzville silt loam, 7 to 12 percent slopes	>200	43.7	33.2%
75C	Willis silt loam, 5 to 12 percent slopes	>200	11.5	8.8%
Totals for Area of Interest			**131.5**	**100.0%**

Rating Options—Depth to Water Table

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

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USDA United States Department of Agriculture

Prime Farmland List for Oregon

March 2015

OREGON PRIME FARMLAND

NRCS Oregon has completed the review of the State prime farmland list. The current list is dated March 2015. The list replaces the previous State list dated May 2007. The 2015 list has not changed significantly since the 2007 list. Fifteen map units were removed from the 2007 list and seventeen map units were added to the list due primarily to the revised soil mapping in Yamhill County. The 2015 State list is current with all prime farmland reports as generated for soil surveys available via Web Soil Survey 2015.

Farmland Classification

(a) Definition

The farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or farmland of unique importance.

(b) Significance

Farmland classification identifies the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. This identification is useful in the management and maintenance of the resource base that supports the productive capacity of American agriculture.

(c) Measurement

NRCS policy and procedures on prime and unique farmlands are published in the Code of Federal Regulations 7CFR657. This regulation is reproduced in Exhibit 622-1 for convenience. The website is: http://www.access.gpo.gov/nara/cfr/waisidx 99/7cfr657 99html.

(d) Entries

Enter the numerical code for the classification of each map unit. Soils of unique, statewide, or local importance are not prime farmland. Allowable entries are numerical codes as follows:

1 - All areas are prime farmland.

2 - Prime farmland if drained.

3 - Prime farmland if protected from flooding or not frequently flooded during the growing season.

4 - Prime farmland if irrigated.

5 - Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.

6 - Prime farmland if irrigated and drained.

7 - Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season.

8 - Prime farmland if subsoiled, completely removing the root inhibiting soil layer.

9 - Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60.

10- Prime farmland if irrigated and reclaimed of excess salts and sodium.

Prime Farmland Soils

(a) Definition

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding. Users of the lists of prime farmland map units should recognize that soil properties are only one of several criteria that are necessary. Other considerations include:

(1) Land use

Prime farmland is designated independently of current land use, but it cannot be areas of water or urban or built-up land as defined for the National Resource Inventories. Map units that are complexes or associations containing components of urban land or miscellaneous areas as part of the map unit name cannot be designated as prime farmland. The soil survey memorandum of understanding determines the scale of mapping and should reflect local land use interests in designing of map units.

(2) Frequency of flooding

Some map units may include both prime farmland and land not prime farmland because of variations in flooding frequency.

(3) Irrigation

Some map units include areas that have a developed irrigation water supply that is dependable and of adequate quality and areas that do not have such a supply. In these units, only the irrigated areas meet the prime farmland criteria.

(4) Water table

Some map units include both drained and undrained areas. Only the drained areas meet the prime farmland criteria.

(5) Wind erodibility

The product of I (soil erodibility) x C (climate factor) cannot exceed 60 to meet prime farmland criteria. A map unit may be considered prime farmland in one part of a survey area but not in another where the climate factor is different.

(b) Purpose

The Natural Resources Conservation Service (NRCS) is committed to the management and maintenance of the resource base that supports the productive capacity of American agriculture. This management and maintenance includes identifying of the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. Prime farmland information may be supplemented with separate designations of soil map units that have state-wide, local, or unique importance as farmland capable of producing these crops.

(c)Code of Federal Regulations

NRCS policy and procedures on prime and unique farmlands are published in the Code of Federal Regulations 7CFR657. The content is reproduced in Exhibit 622-1 for convenience. The website is: http://www.access.gpo.gov/nara/cfr/waisidx 99/7cfr657 99.html.

Final Rule, Prime and Unique Farmlands (Exhibit 622-1)

Federal Register, Volume 43, No.21, January 31, 1978.

The Code of Federal Regulations for title 7 part 657 are maintained at the following website: http://www.gpoaccess.gov/cfr/index.html. The January 1, 1999 version was amended on September 25, 2000 with the changes published in the Federal Register as follows: [Federal Register: September 25, 2000 (Volume 65, Number 186)]

(Rules and Regulations]

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From the Federal Register Online via GPO Access [wais.access.gpo.gov]

[DOCID:fr25se00-2]

TITLE 7--AGRICULTURE

DEPARTMENT OF AGRICULTURE

PART 657--PRIME AND UNIQUE FARMLANDS--Table of Contents

Subpart A--Important Farmlands Inventory

657.1 -- Purpose.

NRCS is concerned about any action that tends to impair the productive capacity of American agriculture. The Nation needs to know the extent and location of the best land for producing food, feed, fiber forage, and oilseed crops. In addition to prime and unique farmlands, farmlands that are of statewide and local importance for producing these crops also need to be identified

657.2 -- Policy.

It is NRCS policy to make and keep current an inventory of the prime farmland and unique farmland of the Nation. This inventory is to be carried out in cooperation with other interested agencies at the national, state, and local levels of government. The objective of the inventory is to identify the extent and location of important rural lands needed to produce food, feed, fiber, forage, and oilseed crops.

657.3 -- Applicability.

Inventories made under this memorandum do not constitute a designation of any land area to a specific land use. Such designations are the responsibility of appropriate local and state officials.

657.4 -- NRCS Responsibilities.

(a) State Conservationist.

Each NRCS state conservationist is to:

(1) Provide leadership for inventories of important farmlands for the state, county, or other subdivision of the state. Each is to work with the appropriate agencies of the state government and others to establish priorities for making these inventories.

(2) Identify the soil mapping units within the state that qualify as prime. In doing this, State Conservationists, in consultation with the cooperators of the National Cooperative Soil Survey, have the flexibility to make local deviation from the permeability criterion or to be more restrictive for other specific criteria in order to assure the most accurate identification of prime farmlands for a state. Each is to invite representatives of the governor's office, agencies of the state government, and others to identify farmlands of statewide importance and unique farmlands that are to be inventoried within the framework of this memorandum.

(3) Prepare a statewide list of:

(i) Soil mapping units that meet the criteria for prime farmland;

(ii) Soil mapping units that are farmlands of statewide importance if the criteria used were based on soil information; and

(iii) Specific high-value food and fiber crops that are grown and, when combined with other favorable factors, qualify lands as unique farmlands.

Copies are to be furnished to NRCS field offices and to the National Soil Survey Center. (See 7 CFR 600.2(c), 600.6.)

(4) Coordinate soil mapping units that qualify as prime farmlands with adjacent states, including Major Land Resource Area Offices (see 7 CFR 600.4, 600.7) responsible for the soil series. Since farmlands of statewide importance and unique farmlands are designated by others at the state level, the soil mapping units and areas identified need not be coordinated among states.

(5) Instruct NRCS district conservationists to arrange local review of lands identified as prime, unique, and additional farmlands of statewide importance by conservation districts and representatives of local agencies. This review is to determine if additional farmland should be identified to meet local decision making needs.

(6) Make and publish each important farmland inventory on a base map of national map accuracy at an intermediate scale of 1:50,000 or 1:100,000. State Conservationists who need base maps of other scales are to submit their requests with justification to the Chief for consideration.

657.5 Identification of important farmlands.

(a) Prime farmlands.

(1) General. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the Land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding. Examples of soils that qualify as prime farmland are Palouse silt loam, 0 to 7 percent slopes; Brookston silty clay loam, drained; and Tama silty clay loam, 0 to 5 percent slopes.

(2) Specific criteria. Prime farmlands meet all the following criteria: Terms used in this section are defined in USDA publications: "Soil Taxonomy, Agriculture Handbook 436'; "Soil Survey Manual, Agriculture Handbook 18"; "Rainfall-erosion Losses From Cropland, Agriculture Handbook 282; "Wind Erosion Forces in the United States and Their Use in Predicting Soil Loss, Agriculture Handbook 346"; and 'Saline and Alkali Soils, Agriculture Handbook 60."

(i) The soils have:

(a) Aquic, udic, ustic, or xeric moisture regimes and sufficient available water capacity within a depth of 40 Inches (1 meter), or in the root zone (root zone is the part of the soil that is penetrated or can be penetrated by plant roots) if the root zone is less than 40 inches deep, to produce the commonly grown cultivated crops (cultivated crops include, but are not limited to, grain, forage, fiber, oilseed, sugar beets, sugarcane, vegetables, tobacco, orchard, vineyard, and bush fruit crops) adapted to the region in 7 or more years out of 10; or

(b) Xeric or ustic moisture regimes in which the available water capacity is limited, but the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown) and of adequate quality; or,

(c) Aridic or torric moisture regimes, and the area has a developed irrigation water supply that is dependable and of adequate quality; and,

(ii) The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches (50 cm), have a mean annual temperature higher than 32 deg. F (0 deg. C. In addition, the mean summer temperature at this depth in soils with an O horizon is higher than 47 deg. F (8 deg. C); in soils that have no O horizon, the mean summer temperature is higher than 59 deg. F (15 deg. C); and,

(iii) The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep; and,

(iv) The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown; and,

(v) The soils can be managed so that, in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15; and,

(vi) The soils are not flooded frequently during the growing season (less often than once in 2 years); *(thus—if the soil is occasionally flooded, protection from flooding is not required for prime farmland designation),* and,

(vii) The product of K (erodibility factor) x percent slope is less than 2.0, and the product of I (soils erodibility) x C (climatic factor) does not exceed 60; and

(viii) The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50 cm) and the mean annual soil temperature at a depth of 20 inches (50 cm) is less than 59 deg. F (15 deg. C); the permeability rate is not a limiting factor if the mean annual soil temperature is 59 deg. F (15 deg. C) or higher; and,

(ix) Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm).

