STORM
DRAINAGE REPORT

FOR

TANGLE RIDGE

City of Spokane, Washington

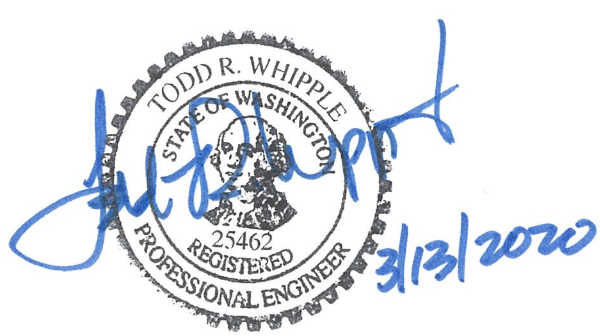
Revised
March 12, 2020

2019-2394

Prepared by:

Whipple Consulting Engineers
21 S. Pines Road
Spokane Valley, WA
PH: (509) 893-2617
FAX: (509) 926-0227

This report has been prepared by Justin Penner, E.I.T. of Whipple Consulting Engineers under the direction of the undersigned professional engineer whose seal and signature appears hereon:



Todd R. Whipple, P.E.

INTRODUCTION

The purpose of this Drainage Report is to identify any drainage impacts resulting from the proposed development of the above referenced project and to determine the improvements necessary to control the increase/decrease in stormwater runoff. As the proposed project lies within City of Spokane, the storm drainage facilities will be designed in accordance with the Spokane Regional Stormwater Manual (SRSM).

PROJECT DESCRIPTION:

The proposed project is a 45-lot residential subdivision located just to the east of the intersection of Tangle Heights Drive and Boulder Drive. The site is currently an undeveloped parcel. The proposed stormwater facilities will adequately collect, treat and discharge the increase in stormwater runoff from the proposed development.

The site is located within the City of Spokane and lies in the NE 1/4 of Section 7, T 24 N., R 43 E., W.M. The site parcel number is 34071.0040. A vicinity map is attached in the Appendix.

GEOTECHNICAL INFORMATION:

As presented on the United States Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) Web Soil Survey map, the site soils consist of Urbaon land-Seaboldt, disturbed complex, 0 to 3 percent slopes (7150) A soil map is included in the Appendix. Per Chapter 5, Appendix 5E of the SRSM, some of the onsite soils are classified as Hydrologic Soil Group Type C.

PRE-DEVELOPMENT BASIN INFORMATION:

As shown on the Pre-Developed Basin Map located in the Appendix, the site is bordered by Eagle Ridge 12th Addition to the west and north and Eagle Ridge 1st Addition the east. There are no predominate flows entering the site. The project site has a relatively flat area on the west side of the project site while the east and north sides have steep embankments. The total relief across the flat area on the west side of the project is approximately 35-feet while the steep embankments on the north and east have a relief of approximately 110-feet.

GEOTECHNICAL INFORMATION:

As presented on the United States Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) Web Soil Survey map, the site soils consist of Seaboldt ashy loam, 0 to 8 percent slopes (3600) and 2046 Klickson-Spiegle-Rock outcrop complex, 30-60 percent slopes. A soil map is included in the Appendix. Per Chapter 5, Appendix 5E of the SRSM, some of the onsite soils are classified as Hydrologic Soil Group Type C.

Table 1 – Existing Basin Summary

Basin	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)
Pre Basin A	529,150	0	529,150

*Refer to basin calculations in Appendix for areas and peak flows for all basins.

Critical Areas:

Critical Area Maps provided by The City of Spokane, (DNR Streams, Fish and Wildlife, Wetlands, Geo-hazard Area and Critical Aquifer Resource Area) were used to evaluate the project site. The Critical Area onsite on the east and north sides of the project where slopes are in the 30%-60% range. It is to be noted that the CARA rating for the project site of high susceptibility. Wetlands, streams, or floodplains are not present and will not create any design restrictions. Stormwater facilities will not be located in the areas of steeper slopes.

POST DEVELOPMENT BASIN INFORMATION:

Methodology:

The City of Spokane has accepted the Spokane Regional Stormwater Manual (SRSM). As required by the SRSM, the storm drainage facilities proposed for this site have been sized to attenuate the 10- and 50-year storms events to accommodate for the downstream conveyance using the Rational Method as outlined in Section 5.5 of the SRSM. Due to the small size of the basins within this analysis, the Rational Method has been used to calculate peak flows and volumes. It was determined that the shape and size and drainage available all generally have the same length of time of concentration, therefore only 4 have been shown for reference. The peak flows and volumes for these storm events are shown in the calculations that are included within the Appendix of this report.

Water Quality Treatment:

The proposed storm drainage pond has been designed to provide treatment volume based on Equation 6-1d (V=1815A) of the SRSM, as outlined in Section 6.7.1 and allowed for under drained ponds. Once the treated stormwater exceeds a height of 12 inches, it will spill into a catch basin and discharge over the hill side at a metered rate that is less than or equal to the pre-developed flow.

