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November 3, 2021

Project G201062

PROJECT: Marshall Creek Estates, Spokane, Washington
SUBJECT: Geohazard Evaluation

This geohazard evaluation is a supplement to our geotechnical engineering report (GER) titled *Geotechnical Engineering Report, Marshall Creek Estates, Spokane, WA*, dated May 10, 2021 (S201062).

INTRODUCTION

Spokane County's *Critical Areas Ordinance* (CAO, 2018) requires evaluation of geologically hazardous areas, principally erosion and landslide hazards (Section 11.20.030 Table A, and 11.20.070 d.2). The purpose of the ordinance is to discourage development in geologically hazardous areas unless proponents demonstrate that such areas can be developed consistent to acceptable standards for public health and safety.

Based on this ordinance, geo-hazard areas in Spokane County exhibit at least one of the following characteristics:

A. A slope of 30 percent or greater;
B. Soils identified by Natural Resource Conservation Service (NRCS) *as posing a severe potential for erosion (see Section 11.20.090M Appendix M);*
C. Hydraulic factors such as existing on-site surface and groundwater or changes in hydraulic factors, caused by proposals that create a severe potential for erosion or landslide hazard;
D. Areas that historically have been prone to land sliding or with one of the following geologic formations: alluvium, landslide deposits, Latah Formation;
E. Areas of uncompacted fill;
F. Areas that are unstable as a result of rapid stream or stream bank erosion;
G. Seismic hazards include the following areas identified on the Liquefaction Susceptibility Map of Spokane County, Washington (source: Washington State Department of Natural Resources, Sept. 2004); and,
H. Seismic hazards include the following areas identified on the Site Class Map of Spokane County, Washington (source: Washington State Department of Natural Resources, Sept. 2004):

i. For public buildings and public assembly buildings and uses those areas classified as having a site class of "D."

The following regulations should be used when a regulated use or activity as described in Table11.20.030A or other use or activity determined by the Director subject to the purpose and intent of this section, which lie within geo-hazard areas:

1. Spokane County Code, Title 3 Buildings and Structures, including Chapter 3.20 Flood Damage Protection, or as amended.

2. Spokane County Erosion and Sediment Control Ordinance, or as amended.

If the regulations noted above do not provide adequate mitigation of impacts as determined by the Director, then a Geohazard Mitigation Plan prepared by a qualified landslide, erosion, or seismic specialist shall be required.

PROJECT CONSIDERATIONS

Approximately 120 acres on the south side of Spokane, Washington are proposed for residential development. Current plans indicate the development will consist of 425 lots. Stormwater drainage swales are proposed in the southwest corner of the site. Off-site improvements include a new, 500,000-gallon water reservoir adjacent to an existing reservoir at 1202 W. Eagle Ridge Blvd.

The site consists of parcel number 24015.0041 to the west of the Eagle Ridge housing community. It is bordered on the west side by Cheney-Spokane Road and the Spokane Memorial Gardens cemetery and bordered by Cedar Road on the east side. The physical address for the site is 6321 S. Cheney-Spokane Road. It is in the southeast ¼ of Section 1, Township 24 North, Range 42 East, Willamette Meridian, Washington. The locations are illustrated in the *Vicinity Map* and *Site Plans*.

Previous subsurface exploration of the site was performed by Budinger & Associates, Inc. in December of 2017.

A Budinger geologist performed a reconnaissance of the site on April 1 and 14, 2021. The 120-acre site rises from an approximate elevation of 1,910 feet mean sea level at Marshall Creek in the northwest corner of the site to approximately 2,276 feet at Cedar Rd. in the southeast corner (NGVD 29). The field in the southwest corner of the property consisted of approximately 7 acres of relatively level land, covered in grasses. The rest of the site was hilly and forested with ponderosa pines. Some portions were so heavily forested that equipment access was not feasible without considerable thinning of trees and brush.

The maximum grade in the north-south direction across the site was approximately 22 percent. The maximum grade across the property in the east-west direction was approximately 50 percent. Two main drainages originating east of Cedar cut through the property and generally trended to the west. Seven other tributary drainages intersected the main valleys at various points, resulting in an uneven topography for the majority of the site. Evidence of erosion from steep hillsides into these drainages was apparent.