NRCS-Oregon has established one state criterion for prime farmland designation. The criterion sets a minimum of 70 consecutive days or more of a frost-free period. Consequently, if a soil map unit meets all of the national criteria as listed above but has a frost-free period of less than 70 days, the map unit is not designated as prime farmland.

Example: **frost-free period range; 70 to 100 days = prime**

frost-free period range; 50 to 90 days = not prime

Also, the "dominant condition" is used to determine Prime for each map unit.

If the map unit contains a miscellaneous major component, the map unit is not designated prime.

If the map unit contains a major component in land capability class 6, 7, or 8, the map unit is not designated prime.

Prime Farmland Codes

1 - All areas are prime farmland.

2 - Prime farmland if drained.

3 - Prime farmland if protected from flooding or not frequently flooded during the growing season.

4 - Prime farmland if irrigated.

5 - Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.

6 - Prime farmland if irrigated and drained.

7 - Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season.

8- Prime farmland if subsoiled, completely removing the root inhibiting soil layer.

9 - Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60.

10- Prime farmland if irrigated and reclaimed of excess salts and sodium.

The following list is a composite listing of prime farmland map units in Oregon as stored in Web Soil Survey on March 1, 2015. NOTE: Map units designated as prime farmland are not available via Web Soil Survey for the map units in the Grant County, Central, soil survey, but they are contained in the composite list. The survey areas are as follows.

Alsea Area
Baker County Area
Benton County
Clackamas County Area
Clatsop County
Columbia County
Coos County
Crater Lake National Park
Curry County
Douglas County Area
Gilliam County
Grant County, Central
Harney County Area
Hood River County Area
Jackson County Area
Josephine County
Klamath County, South
Lake County, North
Lake County, South
Lane County Area
Lincoln County Area
Linn County Area
Malheur County, Northeast
Marion County Area
Morrow County
Multnomah County
Polk County
Prineville Area
Sherman County
Tillamook County
Trout Creek-Shaniko Area
Umatilla County Area
Union County Area
Upper Deschutes River Area
Wallowa County Area
Wallowa-Whitman National Forest
Warm Springs Indian Reservation
Wasco County, North
Washington County
Yamhill County

Mapunit_Name	Prime Farmland Code
Abegg gravelly loam, 2 to 7 percent slopes	4
Abegg gravelly loam, 7 to 12 percent slopes	4
Abegg very gravelly sandy loam, 2 to 12 percent slopes	4
Abin silty clay loam, 0 to 3 percent slopes	1
Abiqua silty clay loam, 0 to 3 percent slopes	1
Abiqua silty clay loam, 3 to 5 percent slopes	1
Abiqua silty clay loam, occasionally flooded, 0 to 3 percent slopes	1
Abiqua silty clay loam, rarely flooded, 0 to 3 percent slopes	1
Abiqua silty clay loam, high precipitation, 0 to 3 percent slopes	1
Abiqua silty clay loam, high precipitation, 3 to 5 percent slopes	1
Adkins fine sandy loam, 0 to 5 percent slopes	4
Adkins fine sandy loam, gravelly substratum, 0 to 5 percent slopes	4
Agency loam, 0 to 3 percent slopes	4
Agency loam, 3 to 8 percent slopes	4
Agency sandy loam, 0 to 3 percent slopes	4
Agency-Madras complex, 0 to 8 percent slopes	4
Alicel fine sandy loam, 1 to 5 percent slopes	1
Alicel loam, 1 to 5 percent slopes	1
Aloha silt loam	2
Aloha silt loam, 0 to 3 percent slopes	2
Aloha silt loam, 3 to 6 percent slopes	2
Aloha silt loam, 3 to 8 percent slopes	2
Aloha variant silt loam	2
Alsea loam, 0 to 5 percent slopes	1
Alsea loam, rarely flooded, 0 to 3 percent slopes	1
Alspaugh clay loam, 2 to 8 percent slopes	1
Amity silt loam	2
Amity silt loam, 0 to 3 percent slopes	2
Anderly silt loam, 1 to 7 percent slopes	4
Anders very fine sandy loam, 3 to 7 percent slopes	4
Applegate silt loam, 2 to 7 percent slopes	4
Athena silt loam, 1 to 7 percent slopes	1
Baker silt loam, 0 to 2 percent slopes	4
Baker silt loam, 0 to 2 percent slopes, warm	4
Baker silt loam, 2 to 7 percent slopes	4
Baker silt loam, 2 to 7 percent slopes, warm	4
Baldock silt loam	6
Baldock silt loam, 0 to 2 percent slopes	6
Balm loam, 0 to 3 percent slopes	6
Balm-Catherine complex, 0 to 3 percent slopes	6
Banning loam	1
Banning loam, 0 to 3 percent slopes	1
Banning loam, 3 to 12 percent slopes	1
Barhiskey gravelly loamy sand, 0 to 3 percent slopes	4
Barhiskey variant gravelly loamy sand, 0 to 3 percent slopes	6
Barnard silt loam, 2 to 7 percent slopes	4

Barron coarse sandy loam, 0 to 7 percent slopes	**4**
Barron coarse sandy loam, 2 to 7 percent slopes	**4**
Bellpine clay loam, 3 to 12 percent slopes	**1**
Bellpine silt loam, 3 to 12 percent slopes	**1**
Bellpine silty clay loam, 3 to 12 percent slopes	**1**
Bellpine-Jory complex, 2 to 12 percent slopes	**1**
Bornstedt silt loam, 0 to 8 percent slopes	**1**
Boyce silt loam, 0 to 2 percent slopes	**6**
Boyce silty clay loam	**6**
Briedwell gravelly loam, 0 to 7 percent slopes	**1**
Briedwell silt loam, 0 to 3 percent slopes	**1**
Briedwell silt loam, 0 to 7 percent slopes	**1**
Briedwell silt loam, 0 to 3 percent slopes, low terrace	**1**
Buckbert ashy sandy loam, 0 to 3 percent slopes	**4**
Buckbert sandy loam, 0 to 3 percent slopes	**4**
Bully silt loam	**4**
Burke silt loam, 1 to 7 percent slopes	**4**
Burlington fine sandy loam, 0 to 8 percent slopes	**1**
Calimus fine sandy loam, 0 to 2 percent slopes	**4**
Calimus fine sandy loam, 2 to 5 percent slopes	**4**
Calimus loam, 0 to 2 percent slopes	**4**
Calimus loam, 2 to 5 percent slopes	**4**
Calimus silt loam, 0 to 5 percent slopes	**4**
Canderly sandy loam, 0 to 3 percent slopes	**4**
Canderly sandy loam, 3 to 8 percent slopes	**4**
Cantala silt loam, 1 to 7 percent slopes	**4**
Capona loam, 0 to 2 percent slopes	**4**
Capona loam, 2 to 5 percent slopes	**4**
Carlton silt loam, 0 to 7 percent slopes	**1**
Cascade silt loam, 3 to 7 percent slopes	**2**
Cascade silt loam, 3 to 8 percent slopes	**2**
Catherine silt loam	**4**
Catherine silt loam, 0 to 2 percent slopes	**4**
Catherine silty clay loam	**4**
Cencove fine sandy loam, 0 to 2 percent slopes	**4**
Cencove fine sandy loam, 2 to 5 percent slopes	**4**
Cencove fine sandy loam, 5 to 8 percent slopes	**4**
Central Point loam, 0 to 3 percent slopes	**1**
Central Point sandy loam	**1**
Central Point sandy loam, 0 to 3 percent slopes	**1**
Chapman loam	**1**
Chapman loam, 0 to 3 percent slopes	**1**
Chapman loam, high precipitation, 0 to 3 percent slopes	**1**
Chapman-Chehalis complex, 0 to 3 percent slopes	**1**
Chehalem silty clay loam, 0 to 3 percent slopes	**2**
Chehalem silty clay loam, 0 to 3 percent slopes, occasionally flooded	**2**
Chehalem silty clay loam, sedimentary, 0 to 3 percent slopes	**2**
Chehalem silty clay loam, volcanic, 0 to 3 percent slopes	**2**