Table 2 –Basin Summary

	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)
Basin A	250,896	94,110	156,789
Basin B	278,198	27,000	251,198
	PGIS Area (sf)	**(Method 1815A (ac)) Treatment Treatment Vol. (cf)**	
		Required	**Area Available**
Basin A	0	2,796	2,868
Basin B	67,110	0	0

*Refer to basin calculations in Appendix for areas and peak flows for all basins.

Operational Characteristics:

The stormwater generated within Basin A will sheet flow across the lots and be collected in the curb and gutter where it will gutter flow to corresponding catch basin and be discharged into the stormwater treatment pond. The treatment will fill to 1' and then discharge through a catch basin into an infiltration trench to disperse the flow as the stormwater discharges over the steep embankment to the northeast. The outflow from the pond will be metered as to not exceed the predevelopment flow rate.

The stormwater generated within Basin B of this site will sheet flow across the lots and continue to the flow to the northeast over the steep embankment as it does in the predevelopment. The flow to the downhill will be reduced compared to the pre-developed flows.

Overflow Sizing:

The pre-development flow rate is 4.77 cfs across pre-basin A based on a 10-year storm event. Per the attached bowstring, there is an overflow of 0.3 cfs in the post-development storm system.

The 3-¼" orifice was sized using the 0.3 cfs rate with a 1' head and using the equation $Q=11.79(d^2)(h^{1/2})$, where "Q" is the outflow rate in gpm, "d" is the diameter of the orifice in inches, and "h" is the pressure head of the system in feet.

Down-Gradient Analysis:

The stormwater generated onsite for the 10-yr storm event will be treated and the 50-yr storm event will be stored onsite with the discharge of excess stormwater over the steep embank through an infiltration trench for dispersion. The flow rate will be reduced compared to the pre-development flow rate.

Results:

As shown in Table 2 within this report we have provided the required treatment volume for the improvements proposed for the development. Table 3 below shows the onsite pond/swale storage summary for the 50-year storm events. Since treatment and storage are met as seen in Table 2 & 3 only a 50-yr bowstring was calculated. See appendix.

Table 3 – Project Site Pond/Swale Storage Summary

Basin	50-YR Storm	
	Required Vol. (cf)	Provided Vol. (cf)
Basin A	6,895	11,472

Perpetual Maintenance of Facilities:

Since this is a residential development with private streets, daily maintenance for the onsite drainage facilities will be provided by the Homeowners association, with replacement of treatment soil and drainage structures to be maintained by the HOA. A maintenance plan may be provided to the homeowner association if requested.

Offsite Easements:

There are no offsite stormwater easements required for this property.

Regional Facilities

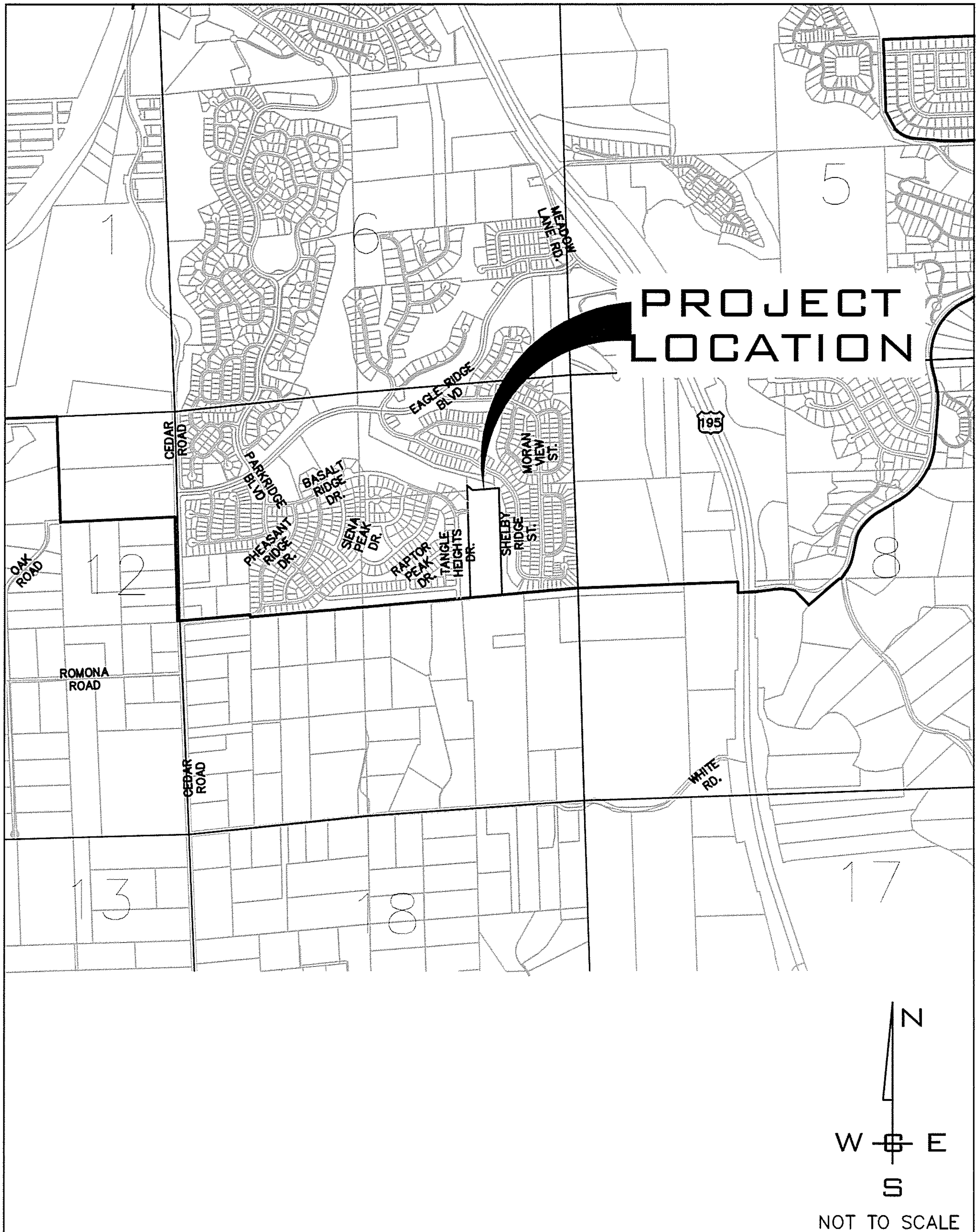
There are no known regional facilities that lie within the project site.