Avista transmission lines were positioned approximately north-south through the center of the property. Access to the site was in the southwest corner adjacent to the cemetery. Several other dirt roads branched off the main access road, often winding adjacent to the drainage valleys or the powerline cut. Some sections of the deepest gullies were impassible for most vehicles.

Surface soils consisted of a mixture of duff, sandy silt, and silty sand topsoil, often penetrated by tree roots up to depths of 8 feet. The surficial soils were consistent with NRCS descriptions.

Approximately 1 acre along the primitive dirt road immediately south of the cemetery was covered in rubble and trash including cars, farm equipment, tires, headstones, coffins, and other anthropogenic waste. Much of the debris was used to construct a paintball course. A wedge of fill soil, approximately 5 to 10-feet thick and covering an area of approximately 7,000 square feet, was observed between the dirt road and cemetery. Some additional trash piles were observed along the western edge of the site in the vicinity of proposed Rainbow Road on the west side of Cedar.

GEOLOGIC HAZARDS

Reconnaissance associated with the GER, and a review of the GER soil descriptions indicate that the following geo-hazard components of the CAO are present:

1) Areas of undocumented fill;
2) Slopes steeper than 30 percent;
3) Hazardous Geology – Alluvium – Qal; and,
4) Erodible soils.

Undocumented Fill

Undocumented fill was observed in test pit 4 (TP-4) at the western end of Garden Side Road (proposed) in the southwestern portion of the proposed development. The undocumented fill extended from ground surface and extending to 9 feet below ground surface (BGS). The condition was loose to very loose. The test pit embankments caved readily when excavation exceeded 5 feet.

Slopes Steeper than 30 Percent

The maximum grade in the north-south direction across the site was approximately 22 percent. The maximum grade across the property in the east-west direction was approximately 50 percent. Slopes between 30 and 50 percent are isolated to lower drainage slopes.

Hazardous Geology

Hazardous geology is typically associated with having a high susceptibility for landslides. Alluvium is mapped in the southwest corner of the site. Alluvial soils (Qal) are located at the southwest corner of the site. These soils may be subject to slope instability due to high water stream erosion or rapidly water drawdown along slopes steeper than 30 percent.

Erodible Soils

Two main drainages cut through the property and generally trended to the west. Seven other tributary drainages intersected the main valleys at various points, resulting in an uneven topography for the majority of the site. Evidence of erosion from steep hillsides into these drainages was apparent.

CONCLUSIONS

Based on our observations and research of the published information for the site, we believe that the proposed project does not adversely impact the site geological conditions if the recommendations of this report are followed. Based on the GER, it appears that isolated, undocumented fill is present in the described in the *Geologic Hazards* section of this report. This fill should be mitigated if structures or infrastructure are to be built in the area.

Shallow groundwater is not present at the site during the subsurface exploration. Mottling of clay observed in B-1 at 14 to 17 feet BGS indicates that groundwater is present at times in the vicinity of the intersection of the proposed new Cedar Road and Cheney Spokane Road. The Federal Emergency Management Agency (FEMA) classifies the site as an *"area of minimal flood hazard."* Groundwater likely becomes seasonally perched atop *clay* during periods of heavy rainfall and snowmelt.

Water well drilling reports from neighboring properties, obtained from the Washington State Department of Ecology, described groundwater levels beginning at depths ranging from 95 to 135 feet BGS.

Isolated slopes steeper than 30 percent are present at the site. These areas are typically the lower slopes of drainages.

The area mapped as *Hazardous Geology* is in an area of potential flooding which could lead to instability of the alluvial soils. Slopes in this area range from relatively level to 13 percent.

Erodible soil hazards are mapped at the site as shown on the attached *Figure*. The NRCS classifies the erodible soils as Marble loamy sand, 15 to 30 percent slopes (Unit 3122).

A K factor for the Unit 3122 soil is not listed. The estimated erosion hazard for this soil unit is severe due to the slope inclinations and the silt and fine sand elements of the soil.

RECOMMENDATIONS

The recommendations in the GER should be followed to address the geohazards identified in this report. Specific recommendations are as follows.

Areas of Undocumented Fill

Areas of undocumented fill should be mitigated by removal and replacement of adequately compacted structural fill as recommended in the GER prior to construction of structures. Alternatively, structure foundations should extend through the fill into the medium dense or denser native soil.