Chehalis silt loam	**1**
Chehalis silt loam, 0 to 3 percent slopes	**1**
Chehalis silt loam, high precipitation, 0 to 3 percent slopes	**1**
Chehalis silt loam, occasional overflow	**1**
Chehalis silty clay loam	**1**
Chehalis silty clay loam, 0 to 3 percent slopes	**1**
Chehalis silty clay loam, occasional overflow	**1**
Chehalis silty clay loam, occasionally flooded	**1**
Chenoweth loam, 1 to 7 percent slopes	**4**
Cherryhill silt loam, 1 to 7 percent slopes	**4**
Chesnimnus gravelly loam, 0 to 3 percent slopes	**4**
Chesnimnus silt loam, 0 to 3 percent slopes	**4**
Cheval silt loam, 0 to 2 percent slopes	**6**
Chilcott silt loam, 2 to 5 percent slopes	**4**
Clackamas gravelly loam	**2**
Clackamas gravelly silt loam	**2**
Clackamas silt loam	**2**
Clackamas variant silt loam	**1**
Clawson sandy loam, 0 to 3 percent slopes	**2**
Clawson sandy loam, 2 to 5 percent slopes	**2**
Clawson sandy loam, 2 to 7 percent slopes	**2**
Clinefalls sandy loam, 0 to 3 percent slopes	**4**
Cloquato silt loam	**1**
Cloquato silt loam, 0 to 3 percent slopes	**1**
Cloquato silt loam, high precipitation, 0 to 3 percent slopes	**1**
Clovkamp loamy sand, 0 to 3 percent slopes	**4**
Clovkamp loamy sand, bedrock substratum, 0 to 3 percent slopes	**4**
Coburg complex, rarely and occasionally flooded, 0 to 3 percent	**1**
Coburg silty clay loam	**1**
Coburg silty clay loam, 0 to 3 percent slopes	**1**
Coburg silty clay loam, 0 to 5 percent slopes	**1**
Coburg silty clay loam, flooded, 0 to 3 percent slopes	**1**
Coburg silty clay loam, occasionally flooded	**1**
Coburg silty clay loam, rarely flooded, 0 to 3 percent slopes	**1**
Coleman loam, 0 to 7 percent slopes	**2**
Condon and Valby silt loams, 1 to 7 percent slopes	**4**
Condon silt loam, 1 to 7 percent slopes	**4**
Conley silty clay loam, 0 to 2 percent slopes	**6**
Conley silty clay loam, 2 to 5 percent slopes	**6**
Conley silty clay loam, 2 to 8 percent slopes	**6**
Cornelius and Kinton silt loams, 2 to 7 percent slopes	**1**
Cornelius silt loam, 3 to 8 percent slopes	**1**
Cornelius variant silt loam, 0 to 3 percent slopes	**1**
Cottrell silty clay loam, 2 to 12 percent slopes	**1**
Cottrell silty clay loam, 2 to 8 percent slopes	**1**
Coughanour silt loam, 0 to 2 percent slopes	**4**
Coughanour silt loam, 2 to 7 percent slopes	**4**
Court gravelly ashy sandy loam, 1 to 8 percent slopes	**4**

Court sandy loam, 1 to 8 percent slopes	**4**
Courtrock loam, 2 to 7 percent slopes	**4**
Crump muck, 0 to 1 percent slopes	**6**
Crump silty clay loam, drained, 0 to 1 percent slopes	**4**
Crump-Ozamis complex, drained, 0 to 1 percent slopes	**4**
Culbertson loam, 0 to 8 percent slopes	**1**
Cumulic Haploxerolls, 0 to 2 percent slopes *1	**4**
Darow silty clay loam, 1 to 5 percent slopes	**1**
Dayville silt loam	**4**
Dee silt loam, 0 to 8 percent slopes	**2**
Defenbaugh loam, 0 to 2 percent slopes	**4**
Dehill fine sandy loam, 0 to 5 percent slopes	**4**
Deschutes ashy sandy loam, 0 to 3 percent slopes	**4**
Deschutes ashy sandy loam, dry, 0 to 3 percent slopes	**4**
Deschutes sandy loam, 0 to 3 percent slopes	**4**
Deschutes sandy loam, 3 to 8 percent slopes	**4**
Deschutes sandy loam, dry, 0 to 3 percent slopes	**4**
Deschutes-Houstake complex, 0 to 8 percent slopes	**4**
Deskamp loamy sand, 0 to 3 percent slopes	**4**
Deskamp loamy sand, 3 to 8 percent slopes	**4**
Deskamp sandy loam, 3 to 8 percent slopes	**4**
Deter clay loam, 0 to 2 percent slopes	**4**
Deter clay loam, 2 to 7 percent slopes	**4**
Deter loam, 0 to 5 percent slopes	**4**
Deter loam, low precipitation, 0 to 5 percent slopes	**4**
Dixon gravelly fine sandy loam, 0 to 5 percent slopes	**4**
Dixon gravelly fine sandy loam, alkali, 0 to 2 percent slopes	**4**
Dodes loam, 0 to 2 percent slopes	**4**
Donica gravelly loam, 0 to 5 percent slopes	**4**
Dotta sandy loam, 0 to 5 percent slopes	**4**
Drews loam, 0 to 5 percent slopes	**4**
Drewsey very fine sandy loam, 1 to 5 percent slopes	**4**
Drewsgap loam, 0 to 5 percent slopes	**4**
Drybed silt loam, 0 to 8 percent slopes	**4**
Dryck gravelly loam, 0 to 2 percent slopes	**4**
Dryck loam, 0 to 2 percent slopes	**4**
Duart silt loam, 1 to 7 percent slopes	**4**
Dufur silt loam, 1 to 7 percent slopes	**4**
Dumont gravelly clay loam, 1 to 12 percent slopes	**1**
Dumont gravelly loam, 2 to 12 percent slopes	**1**
Ellisforde silt loam, 1 to 7 percent slopes	**4**
Endersby fine sandy loam	**4**
Endersby fine sandy loam, 0 to 3 percent slopes	**4**
Endersby loam	**4**
Endersby-Hermiston complex, 0 to 3 percent slopes	**4**
Enko loam, 1 to 10 percent slopes	**4**
Enko loamy sand, 2 to 8 percent slopes	**4**
Enko sandy loam, 0 to 6 percent slopes	**4**

Enko-Catlow complex, 1 to 7 percent slopes	**4**
Enko-McConnel complex, 0 to 5 percent slopes	**4**
Era ashy loam, 0 to 3 percent slopes	**4**
Era ashy sandy loam, 0 to 3 percent slopes	**4**
Era ashy sandy loam, 3 to 8 percent slopes	**4**
Era sandy loam, 3 to 8 percent slopes	**4**
Era sandy loam, cobbly substratum, 0 to 3 percent slopes	**4**
Era soils, 1 to 8 percent slopes	**4**
Esquatzel silt loam	**4**
Esquatzel silt loam, 0 to 3 percent slopes	**4**
Evans loam	**1**
Evans loam, 0 to 3 percent slopes	**1**
Evans silt loam, 0 to 3 percent slopes	**1**
Falk variant fine sandy loam	**4**
Faloma silt loam	**5**
Faloma silt loam, protected	**2**
Foehlin gravelly loam, 0 to 3 percent slopes	**1**
Foehlin gravelly loam, 3 to 12 percent slopes	**1**
Fordney gravelly loamy sand, 0 to 5 percent slopes	**4**
Fordney gravelly loamy sand, 5 to 15 percent slopes	**4**
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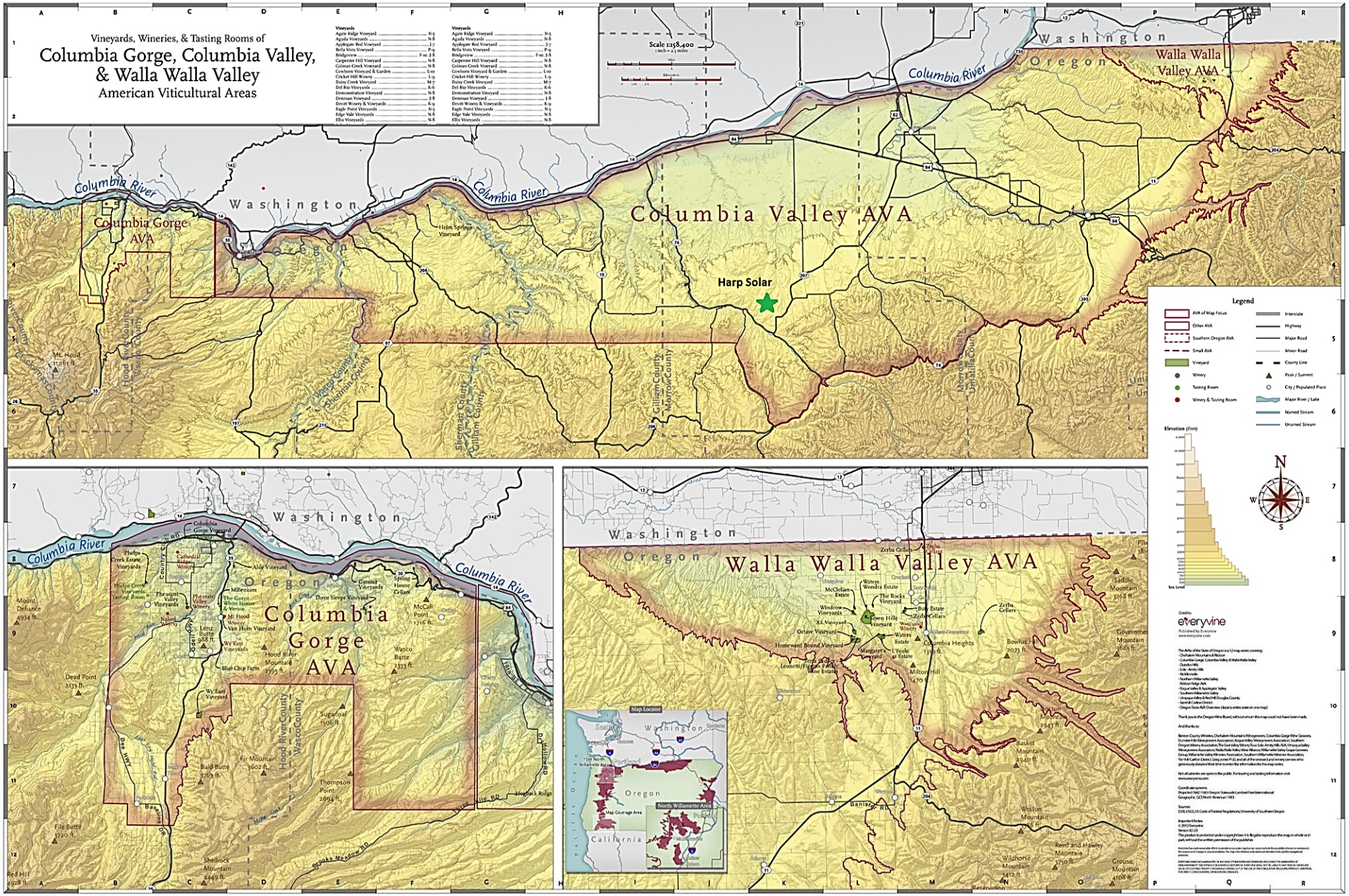
*1 only in Baker and Union Soil Surveys
*2 only in Clackamas, Linn, Marion, and Yamhill Soil Surveys
*3 only in Lane, Polk, and Washington Soil Surveys