CONCLUSION

As required by The City of Spokane and the Spokane Regional Stormwater Manual, the proposed onsite storm detention facilities for this project are anticipated to adequately collect, and discharge stormwater runoff generated by the site during the 10 &50-year storm event. Therefore, it is our conclusion that this project will have the ability to treat and store stormwater onsite, and we recommend that the project be allowed to move forward through the development process so that project specific storm drainage reports may be provided.

APPENDIX

VICINITY MAP



DRAINAGE REPORT

TANGLE RIDGE

TANGLE HEIGHTS DR & BOULDER RIDGE DR

SPOKANE, WASHINGTON

FIGURE 1

VICINITY MAP

WCE

WHIPPLE CONSULTING ENGINEERS

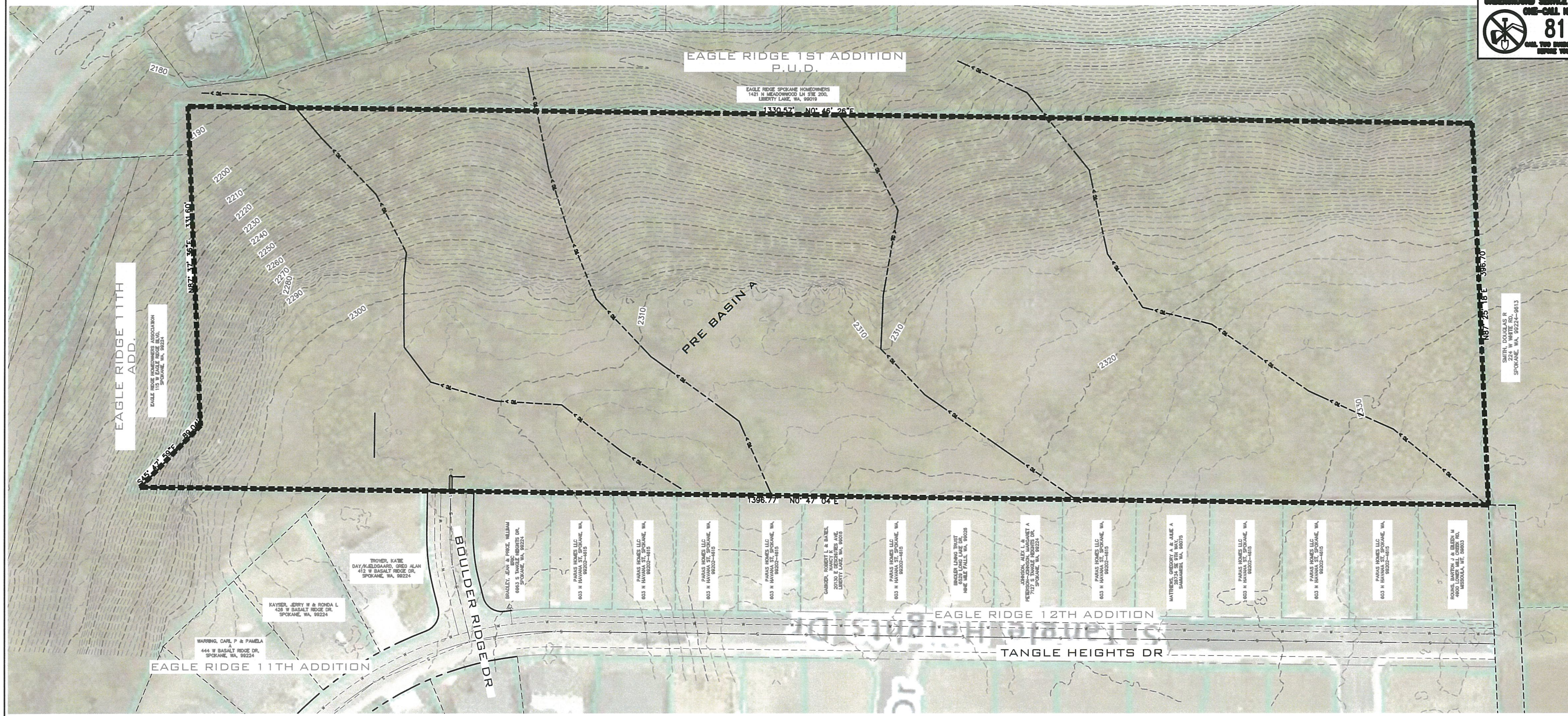