Slopes Steeper than 30 Percent

Construction on slopes as steep as 50 percent should not adversely impact the site geologic conditions if the recommendations of the GER are followed. The steepest slopes observed at the site were approximately 50 percent.

Hazardous Geology

The hazard associated with the alluvium soil will typically be erosion. This hazard should be mitigated as described in the *Soil Erosion* section of this report and the GER.

Soil Erosion

Soil erosion potential is considered severe through much of the site but should be manageable with typical BMPs and not disturbing slopes when possible. These soils are also susceptible to tracking off site by vehicle traffic in wet conditions. Typical BMPs such as rock armoring of egress points and silt fencing, will address this hazard. These BMPs should be included in the grading and erosion plan for the site.

LIMITATIONS

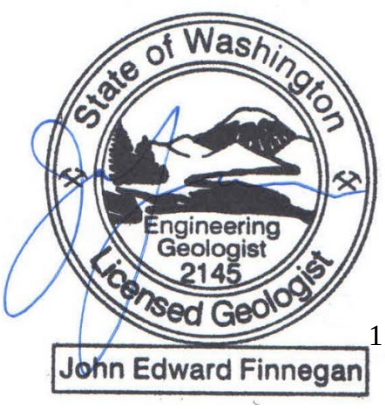
The conclusions presented herein represent our professional opinions based on the limited scope of work performed to date. This report is intended for the sole use of our client for the purposes stated herein and should not be used by other parties for other purposes without contacting us to provide specific evaluation and recommendations. Specific geotechnical evaluation and design for construction is beyond the scope of this report.

We attempted to complete these services in a manner consistent with the level of skill and care ordinarily exercised by members of the profession currently practicing in this area with similar budget and time constraints. No express or implied warranties are offered or made.

Be aware that geohazard evaluation reports do not substitute for a GER to design slopes, walls, roads, utilities, stormwater facilities, structures, and earthwork. The original GER should be reviewed to address such designs.