Vineyards, Wineries, & Tasting Rooms of
Columbia Gorge, Columbia Valley, & Walla Walla Valley
American Viticultural Areas
Scale 1:158,400
Columbia Gorge AVA
Columbia Valley AVA
Walla Walla Valley AVA
Harp Solar
Columbia River
Washington
Oregon
Legend
Elevation (Feet)
Map Locator
North Willamette Area
Credits:
everyvine

Wildlife and Habitat Assessment
of the
Harp Solar Project
Morrow County, Oregon

Prepared for:

OneEnergy Development, LLC
911 NE Davis Street
Portland, Oregon 97232

Prepared by:

Rick Gerhardt and Karen Kronner
Northwest Wildlife Consultants, Inc.
815 NW 4th St.
Pendleton, Oregon 97801

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Appendices

1.0 INTRODUCTION

OneEnergy Development, LLC (OED) is developing a solar energy project (Harp Solar or the Project) on private land in Morrow County, Oregon. As part of the review for biological resources, OED contracted with Northwest Wildlife Consultants, Inc. (NWC) to conduct a wildlife and habitat assessment. This included a spring season survey for special status wildlife species, recording all vertebrate wildlife species detected. The primary focus was the special status species Washington ground squirrel (*Urocitellus washingtoni*; WGS) and the potential for their occurrence. This species' current status is State Endangered (ODFW, 2016) and federal Species of Concern (USFWS, 2016). All other vertebrate wildlife species—including those with special state or federal status—were to be recorded as detected. This memorandum summarizes methods and results of information reviews, pre-field investigations and of the May 30, 2017 biological surveys; this was within the optimal period for detecting all species of interest and assessing habitat. Aquatic species were not assessed in detail due to lack of suitable habitat within the Project study area.

2.0 METHODS

The survey area comprised 207 acres of farmland approximately 5 miles north of the town of Lexington, Morrow County; it is primarily in active wheat production (Figure 1). Prior to field surveys, aerial imagery was studied for understanding the general land cover. NWC staff with 25+ years' experience in the area discussed potential special status species. A list was created for special status vertebrate wildlife species known in the general Project area during the breeding season within Project. This list can be found as Appendix A (which is updated to include the 2017 spring season survey results and subsequent likelihood of occurrence).

2.1 USFWS Query

OED requested from the United States Fish and Wildlife Service (USFWS) a list of threatened, endangered, and candidate species expected to occur and a list of critical habitats designated within the Project area. The USFWS response letter can be found as Appendix B.

2.2 Soils

OED also requested from the National Resources Conservation Service (NRCS) a custom soil resource report for the Project area.

2.3 Wildlife

An experienced biologist traversed the non-agricultural portion of the proposed Project on May 30, 2017, recording all vertebrate wildlife species encountered. Due to lack of habitat to support breeding season species (Appendix A), one survey instead of two was deemed sufficient by the experienced biologist as being appropriate for the Project habitat.

2.4 Habitat

During the wildlife survey, habitat was visually assessed for habitat type and quality and rated into categories based on definitions found in Oregon Administrative Rule (OAR) 635-415-0025. This rule defines six habitat categories and establishes mitigation goals and implementation standards for each.

3.0 RESULTS

This section presents results of information queries and the wildlife survey and habitat assessment.

3.1 USFWS Response

OED received a response from the USFWS dated June 2, 2017 (Appendix B) regarding a list of species expected on the Project area in the request and critical habitats designated within the Project area. The Project area requested was defined "Marquardt" (part of the full Harp Solar). The relevant contents of that letter are two. One is "There is a total of 0 threatened, endangered, or candidate species on your species list." The other is "There are no critical habitats within your project area" (Appendix B).

3.2 Soils

According to the custom soil report produced by NRCS (NRCS, 2017), four types of soil are found on the Project area. The majority of the area is composed of Ritzville silt loam and Willis silt loam. These soil types have the depth and stability preferred by WGS (Marr, 2001), but are also well suited for wheat production. A small portion of the area consists of Lickskillet very stony loam, and an even smaller portion is Xeric Torriorthents (NRCS, 2017).

3.3 Wildlife Species

No Washington ground squirrels or sign of their use were detected on any of the survey areas. The only wildlife recorded was horned lark (*Eremophila alpestris*), a common native species that adapts well to wheat and stubble fields.

3.4 Habitat

Almost the entire area is in active wheat production, defined as Category 6 developed agriculture. There is a small piece of non-agriculture toward the center of the middle section (Figure 1 & Figure 2). That small portion consists primarily of non-native cheatgrass (*Bromus tectorum*) and feral wheat, and offers little in the way of habitat for wildlife during the breeding season; this small area constitutes Category 4 exotic annual grassland.

4.0 SUMMARY

The Harp Solar Project area is almost entirely in active wheat production, contains no habitat suitable for Washington ground squirrel, and provides little value for native wildlife species during the breeding season.

5.0 REFERENCES

Marr, V. 2001. Effects of 1998 wildfire on Washington ground squirrels and their habitat at Naval Weapons Systems Training Facility, Boardman, Oregon.

National Resources Conservation Service (NRCS). 2017. Custom soil resource report for Morrow County, Oregon: Harp Tract. Produced for OneEnergy Development, LLC. (Available upon request from OED.)

Oregon Biodiversity Information Center (ORBIC). 2016. Rare, Threatened and Endangered Species of Oregon.

Oregon Department of Fish and Wildlife (ODFW). 2016. Sensitive species list. http://www.dfw.state.or.us/wildlife/diversity/species/docs/2017_Sensitive_Species_List.pdf.

United States Fish and Wildlife Service (USFWS). 2016. USFWS Oregon Species Statewide List. https://www.fws.gov/oregonfwo/promo.cfm?id=177175701

6.0 FIGURES

Figure 1. Harp Solar Project 2017 wildlife and habitat assessment area. Aerial imagery showing extent of agriculture at Harp Solar Project.

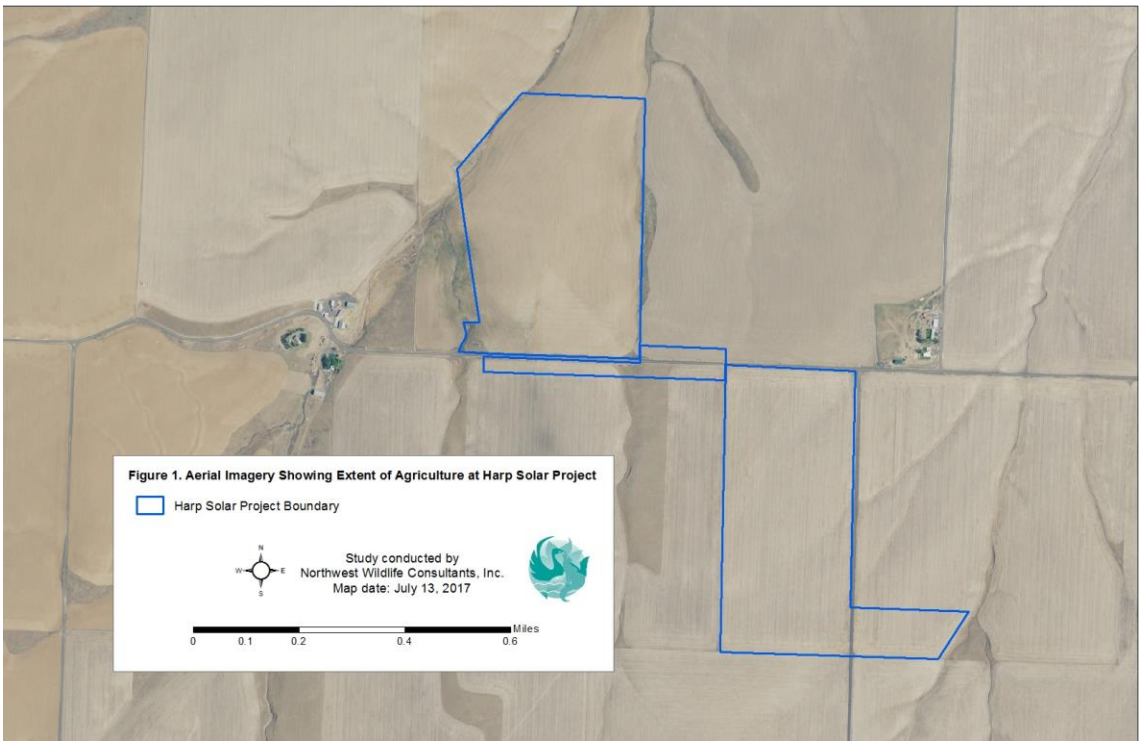
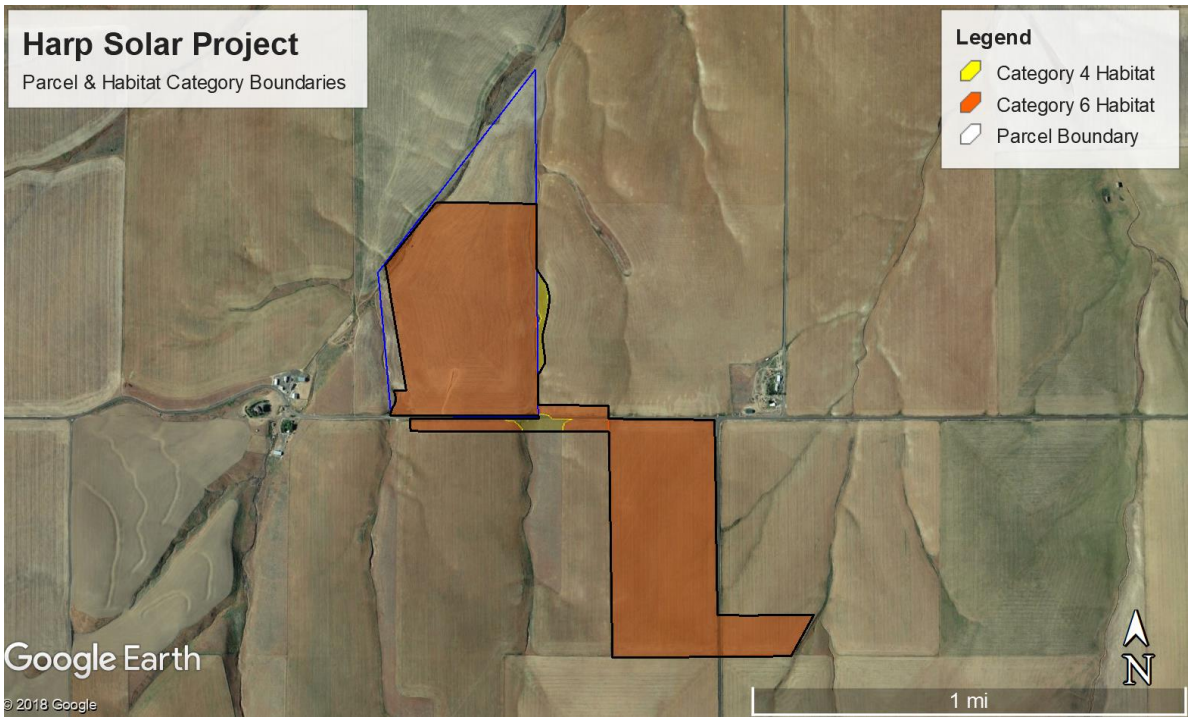