21 SOUTH PINES RD

SPOKANE VALLEY, WASHINGTON 99206

PH: 509-893-2617 FAX: 509-926-0227

BASIN MAPS

UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
811
CALL TWO BUSINESS DAYS BEFORE YOU DIG



SITE PLAN

SCALE: 1"=50'

GRAPHIC SCALE

50 0 25 50 100

(IN FEET)
1 inch = 50 ft.

NAVD - 88
CENTERLINE MONUMENT LOCATED AT THE INTERSECTION OF TANGLE HEIGHTS DRIVE AND BOULDER RIDGE DRIVE
EL: TO BE VERIFIED AT TIME OF ENGINEERING AND PLATTING

NO.	DATE	BY	REVISIONS

SCALE:
HORIZONTAL: 1"=60'
VERTICAL: N/A

PROJ #: 19-2394
DATE: 02/04/20
DRAWN: JPP
REVIEWED:

CIVIL
STRUCTURAL
SURVEYING
TRAFFIC
X PLANNING
LANDSCAPE
OTHER

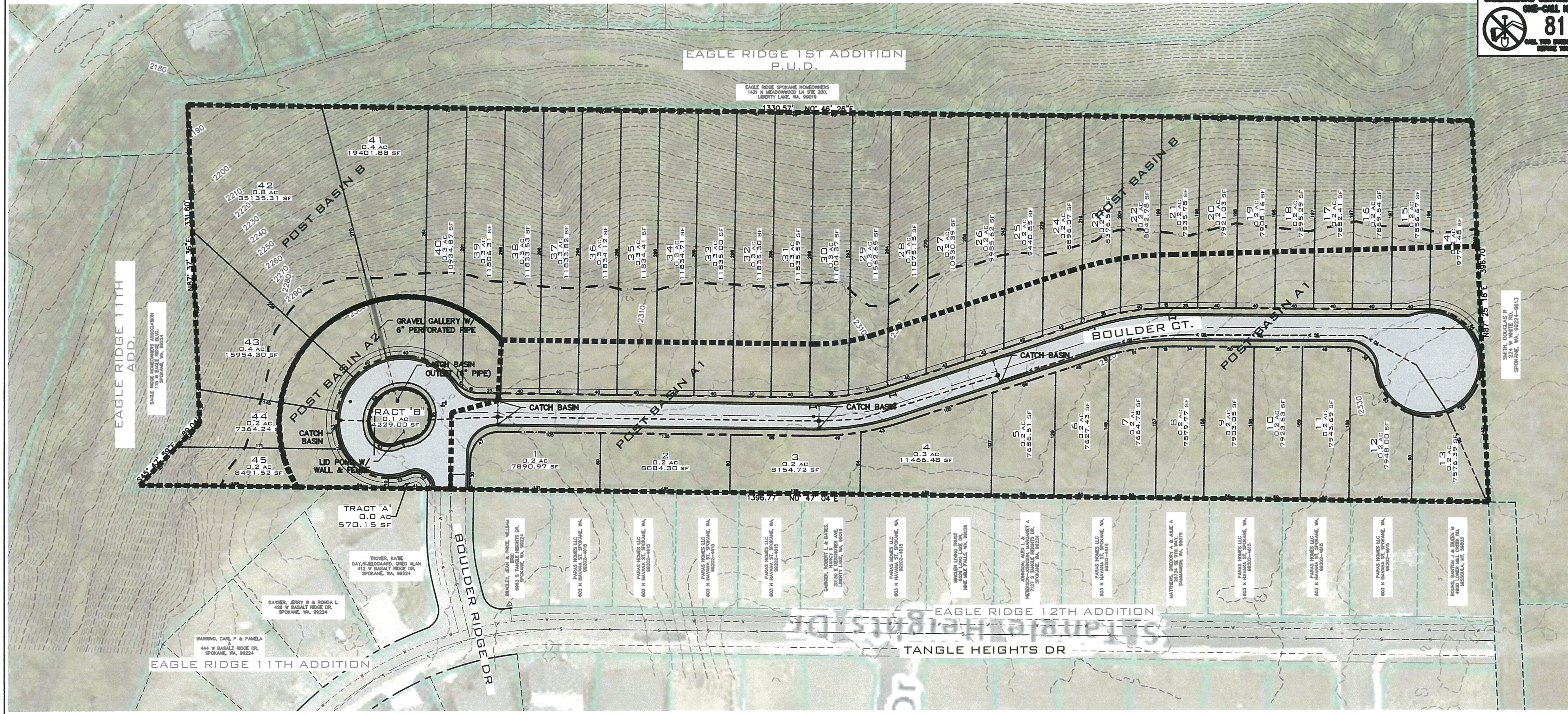
WCE
WHIPPLE CONSULTING ENGINEERS
21 S. PINES ROAD
SPOKANE VALLEY, WA 99206
PH: 509-893-2617 FAX: 509-926-0227