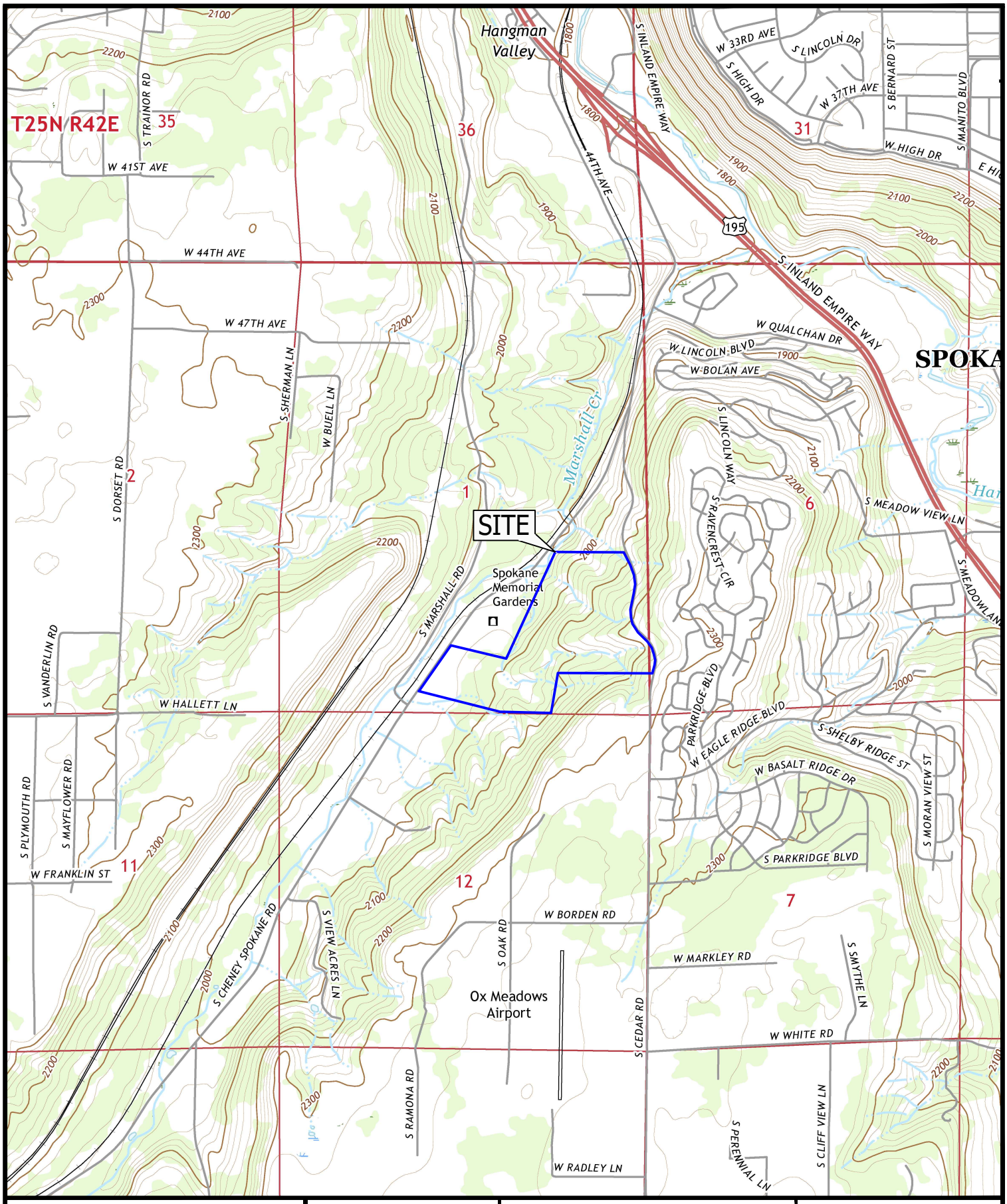
Prepared by:
BUDINGER & ASSOCIATES

John (Hank) Swift, PE, GE
Senior Engineer



John Finnegan, PE, GE, LHG
Principal Geotechnical Engineer 11/03/2021

Attachments
Figure 1: Vicinity Map
Figure 2: Site Plan
Figure 3: Geohazard Map