Figure 2. Harp Solar Project 2017 Survey Map. Annotated aerial map with parcel, survey, and habitat categorization boundaries.



7.0 APPENDICES

Appendix A. Special status vertebrate wildlife species of potential occurrence* on the Harp Solar Project during the breeding season.

Common Name and Scientific Name	Federal Status	ODFW Status	Occurrence in Solar Site Boundary and Transmission Line P=Potential to Occur N=No Potential to Occur
Mammals			
Washington ground squirrel *Urocitellus washingtoni*	SoC	E	**N**–No holes, pellets or sign of Washington Ground Squirrel (WGS) were detected during surveys. WGS not expected in developed agriculture or small patches of non-agriculture surrounded by agriculture. Extremely unlikely to occur on Project area.
Birds			
Swainson's hawk *Buteo swainsoni*	–	S	**P**–Not observed during surveys, but present in surrounding area. Project area offers no nest sites and little or no foraging opportunities. Has low potential to occur on Project.
Ferruginous hawk *Buteo regalis*	SoC BoCC	SC	**P**–Not observed during surveys, but present in surrounding area. Project area offers no nest sites and little or no foraging opportunities. Has low potential to occur on Project.
Golden eagle *Aquila chrysaetos*	EPA BoCC	–	**N**–Not documented on Project. Not expected on Project area during breeding season.
Bald eagle *Haliaeetus leucocephalus*	NW EPA BoCC	–	**N**–Not observed during surveys. Project area offers no foraging opportunities. Not expected on Project during breeding season.
Long-billed curlew *Numenius americanus*	BoCC	SC	**P**–Not observed during surveys, but present in surrounding area. Project area offers no nest sites and little or no foraging opportunities. Has low potential to occur on Project.
Western burrowing owl *Athene cunicularia hypugaea*	SoC	SC	**N**–No individuals or sign detected during surveys. No suitable habitat. Extremely unlikely to occur on Project area.
Loggerhead shrike *Lanius ludovicianus*	BoCC	S	**N**–None detected during surveys. No suitable habitat. Extremely unlikely to occur on Project area.
Sagebrush sparrow *Artemisiospiza nevadensis*	BoCC	SC	**N**–None detected during surveys. No suitable habitat. Extremely unlikely to occur on Project area.
Grasshopper sparrow *Ammodramus savannarum*	–	S	**N**–None detected during surveys. No suitable habitat. Extremely unlikely to occur on Project area.
Amphibians, Reptiles, and Turtles			
Northern sagebrush lizard *Sceloparus graciosus graciosus*	SoC	S	**N**–None detected during surveys. No suitable habitat. Extremely unlikely to occur on Project area.

*Based on information reviews and 2017 surveys.

Status Key

Federal:

T	Threatened	SoC	Species of Concern	BoCC	USFWS Birds of Conservation Concern
E	Endangered	NW	Not Warranted; delisted	–	No special status
C	Candidate	EPA	Bald and Golden Eagle Protection Act		

Note: All native migratory birds are protected by the federal Migratory Bird Treaty Act (MBTA).

Oregon:

- T Threatened
- E Endangered
- SC "Sensitive-Critical" species are those that have current or legacy threats that are significantly impacting their abundance, distribution, diversity, and/or habitat. They may decline to the point of qualifying for threatened or endangered status if conservation actions are not taken.
- S "Sensitive species" are not in imminent danger of being listed as threatened or endangered, but could become sensitive-critical, threatened, or endangered with changes in populations, habitats or threats.

Sources for status = ODFW, 2016; ORBIC, 2016; USFWS, 2016

Appendix B. USFWS response letter regarding threatened, endangered, and candidate species expected in, and critical habitats designated on, Harp Solar Project area (cover page and results pages).

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon Fish And Wildlife Office
2600 Southeast 98th Avenue, Suite 100
Portland, OR 97266-1398
Phone: (503) 231-6179 Fax: (503) 231-6195
https://www.fws.gov/oregonfwo/articles.cfm?id=149489416

In Reply Refer To:
Consultation Code: 01EOFW00-2017-SLI-0416
Event Code: 01EOFW00-2017-E-00664
Project Name: Marquardt Solar

June 02, 2017

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the

Project Summary

Consultation Code: 01EOFW00-2017-SLI-0416

Event Code: 01EOFW00-2017-E-00664

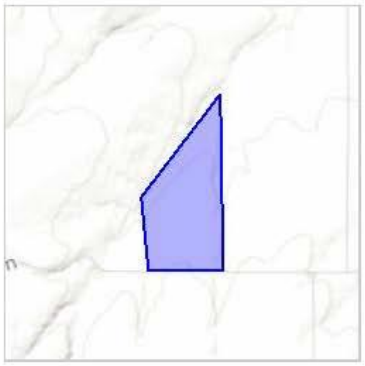
Project Name: Marquardt Solar

Project Type: POWER GENERATION

Project Description: Marquardt Solar will include approximately 110 acres of Agricultural land in the city of Lexington, Oregon. Some light grading and clearing may take place but there will be little change to the quantity of impervious surface. It is expected that the project will generate 10 MW of power.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/45.52236847554481N119.69016100286478W



Counties: Morrow, OR

Endangered Species Act Species

There is a total of 0 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area. Please contact the designated FWS office if you have questions.

Critical habitats

There are no critical habitats within your project area.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon Fish And Wildlife Office
2600 Southeast 98th Avenue, Suite 100
Portland, OR 97266-1398
Phone: (503) 231-6179 Fax: (503) 231-6195
https://www.fws.gov/oregonfwo/articles.cfm?id=149489416

In Reply Refer To:
Consultation Code: 01EOFW00-2018-SLI-0236
Event Code: 01EOFW00-2018-E-00449
Project Name: Harp Solar

February 09, 2018

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to investigate opportunities for incorporating conservation of threatened and endangered species into project planning processes as a means of complying with the Act. If you have questions regarding your responsibilities under the Act, please contact the Endangered Species Division at the Service's Oregon Fish and Wildlife Office at (503) 231-6179. For information regarding listed marine and anadromous species under the jurisdiction of NOAA Fisheries Service, please see their website (http://www.nwr.noaa.gov/habitat/habitat_conservation_in_the_nw/habitat_conservation_in_the_nw.html).

Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Oregon Fish And Wildlife Office
2600 Southeast 98th Avenue, Suite 100
Portland, OR 97266-1398
(503) 231-6179

Project Summary

Consultation Code: 01EOFW00-2018-SLI-0236

Event Code: 01EOFW00-2018-E-00449

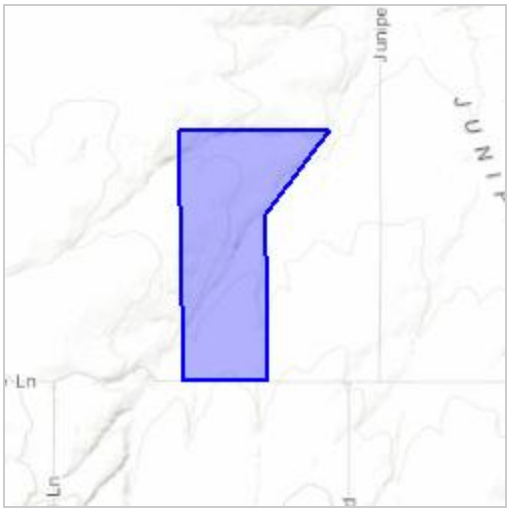
Project Name: Harp Solar

Project Type: POWER GENERATION

Project Description: Harp Solar will include approximately 80 acres of Agricultural land within the 312 acre parcel located in the city of Lexington, Oregon. Some light grading and clearing may take place but there will be little change to the quantity of impervious surface. It is expected that the project will generate 10 MW of power.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/45.52557903263914N119.69126009439586W



Counties: Morrow, OR

Endangered Species Act Species

There is a total of 0 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Oregon
Kate Brown, Governor

Department of Fish and Wildlife
Heppner District Office
P.O. Box 363
54173 Highway 74
Heppner, Oregon 97836
541-676-5230
Fax: 541-676-9075
www.dfw.state.or.us/

February 12, 2018

Ann Siqveland, Director, Project Development
OneEnergy Renewables
ann@oneenergyrenewables.com
503-232-3859 (Office)
503-985-9201 (Mobile)

RE: Harp Solar near Lexington, OR

Dear Ann:

Thank you for the site visit to Harp Solar on 2-8-2018. As we discussed the facility is sited appropriately. The current completed on-site surveys are acceptable to ODFW. The final survey that needs to be completed before construction is the raptor nest survey. This survey should be completed during the active nesting season in areas with potential nesting habitat, and within a one-half mile radius from the project boundary.

I appreciate the opportunity to visit and comment on this proposed project and look forward to continuing working with you. Please feel free to contact me if you have any questions regarding my comments.

Respectfully,

Melody Henderson
Wildlife Biologist
Email: Melody.B.Henderson@state.or.us
Phone: 541-676-5230

Blake Bjornson

From: Martens, Justin <justin_martens@fws.gov>
Sent: Monday, February 12, 2018 10:36 AM
To: Ann Siqveland
Cc: Blake Bjornson
Subject: Technical Assistance for Harp Solar (10 megawatts), [redacted] Renewable Energy Projects in Morrow County, Oregon

Ann Siqveland
Director + Project Development
OneEnergy Renewables
911 NE Davis St.
Portland, OR 97232
503-232-1989

Dear Ms. Siqveland,
This is in response to OneEnergy Renewables' correspondence requesting feedback from the Fish and Wildlife Service (Service) with respect to the Harp Solar (10 megawatts), [redacted] projects in Morrow County. You initially requested feedback on December 20, 2017, which was followed up by a phone conversation on January 5, 2018, followed by a site visit on February 8, 2018. OneEnergy Renewables provided initial project descriptions, site maps, and wildlife survey information conducted by Northwest Wildlife Consultants, Inc., that indicated no listed or proposed threatened or endangered Species were found in or near the vicinity of any of the project sites. Formal or informal consultation with the Service requires that an action must be either authorized, funded, or carried out by a Federal Agency and the presence of T&E species, neither of which is the case for any of these projects. Although we typically do not consult or provide a written response for "no effect" determinations, this email has been prepared, per your request, in order to document our review of the information you provided in your correspondence.

OneEnergy Renewables is proposing to install and develop 4 separate photovoltaic solar energy generation projects listed above in Morrow County, Oregon. These projects (Harp Solar (10 megawatts), [redacted]) will occur on non-federal land and do not intersect with any listed or proposed threatened or endangered species or mapped critical habitat.

Based on our review of the information submitted in your correspondence, we do not anticipate further Service review. We appreciate your efforts for conserving listed and candidate species. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, these determinations may be reconsidered. If you have any questions or concerns about this letter, please contact me at the contact information below.

Sincerely,

--

Justin Martens

Fish and Wildlife Biologist
US Fish and Wildlife Service
La Grande Field Office
3502 Highway 30,La Grande, OR 97850
Office: (541) 962-8586
Fax: (541) 962-8581
Email: justin_martens@fws.gov
http://www.fws.gov/oregonfwo/FieldOffices/LaGrande

Solar Glare Hazard Analysis Report

Generated June 16, 2017, 5:12 p.m.

No glare found

Print

Inputs

Analysis name	Harp Solar
PV array axis tracking	single
Tilt of tracking axis (deg)	0.0
Orientation of tracking axis (deg)	0.0
Offset angle of module (deg)	0.0
Limit rotation angle?	True
Maximum tracking angle (deg)	60.0

Rated power (kW)	10000.0
Vary reflectivity	True
PV surface material	Light textured glass with ARC

Timezone offset	-8.0
Subtended angle of sun (mrad)	9.3
Peak DNI (W/m^2)	1000.0
Ocular transmission coefficient	0.5
Pupil diameter (m)	0.002
Eye focal length (m)	0.017
Time interval (min)	1
Correlate slope error with material	True
Slope error (mrad)	9.16

PV array vertices

id	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Height of panels above ground (ft)	Total elevation (ft)
1	45.51651923	-119.686822	549.7	7.0	556.7
2	45.52821772	-119.6869944	493.02	7.0	500.02
3	45.52136314	-119.6945171	509.07	7.0	516.07
4	45.51658796	-119.6938423	568.53	7.0	575.53
5	45.51651923	-119.686822	568.73	7.0	575.73

Observation Points

	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Eye-level height above ground (ft)
1	45.5174139177	-119.699006081	1324.54	10.0

No glare found.

Solar Glare Hazard Analysis Report

Generated June 16, 2017, 5:12 p.m.

No glare found

Print

Inputs

Analysis name	Harp Solar
PV array axis tracking	single
Tilt of tracking axis (deg)	0.0
Orientation of tracking axis (deg)	0.0
Offset angle of module (deg)	0.0
Limit rotation angle?	True
Maximum tracking angle (deg)	60.0

Rated power (kW)	10000.0
Vary reflectivity	True
PV surface material	Light textured glass with ARC

Timezone offset	-8.0
Subtended angle of sun (mrad)	9.3
Peak DNI (W/m^2)	1000.0
Ocular transmission coefficient	0.5
Pupil diameter (m)	0.002
Eye focal length (m)	0.017
Time interval (min)	1
Correlate slope error with material	True
Slope error (mrad)	9.16

PV array vertices

id	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Height of panels above ground (ft)	Total elevation (ft)
1	45.51651923	-119.686822	549.7	7.0	556.7
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3	45.52136314	-119.6945171	509.07	7.0	516.07
4	45.51658796	-119.6938423	568.53	7.0	575.53
5	45.51651923	-119.686822	568.73	7.0	575.73

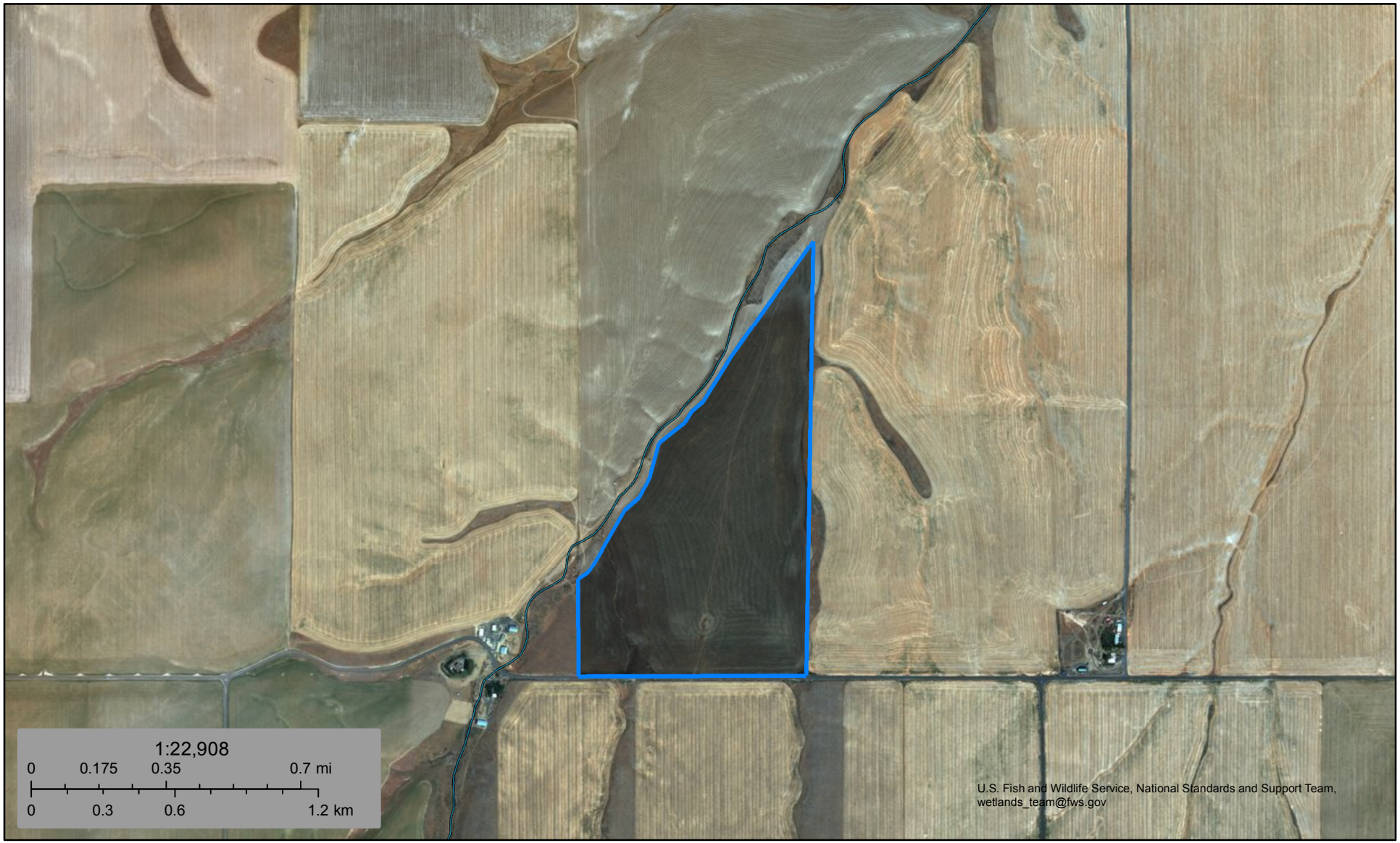
Observation Points

	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Eye-level height above ground (ft)
2	45.5178950429	-119.675574303	1356.96	10.0

No glare found.