TANGLE RIDGE
PRELIMINARY BASIN MAP
BOULDER RIDGE
SPOKANE, WA

SHEET
1 OF 1

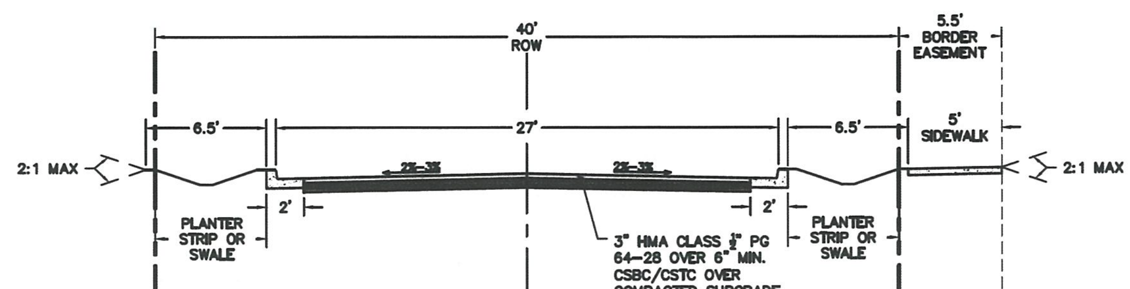
JOB NUMBER
19-2394

UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
811
CALL TWO BUSINESS DAYS BEFORE YOU DIG



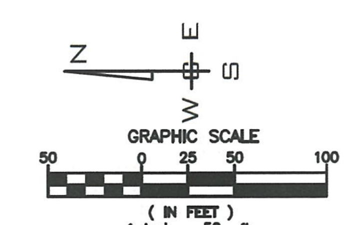
SITE PLAN

SCALE: 1"=50'



TYP. ROAD CROSS SECTION

SCALE: NTS



NAVD - 88
CENTERLINE MONUMENT LOCATED AT THE INTERSECTION OF TANGLE HEIGHTS DRIVE AND BOULDER RIDGE DRIVE
EL: TO BE VERIFIED AT TIME OF ENGINEERING AND PLATTING

NO.	DATE	BY	REVISIONS

SCALE:	
HORIZONTAL:	1"=60'
VERTICAL:	N/A

PROJ #:	19-2394
DATE:	02/04/20
DRAWN:	JPP
REVIEWED:	

CIVIL
STRUCTURAL
SURVEYING
TRAFFIC
X PLANNING
LANDSCAPE
OTHER

WCE
WHIPPLE CONSULTING ENGINEERS
21 S PINES ROAD
SPOKANE VALLEY, WA 99206
PH: 509-893-2617 FAX: 509-926-0227

TANGLE RIDGE
POST BASIN MAP
BOULDER RIDGE
SPOKANE, WA

SHEET
1 OF 1
JOB NUMBER
19-2394

BASIN SUMMARY SHEET

Whipple Consulting Engineers
Basin Calculation Worksheet

Imp 0.9
Per 0.15

WCE No.
3/12/2020 19-2394 Tangle Ridge
JPP

Intensities from SRSM eqn. 5-13, per Table 5-7, Assumes Tc = 5 min

I (2 yr) = 1.418 inches I (10 yr)= 2.619 inches
I (25 yr) = 3.319 inches I (50 yr)= 3.843 inches
I (100 yr) = 4.381 inches

NOTE:

SPOKANE COUNTY - SRSM - GRASSED PERCOLATION METHOD

Basin	Total	Access/Parking	Sidewalk	DV	Buildings	Total	Total	Weighted	PGIS	1815 A		Q=CIA (cfs)				
										Pond	Pond					
	sf	/Street (sf)	sf	WY	sf	Impervious	Pervious	"C"	sf	Area (sf)	Vol (cf)	2 yr	10 yr	25 yr	50 yr	100 yr
PRE A	529,150	0	0	0	0	0	529,150	0.15	0	0.00	0.00	2.58	4.77	6.05	7.00	7.98
			0						0							
Pre Total	**529,150**	**0**	**0**	**0**	**0**	**0**	**529,150**	**0.15**	**0**	**0**	**0**	2.58	4.77	6.05	7.00	7.98
Post Onsite Flow																
BASIN A1	215,174	37,584	5,500	2,800	22,800	68,684	146,490	0.39	45,884	3,824	1,912	2.73	5.04	6.38	7.39	8.43
BASIN A2	35,722	4,176	1,850	15,200	4,200	25,426	10,296	0.68	21,226	1,769	884	0.80	1.47	1.86	2.16	2.46
A Total	250,896	41,760	7,350	18,000	27,000	94,110	156,786	0.43	67,110	5,593	2,796	3.52	6.51	8.25	9.55	10.88
BASIN B	278,198	0	0	0	27,000	27,000	251,198	0.22	0	0	0	2.02	3.73	4.72	5.47	6.23
TOTAL	**529,094**	**41,760**	**7,350**	**18,000**	**54,000**	**121,110**	**407,984**	0.32	**134,220**	**11,185**	**5,593**	**5.54**	**10.23**	**12.97**	**15.02**	**17.12**