Figure 4-1 to 4-3: Soil Map Legend



N

SCALE: 1"=2000'

0 1000 2000

SECTION 1
T 24 N R 42 E
USGS 2020

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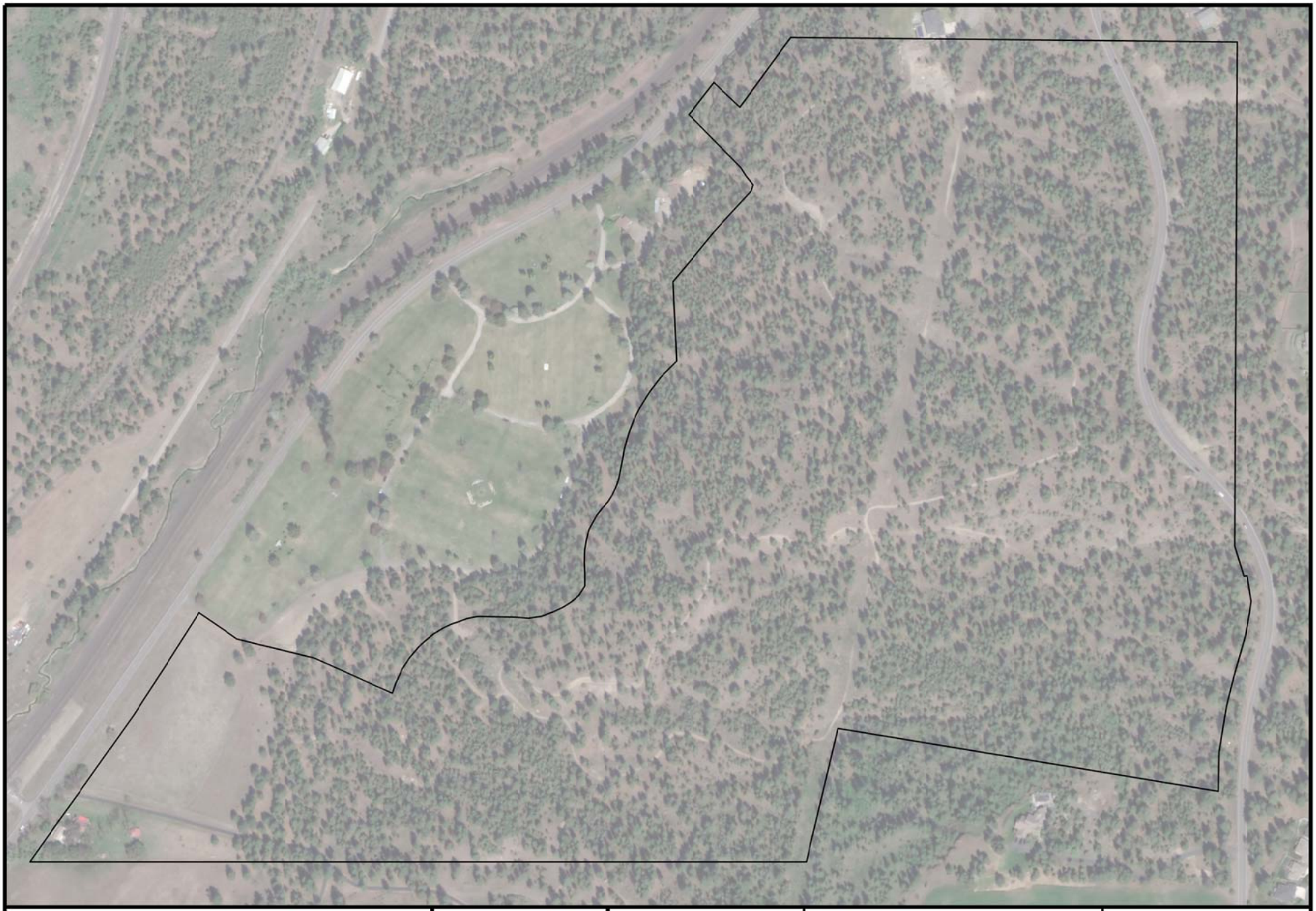
VICINITY MAP	FIGURE 1
MARSHALL CREEK ESTATES SPOKANE, WASHINGTON	PROJECT NUMBER S201062
	DATE: 4/2021