U.S. Fish and Wildlife Service
National Wetlands Inventory

Harp NWI Map - Project Area Extent



March 1, 2018

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator zone 11. The **horizontal datum** was NAD 83, GRS 80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by the Oregon Geospatial Enterprise Office (GEO). This information was compiled from many local sources and includes transportation features, water features, political boundaries, and Public Land Survey System features. Aerial photographs dated 2000-2001 were provided by the United States Geological Survey (USGS).

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on this map.

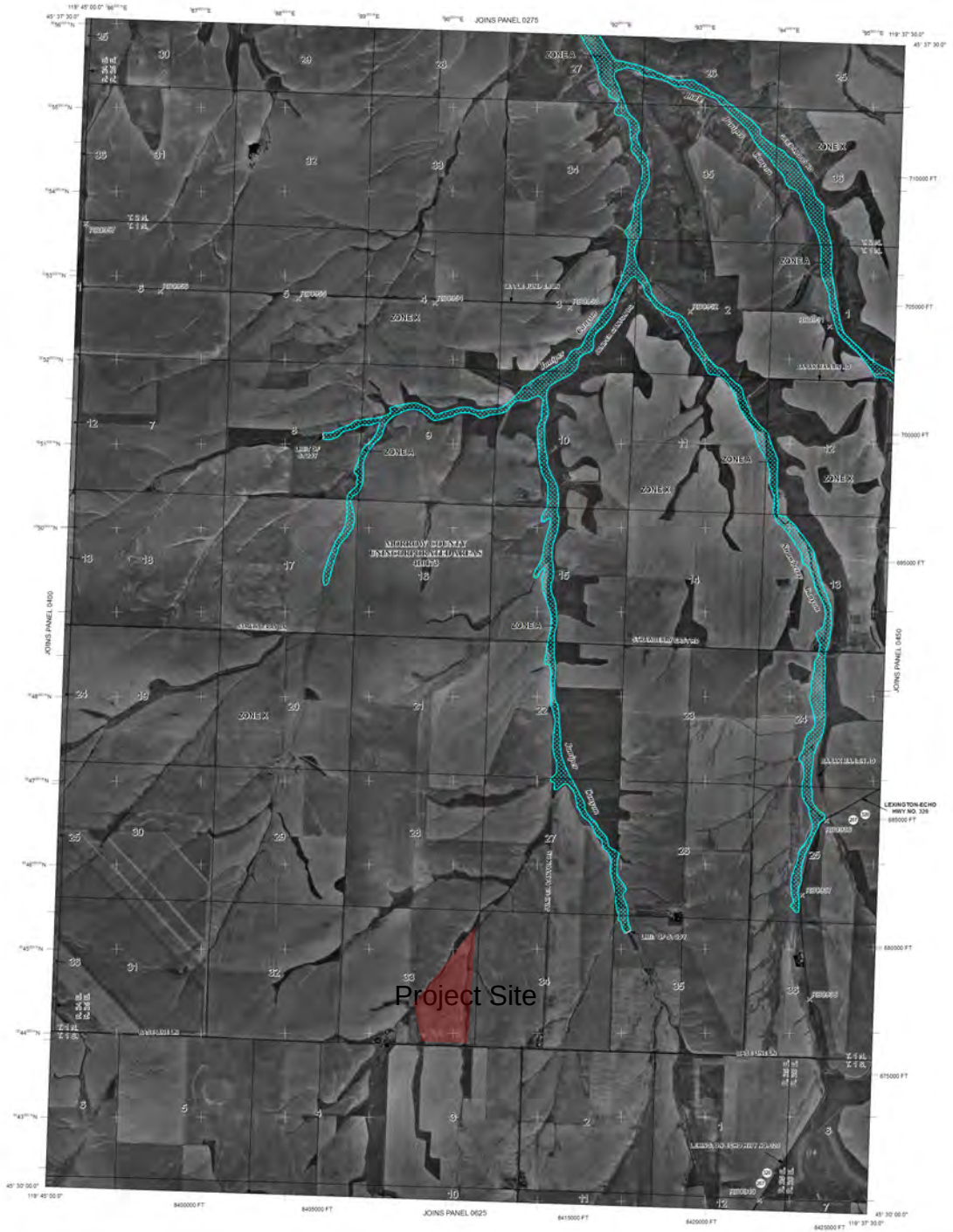
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://msc.fema.gov/.

The "profile base lines" depicted on this map represent the hydraulic modeling base lines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line," in some cases may deviate significantly from the channel centerline or appear outside the SFHA.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

- **ZONE A** No Base Flood Elevations determined.
- **ZONE AE** Base Flood Elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** Area of special hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance of greater flood event.
- **ZONE A99** Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones, and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet *
- (EL 978) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 97°10'30.5", 32°10'30.5" — Geographic coordinates referenced to North American Datum of 1983 (NAD 83)
- 4276000mE — 1000-meter Universal Transverse Mercator grid values, zone 11
- 600000 FT — 5000-foot grid ticks: Oregon State Plane coordinate system, North zone (FIPSZONE 3601), Lambert Conformal Conic projection
- MG5510 X — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- •M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
December 18, 2007

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

600 0 600 1200 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0425D

FIRM

FLOOD INSURANCE RATE MAP

MORROW COUNTY, OREGON AND INCORPORATED AREAS

PANEL 0425 OF 1400

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MORROW COUNTY: UNINCORPORATED AREAS	410173	0425	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
41049C0425D

EFFECTIVE DATE
DECEMBER 18, 2007

Federal Emergency Management Agency

Oregon
Kate Brown, Governor

Parks and Recreation Department
State Historic Preservation Office
725 Summer St NE Ste C
Salem, OR 97301-1266
Phone (503) 986-0690
Fax (503) 986-0793
www.oregonheritage.org

January 12, 2018

Ms. Ann Siqveland
One Energy Renewables
911 NE Davis
Portland, OR 97232

RE: SHPO Case No. 15-1623
OneEnergy Renewables, HARP Solar Farm Project
Develop 80 acre solar farm
69695 Lone Boardman Road (1N 24E 33), Lone Rock

Dear Ms. Siqveland:

We have reviewed the materials submitted on the project referenced above, and we concur there will be no historic properties affected for this undertaking. This letter refers to above-ground historic resources only. Comments pursuant to a review for archaeological resources have been sent separately.

This concludes the requirement for consultation with our office under Section 106 of the National Historic Preservation Act (per 36 CFR Part 800) for above-ground historic properties. Local regulations, if any, still apply and review under local ordinances may be required. Please feel free to contact me if you have any questions, comments or need additional assistance.

Sincerely,

Jason Allen, M.A.
Historic Preservation Specialist
(503) 986-0579
jason.allen@oregon.gov

Oregon
Kate Brown, Governor

Parks and Recreation Department
State Historic Preservation Office
725 Summer St NE Ste C
Salem, OR 97301-1266
Phone (503) 986-0690
Fax (503) 986-0793
www.oregonheritage.org

November 28, 2017

Ms. Ann Siqveland
One Energy Renewables
911 NE Davis
Portland, OR 97232

RE: SHPO Case No. 15-1623
OneEnergy Renewables, HARP Solar Farm Project
Develop 80 acre solar farm
69695 Lone Boardman Road (1N 24E 33), Lone Rock

Dear Ms. Siqveland:

Our office recently received a request to review your application for the project referenced above. In checking our statewide archaeological database, it appears that there have been no previous surveys completed near the proposed project area. However, the project area lies within an area generally perceived to have a high probability for possessing archaeological sites and/or buried human remains. In the absence of sufficient knowledge to predict the location of cultural resources within the project area, extreme caution is recommended during project related ground disturbing activities. Under state law (ORS 358.905 and ORS 97.74) archaeological sites, objects and human remains are protected on both state public and private lands in Oregon. If archaeological objects or sites are discovered during construction, all activities should cease immediately until a professional archaeologist can evaluate the discovery. If you have not already done so, be sure to consult with all appropriate Indian tribes regarding your proposed project. If the project has a federal nexus (i.e., federal funding, permitting, or oversight) please coordinate with the appropriate lead federal agency representative regarding compliance with Section 106 of the National Historic Preservation Act (NHPA). If you have any questions about the above comments or would like additional information, please feel free to contact our office at your convenience. In order to help us track your project accurately, please reference the SHPO case number above in all correspondence.

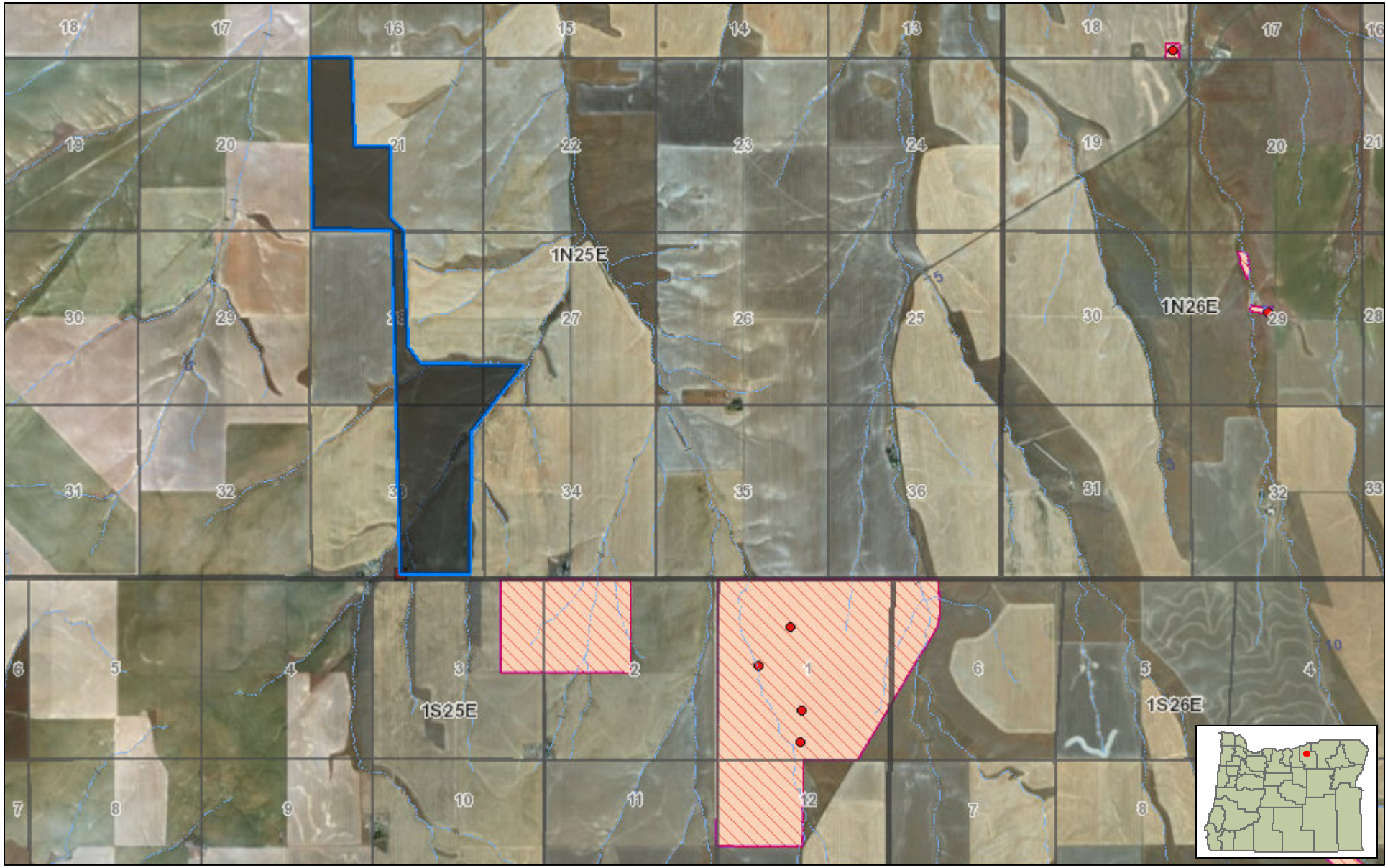
Sincerely,

Dennis Griffin, Ph.D., RPA
State Archaeologist
(503) 986-0674
dennis.griffin@oregon.gov

Harp Full Tract Solar Water Rights Map

February 27, 2018

Oregon Water Resources Department
725 Summer St NE, Suite A, Salem, OR 97301
(503)986-0900



Water Rights by Type

Points of Diversion
Places of Use
Storage Water
Surface Water
Groundwater

Water Rights by Use

Recreation
Fish
Wildlife
Instream
Misc.
Agriculture
Livestock
Irrigation
Mining
Power
Commercial
Domestic

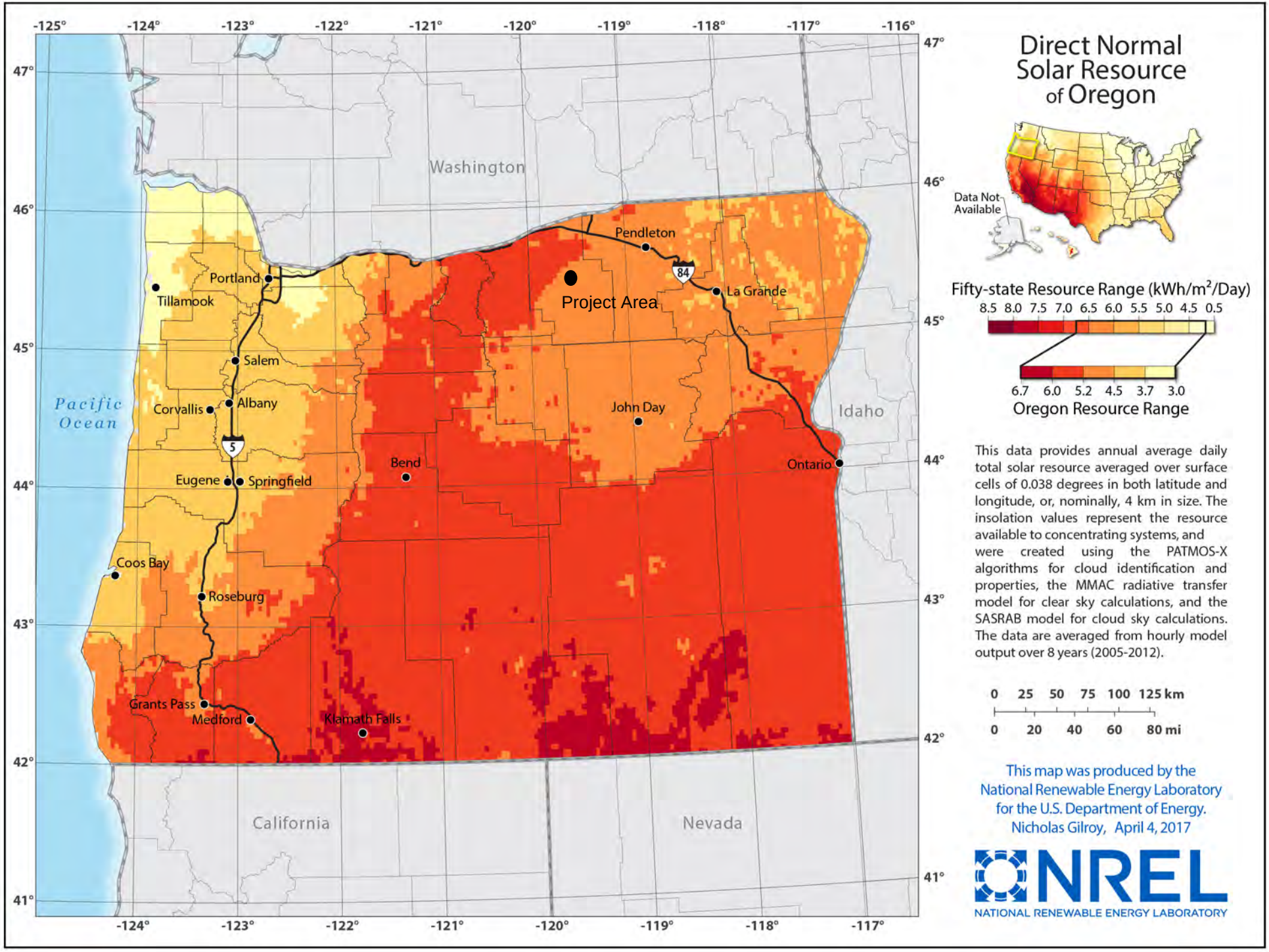
By Primary/Supplemental

Primary
Supplemental

1:72,224

0 0.5 1 2 mi
0 1 2 4 km

Disclaimer: http://www.oregon.gov/owrd/pages/MAPS/index.aspx#Disclaimer


Direct Normal Solar Resource of Oregon
Data Not Available
Fifty-state Resource Range (kWh/m²/Day)
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 0.5
6.7 6.0 5.2 4.5 3.7 3.0
Oregon Resource Range
This data provides annual average daily total solar resource averaged over surface cells of 0.038 degrees in both latitude and longitude, or, nominally, 4 km in size. The insolation values represent the resource available to concentrating systems, and were created using the PATMOS-X algorithms for cloud identification and properties, the MMAC radiative transfer model for clear sky calculations, and the SASRAB model for cloud sky calculations. The data are averaged from hourly model output over 8 years (2005-2012).
0 25 50 75 100 125 km
0 20 40 60 80 mi
This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.
Nicholas Gilroy, April 4, 2017
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
Project Area
Washington
Idaho
California
Nevada
Pacific Ocean
Portland
Tillamook
Salem
Albany
Corvallis
Eugene
Springfield
Coos Bay
Roseburg
Grants Pass
Medford
Klamath Falls
Bend
John Day
Pendleton
La Grande
Ontario
84
5
-125° -124° -123° -122° -121° -120° -119° -118° -117° -116°
47° 46° 45° 44° 43° 42° 41°