POND VOLUME WORKSHEET

WHIPPLE CONSULTING ENGINEERS
POND VOLUME CALC SHEET

3/12/2020

19-2394 MORAN SOUTH ESTATES
Engineer JPP

						Treatment			Storage		
Basins	Ponds/ Swales	Bottom Area sf	Pond Bottom Elevation at Drywell	Pond Outlet Elevation	Pond Inlet Elevation (avg)	Conic Volume to Rim cf	Side Slope Volume cf	Total Volume to Rim cf	Conic Volume to Inlet cf	Side Slope Volume cf	Total Volume to Inlet cf
A	POND 1	2,868	1000.00	1001.00	1004.00	2,868	0	2,868	11,472	0	11,472
Overall Total		**2,868**	-	-	-	**2,868**	**0**	**2,868**	**11,472**	**0**	**11,472**

50-YEAR BOWSTRING CALCULATIONS

SRSM RATIONAL METHOD

50-Year Design Storm

PROJECT: **19-2394**

PROJECT INFORMATION

BASIN: A

Tot. Area	250,896	SF		5.76	Acres
Imp. Area	94,110	SF	C=	0.9	
Perv. Area	156,786	SF	C=	0.15	
Wt. C =	0.43		PGIS Area =	67,110	

WCE Applicable Travel Time Ground Cover Coefficients		
Per Table 5-6 SRSM		
Type of Cover		K (ft/min)
Short Pasture		420
Nearly Bare Ground		600
Small Roadside Ditch/ Grass		900
Paved Area (use for parking lots)		1200
Gutter - 4 inches deep		1500
Gutter - 6 inches deep		2400
Pipe - 12-inch PVC/DI		3000
Pipe - 15/18-inch PVC/DI		3900
Pipe - 24-inch PVC/DI		4700
Reaches		
Reach 1	Offsite	also applicable for Pre-Developed Tc
Length	0.00	
K	420.00	
Slope (ft/ft)	0.0400	be sure this is decimal equivalent slope 0.0000
Travel Time	0.00	Minutes
Reach 2	Finished Lot from House to Street	
Length	100.00	
K	420.00	
Slope (ft/ft)	0.0300	be sure this is decimal equivalent slope 0.0000
Travel Time	1.37	Minutes
Reach 3	Gutter Flow to Inlet/Catch Basin	
Length	500.00	
K	2400.00	
Slope (ft/ft)	0.0200	be sure this is decimal equivalent slope 0.0000
Travel Time	1.47	Minutes
Reach 4	Pipe Flow 1	Pipe Reach One (only need one if no Diam change)
Length	300.00	
K	3000.00	12-inch Pipe minimum
Slope (ft/ft)	0.0400	Average Slope for total pipe run
Travel Time	0.50	Minutes
Reach 5	Pipe Flow 2	Add additional pipe reacheds for other Diam
Length	300.00	
K	3900.00	15/18-inch Pipe
Slope (ft/ft)	0.0050	Average Slope for total pipe run
Travel Time	1.09	Minutes
Sum of Tc	4.44	Minutes
Tc for Analysis	5.00	Minutes

BOWSTRING METHOD

PROJECT: 19-2394
BASIN: A
DESIGNER TRW
DATE: 12-Mar-20

Time Increment (min)	5
Time of Conc. (min)	5.00
Outflow (cfs)	0.3
Design Year Flow	50
Area (acres)	5.76
Impervious Area (sq ft)	94110
'C' Factor	0.43
Area * C	2.484
PGIS Area	67,110

Rainfall Intensity Coefficients for ***Spokane*** taken from Table 5-7 SRSM

M_{50} = 10.68

N_{50} = 0.635

Flow (weighted C)

Qwc= 9.55 cfs

Flow (time of Concentration)