N

SCALE: 1"=400'

0 200 400

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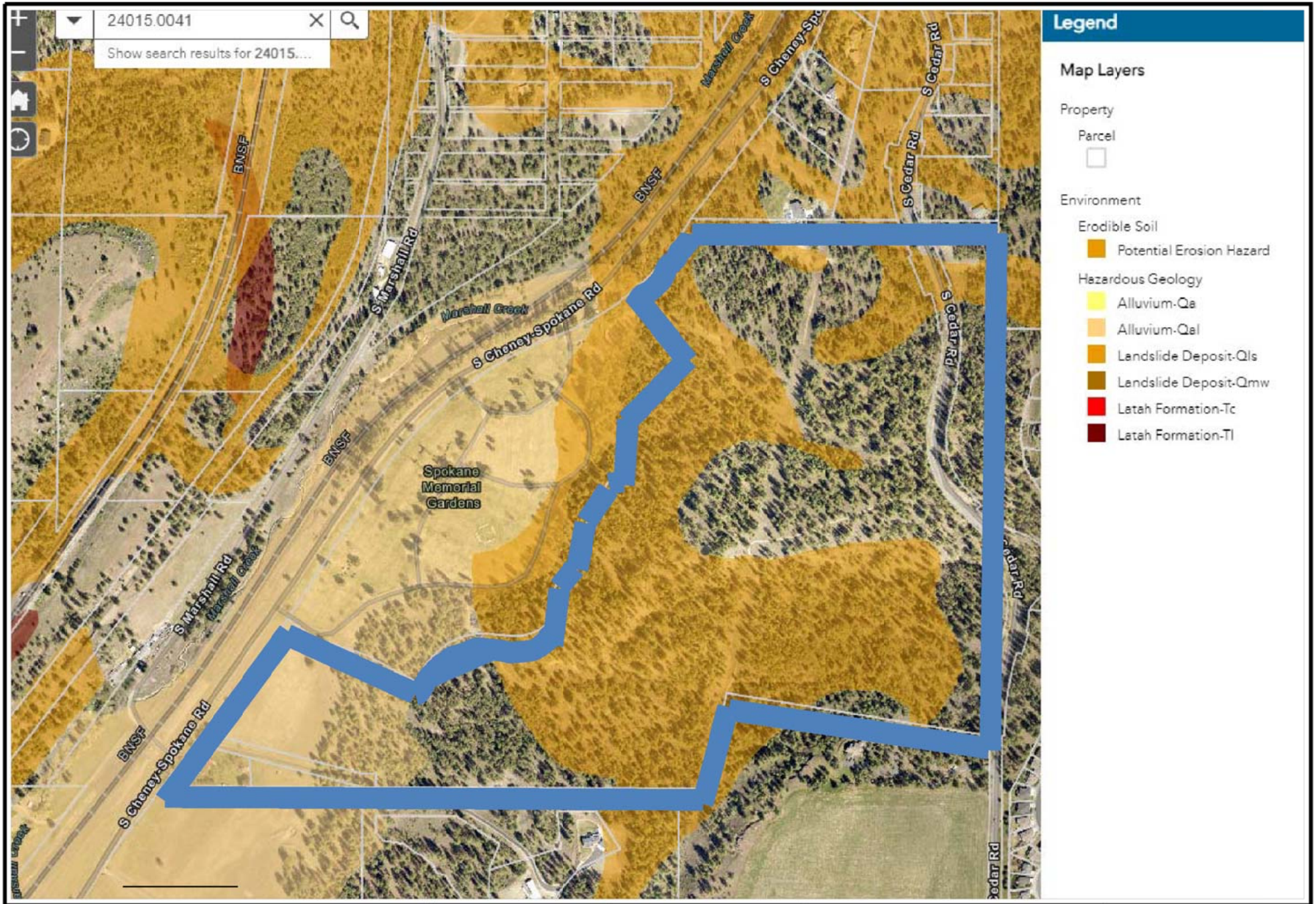
SITE PLAN

MARSHALL CREEK ESTATES
SPOKANE, WASHINGTON

FIGURE 2

PROJECT NUMBER G201062

DATE: 4/2021



N

SCALE: 1"=600'

0 300 600

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EROSIVE/HAZARDOUS SOIL PLAN

MARSHALL CREEK ESTATES
SPOKANE, WASHINGTON

FIGURE 3

PROJECT NUMBER G201062

DATE: 4/2021

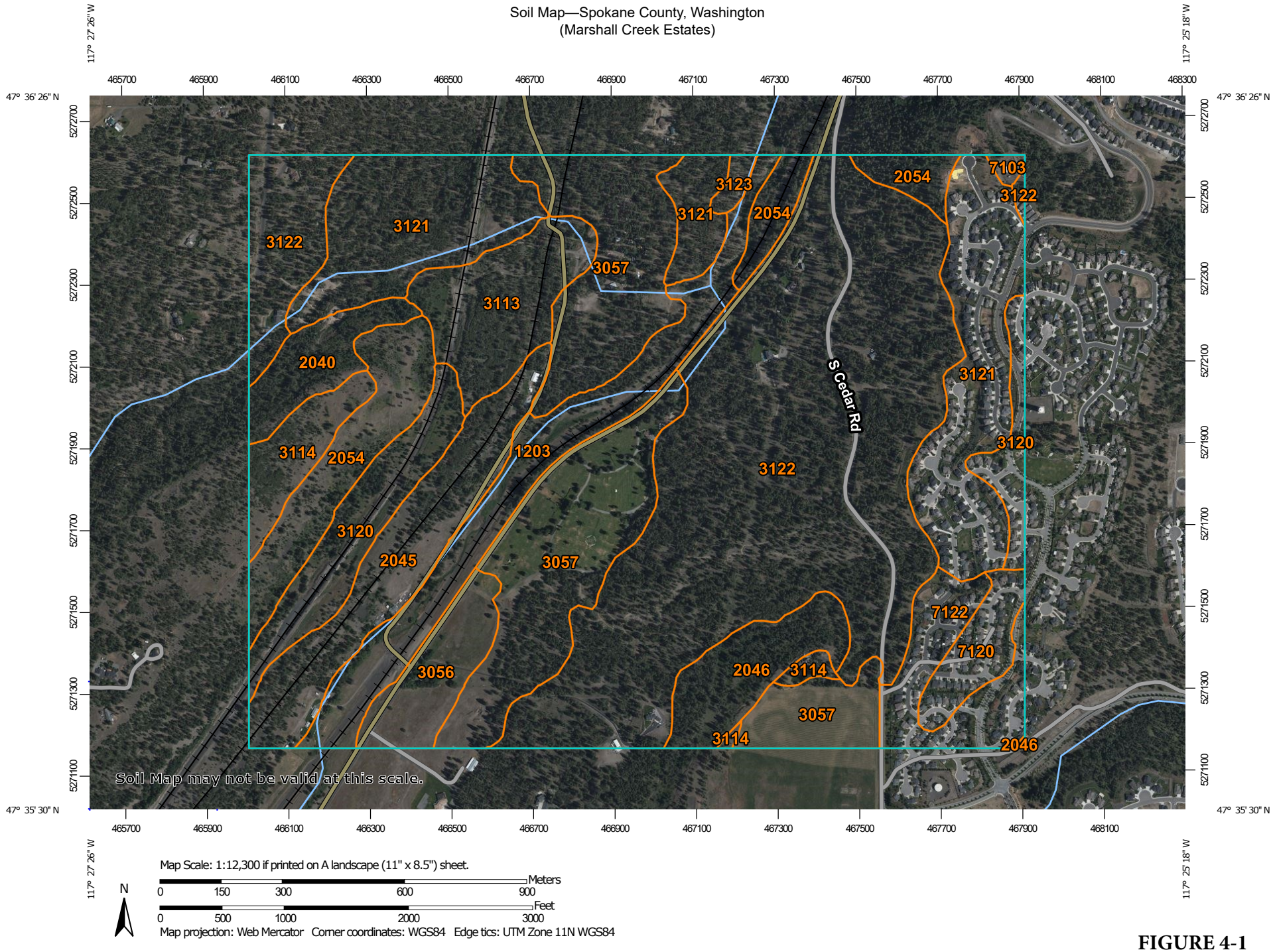
Soil Map—Spokane County, Washington
(Marshall Creek Estates)
117° 27' 26" W
117° 25' 18" W
47° 36' 26" N
47° 35' 30" N
465700
465900
466100
466300
466500
466700
466900
467100
467300
467500
467700
467900
468100
468300
5272700
5272500
5272300
5272100
5271900
5271700
5271500
5271300
5271100
3122
3121
3123
2054
7103
3122
3057
3113
2040
S Cedar Rd
3121
3114
2054
1203
3122
3120
3120
2045
3057
7122
7120
3056
2046
3114
3057
3114
2046
Soil Map may not be valid at this scale.
Map Scale: 1:12,300 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
150
300
600
900
Feet
0
500
1000
2000
3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

FIGURE 4-1

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 13, Aug 23, 2021

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

Date(s) aerial images were photographed: Jul 12, 2020—Aug 14, 2020

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.

FIGURE 4-2

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1203	Haploxerolls ashy silt loam, channeled, 0 to 8 percent slopes	41.8	6.1%
2040	Klickson gravelly ashy silt loam, mass wasted, 15 to 30 percent slopes	14.1	2.1%
2045	Marble-Speigle complex, mass wasted, 8 to 30 percent slopes	37.7	5.5%
2046	Klickson-Speigle-Rock outcrop complex, 30 to 60 percent slopes	19.7	2.9%
2054	Speigle-Rubble land-Rock outcrop complex, 30 to 90 percent slopes	37.3	5.4%
3056	Hagen ashy sandy loam, 0 to 3 percent slopes	17.3	2.5%
3057	Hagen ashy sandy loam, 3 to 8 percent slopes	100.3	14.6%
3113	Stutler-Springdale complex, 3 to 15 percent slopes	28.2	4.1%
3114	Rockly-Fourmound complex, 0 to 15 percent slopes	15.0	2.2%
3120	Marble loamy sand, 0 to 8 percent slopes	32.5	4.7%
3121	Marble loamy sand, 8 to 15 percent slopes	90.5	13.2%
3122	Marble loamy sand, 15 to 30 percent slopes	214.8	31.4%
3123	Marble loamy sand, 30 to 55 percent slopes	2.1	0.3%
7103	Xerolls silt loam, warm, mass wasted, 8 to 25 percent slopes	1.2	0.2%
7120	Urban land-Marble, disturbed complex, 0 to 3 percent slopes	11.5	1.7%
7122	Urban land-Marble, disturbed complex, 8 to 15 percent slopes	21.1	3.1%
Totals for Area of Interest		**685.0**	**100.0%**

FIGURE 4-3