Qtc= 9.55 cfs

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel. (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)	
5.00	300	3.84	9.55	3838	90	3748	
5	300	3.84	9.55	3838	90	3748	
10	600	2.47	6.15	4316	180	4136	
15	900	1.91	4.75	4762	270	4492	
20	1200	1.59	3.96	5155	360	4795	
25	1500	1.38	3.44	5505	450	5055	
30	1800	1.23	3.06	5821	540	5281	
35	2100	1.12	2.78	6111	630	5481	
40	2400	1.03	2.55	6379	720	5659	
45	2700	0.95	2.37	6629	810	5819	
50	3000	0.89	2.21	6864	900	5964	
55	3300	0.84	2.08	7086	990	6096	
60	3600	0.79	1.97	7296	1080	6216	
65	3900	0.75	1.87	7496	1170	6326	
70	4200	0.72	1.79	7688	1260	6428	
75	4500	0.69	1.71	7872	1350	6522	
80	4800	0.66	1.64	8048	1440	6608	
85	5100	0.64	1.58	8218	1530	6688	
90	5400	0.61	1.52	8382	1620	6762	
95	5700	0.59	1.47	8541	1710	6831	
100	6000	0.57	1.42	8695	1800	6895	<==

"1815A" TREATMENT REQUIREMENTS

Minimum "1815A" Volume Required	2,796	cu ft
Provided Treatment Volume - Min.	2,868	cu ft

DRYWELL REQUIREMENTS - 50 YEAR DESIGN STORM

Maximum Storage Required by Bowstring	6895	cu ft
Provided Storage Volume to Inlet - Minumum	11,472	cu ft
Number and Type of Drywells Required	1	Single
	0	Double

NRCS SOILS MAP

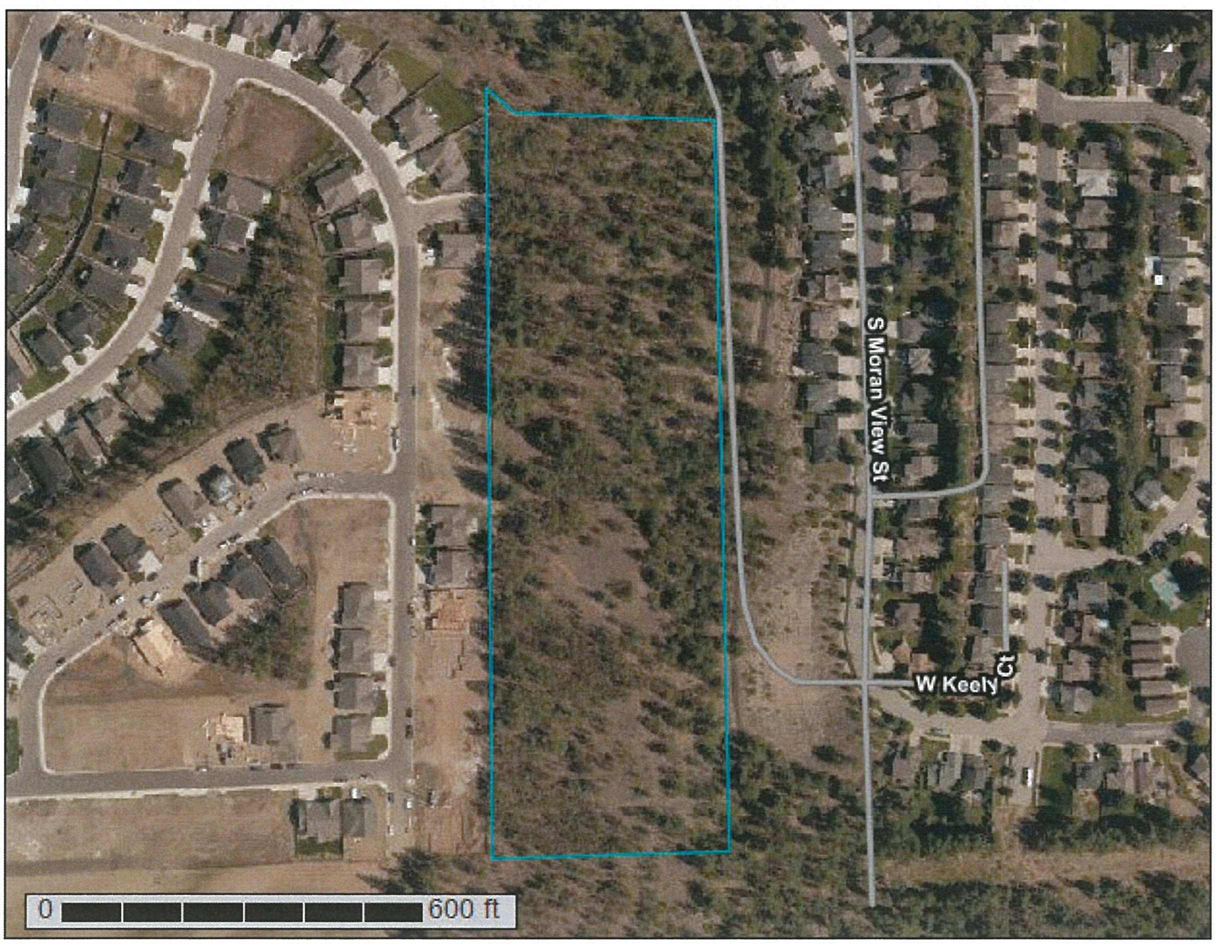
United States Department of Agriculture

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 Spokane County, Washington



March 12, 2020

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 alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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.

Soil Map


117° 25' 7" W
117° 24' 50" W
47° 35' 29" N
47° 35' 13" N
468550
468600
468650
468700
468750
468800
468850
5270960
5270910
5270860
5270810
5270760
5270710
5270660
5270610
5270560
5270510
3600
2046
S Moran View St
Soil Map may not be valid at this scale.
N
Map Scale: 1:2,280 if printed on A portrait (8.5" x 11") sheet.
Meters
0 30 60 120 180
Feet
0 100 200 400 600
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: Spokane County, Washington
Survey Area Data: Version 11, Sep 16, 2019

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

Date(s) aerial images were photographed: Jun 18, 2019—Jul 23, 2019

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
2046	Klickson-Speigle-Rock outcrop complex, 30 to 60 percent slopes	5.5	50.0%
3600	Seaboldt ashy loam, 0 to 8 percent slopes	5.5	50.0%
Totals for Area of Interest		**11.0**	**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.

Spokane County, Washington

2046—Klickson-Speigle-Rock outcrop complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: nv48
Elevation: 1,650 to 2,600 feet
Mean annual precipitation: 18 to 23 inches
Mean annual air temperature: 42 to 50 degrees F
Frost-free period: 90 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Klickson and similar soils: 35 percent
Speigle and similar soils: 35 percent
Rock outcrop: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Klickson

Setting

Landform: Escarpments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with minor amounts of volcanic ash over residuum and/or colluvium derived from basalt

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A1 - 3 to 8 inches: gravelly ashy silt loam
A2 - 8 to 12 inches: gravelly ashy loam
BA - 12 to 17 inches: gravelly ashy loam
Bt1 - 17 to 28 inches: very cobbly loam
Bt2 - 28 to 35 inches: very stony loam
Bt3 - 35 to 50 inches: extremely stony loam
BC - 50 to 60 inches: extremely cobbly loam

Properties and qualities

Slope: 30 to 60 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 (0.20 to 1.98 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 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e

Hydrologic Soil Group: C
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

Description of Speigle

Setting

Landform: Escarpments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with minor amounts of volcanic ash over colluvium derived from basalt

Typical profile

A - 0 to 6 inches: cobbly ashy loam
AB - 6 to 17 inches: very gravelly ashy loam
Bt1 - 17 to 23 inches: very cobbly loam
Bt2 - 23 to 35 inches: extremely gravelly loam
BC - 35 to 44 inches: extremely cobbly sandy loam
C - 44 to 65 inches: extremely cobbly sandy loam

Properties and qualities

Slope: 30 to 60 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
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: ponderosa pine/common snowberry (CN170)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Lacy

Percent of map unit: 5 percent
Landform: Escarpments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: ponderosa pine/Idaho fescue (CN140)
Hydric soil rating: No

Spens

Percent of map unit: 3 percent
Landform: Outwash terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Other vegetative classification: ponderosa pine/Idaho fescue (CN140)
Hydric soil rating: No

Rubble land

Percent of map unit: 2 percent
Hydric soil rating: No

3600—Seaboldt ashy loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: qv8z
Elevation: 2,100 to 2,400 feet
Mean annual precipitation: 18 to 25 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 90 to 140 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Seaboldt and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Seaboldt

Setting

Landform: Outwash plains on plateaus
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Loess mixed with minor amounts of volcanic ash over glaciofluvial deposits over residuum from basalt

Typical profile

Ap1 - 0 to 7 inches: ashy loam
Ap2 - 7 to 10 inches: ashy loam
Bw1 - 10 to 16 inches: loam
2Bw2 - 16 to 23 inches: sandy loam
2C - 23 to 28 inches: extremely gravelly sandy loam
3R - 28 to 38 inches: bedrock

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 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
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Warm Mesic Xeric Loamy Foothills, Terraces, mixed ash surface (Ponderosa Pine/Shrub) Pinus ponderosa / Symphoricarpos albus, Pinus ponderosa / Physocarpus malvaceus (F043AY502WA)
Other vegetative classification: ponderosa pine/common snowberry (CN170)
Hydric soil rating: No

Minor Components

Uhlig

Percent of map unit: 10 percent
Landform: Outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/bluebunch wheatgrass (CN130)
Hydric soil rating: No

Rockly

Percent of map unit: 8 percent
Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: VERY SHALLOW 16-24 PZ (R009XY301WA)
Hydric soil rating: No

Brincken, moist

Percent of map unit: 5 percent
Landform: Outwash terraces on loess hills
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/Idaho fescue (CN140)
Hydric soil rating: No

Fourmound

Percent of map unit: 5 percent
Landform: Plateaus
Microfeatures of landform position: Mounds
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Other vegetative classification: ponderosa pine/common snowberry (CN170)
Hydric soil rating: No

Phoebe

Percent of map unit: 5 percent
Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/common snowberry (CN170)
Hydric soil rating: No

Narcisse

Percent of map unit: 2 percent
Landform: Drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: LOAMY BOTTOM 16-24 PZ (R009XY402WA)
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

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.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

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. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf