TIOGA APPENDIX: GEOLOGY, SOILS AND EROSION
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Geology of Tioga Creek Subwatershed
The Tioga Subwatershed lies within the Tyee Basin which is part of the Coast Range Physiographic Province of Oregon. The Coast Range Province and most of the Willamette Valley Physiographic Province was part of a large, partially enclosed basin called a geosyncline. A chain of volcanic peaks may have existed west of the shoreline between 80 to 100 million years ago. From them, came vast amounts of submarine basalt flows, breccias, and tuffaceous sediments. The Tyee Basin which comprises most of the southern portion of the Coast Range Physiographic Province, sits atop this basaltic basement rock The Tyee Formation which dominates the basin began to form between 50 and 65 million years ago during the beginning of the Tertiary Geologic Period in the early part of the Eocene Epoch. Western Oregon marine sediments were deposited in a basin with shifting shorelines, widening as the basin sank, and narrowing as deltas pushed out into shallowing waters. Fossil evidence indicates that the climate was much warmer and wetter than today and that large rivers with tremendous volumes of water were eroding the northern Rocky Mountains; transporting the sediment through the Klamath Mountain Physiographic Province and depositing them into that warm sea. The Klamath Mountain Province borders the Coast Range Province on the south and extends into California as far south as San Francisco. From paleiomagnetic, fossil and other evidence, it is believed that all of this deposition and delta building was taking place near the Idaho-Oregon boarder. At this time, this was the western boundary of the continent. The Klamath Provence was transported by plate tectonics and had collided with the north American continental plate some 250 million years ago. Following deposition and emplacement the Klamath Mountain and attached Coast Rang Provence, they were both subsequently torn away and rifted from the rest of the continent and transported to their present position by additional plate tectonics or continental drift.

The Tioga Creek subwatershed is entirely within the Tyee Geologic Formation. This Eocene, sedimentary formation is composed of about 12,000 feet of hard, massive, micaceous sandstones rhythmically interbedded with layers of siltstone. The siltstones are softer and weather more rapidly and more deeply than the sandstones, whereas the hard massive sandstones form ridges and outcropping bands of rock. Some coal seams can be found in this formation. These sedimentary beds are almost entirely flat lying and are mostly impervious to water as they have very little fracturing. Because of this, they store very little groundwater. It is this geology along with climate over time that has created the steep rugged topography of the Tioga Subwatershed. Landsliding (mass movement) is the dominant form of soil erosion in the subwatershed.

The Umpqua River is the predominant river drainage in this portion of the Tyee Basin. Unlike the other coastal streams including Tioga Creek, The Umpqua River is fed by snow melt from the Cascade Mountains to the east. This is why, during the summer months it has a significantly higher flow as compared with the other streams who`s headwaters are in the Coast Range. These coastal streams including Tioga Creek and are not fed by summer snow melt and usually dry up during the summer months.

The potentially hazardous areas within the Watershed, include most all of the steep north facing slopes. They retain moisture longer in the year and therefore tend to erode more readily. Also on hillsides which parallels the strike of the bedding planes and where the steepness of the slopes exceeds the bedding plane dipping angle. Many of the bedrock failures in this vicinity are related to ground disturbing activities on slopes where the slope exceeds the angle of the out dipping bedding planes. Land failures common to this watershed come in the form of soil creep, debris flows, rotational slides, slumps, debris avalanches and rock falls. Any of the catastrophic failure types could contribute large volumes of silt, sediment and other larger material into the surface drainage system of this watershed over a very short period of time.

There are no mining claims or active rock quarries located within the boundaries of the subwatershed. The area is however considered to have a high potential for the existence of oil and/or gas.

Soils and the Potential for Landsliding in the Tioga Creek Subwatershed
High potential - These are steep fragile lands. There are only four soil map units that are in a high landslide potential category. The four combined, with 4,743 acres, make up about 19.2% of the subwatershed. Of these, the Umpcoos-Rock-outcrop on 70 to 99% slopes (58F) has 4,432 acres and is 18% of the subwatershed. Umpcoos soils

are skeletal (>35% rock fragments in the soil profile), and shallow (<20" deep over hard sandstone). Rock outcrop (R) is a miscellaneous land type that has a high percentage of sandstone outcropping but it also includes soils less than 1 0" deep over sandstone. The other soil map units in this class make up only 1.2% of the subwatershed. They include the Digger-Bohannon-Umpcoos on 60-90% (240G) slopes, Damewood-Bohannon-Umpcoos on 60-90% slopes (241G), and Digger-Umpcoos-Rock-outcrop also on 60-90% slopes (437G). Although mapped down to 60% slopes, most of the acreage is in the 80%+ range. Digger soils are moderately deep (20-40") over fractured of weathered sandstone and are also skeletal. Bohannon soils are fine loamy and moderately deep over sandstone or siltstone. Damewood soils are very similar to Digger soils but have a dark, thick surface horizon.

Moderate to High Potential - These soils are on steep relatively fragile lands. There are four soil map units in this category, and with 14,403 acres, making up 58.4% of the subwatershed, it is the largest category. As with the high category, not much of the acreage is in the 60% slopes range; most of it is in the 70-80%+ range. Soil map units include: Bohannon-Preacher-Damewood on 60-90% slopes (311 G); Preacher-Bohannon-Digger on 60-90% slopes (350G), Milbury-Bohannon-Umpcoos on 50 to 80% slopes (38F)-- With 6,292 acres, this unit makes up 25.5% of the subwatershed. And Preacher-Bohannon loams on 60-90% slopes (46F)-- With 7,986 acres, this unit makes up 32.4% of the subwatershed-- the largest soil map unit. Preacher soils are deep (>40" over bedrock), fine loamy soils that are highly productive for timber. Milbury soils are similar to the Digger and Damewood soils, they are moderately deep and skeletal with dark surface soils.

Low to Moderate Potential - These are the soils on mostly medium slopes, i.e. 30 to 60%. They are mostly not fragile. There are seven soil map units in this group and they make up about 10.2% of the subwatershed with 2,563 acres. The two largest map units are 46E, Preacher-Bohannon loams on 30-60% slopes with 1,291 acres and 5.2% of the subwatershed, and 44E Preacher-Blachly on 30-60% slopes with 899 acres and 3.6% of the subwatershed. The other soil map units in this category are Preacher-Bohannon on 30-60% slopes (312F), Digger-Bohannon on 30-60% slopes (240F), Orford gravelly silt loam, 30-60% slopes (325F), Preacher-Blachly-Digger on 30-60% slopes, and Remote-Digger-Preacher on 30-50% slopes (50E). Blachly soils are deep, red, clayey soils that have a moderate hazard for mass movement as rotational slumps or earth flows when disturbed and on the steeper slopes of their range, Orford soils are also deep, clayey soils but they have yellowish brown colors. Like the Blachly series, they are prone to mass movement on the steeper end of their mapped range when wet, and disturbed. Remote soils are deep, and loamy skeletal, but are otherwise similar to the Digger series.

Low Potential - These are mostly deep soils on gentle slopes. They are not fragile and have a low probability for any kind of mass movement, although occasionally when the deep, clayey soils are wet, and disturbed as in road construction, they can move as earth flows or rotational slumps, There are 2,641 acres in this class, and it makes up 10.6% of the subwatershed. These are typically highly productive soils. The two largest map units are Preacher-Bohannon loams on 3-30% slopes (46D) with 1,731 acres, it makes up about 7 percent of the subwatershed. And Preacher-Blachly on 12-30% slopes (44D) has 563 acres and makes up about 2.3% of the subwatershed. The other six map units in this class make up 2.3% of the subwatershed. They are: Honeygrove gravelly clay loam on 3-30% slopes (305E), Preacher-Bohannon loams on 3-30% slopes (311 E), Preacher-Blachly on 12-30% slopes (314E) (Douglas Co.), Orford gravelly silt loam, 3-30% slopes (325E), Blachly on 0-30% slopes (4D), and Remote-Digger-Preacher on 12-30% slopes (50D).

No hazard -These are soils that occur on terraces and floodplains along the main stem of Tioga Creek. They have no mass movement potential, but are subject to flooding depending upon rainfall duration, intensity, and frequency. Flooding frequency is unknown but probably depends on elevation relative to Tioga Creek. There are only two soils in this class, and they have a total of 303 acres mapped for 1.2% of the subwatershed. Kirkendall silt loam (33) has 257 acres and makes up one percent of the subwatershed; Quosatana silt loam (48) has 46 acres and makes up 0.2%. Both of these soils are deep fine silty soils that occur on floodplains and low terraces along Tioga Creek. Kirkendall is well drained and Quosatana is poorly drained, Although alluvium occurs along the creek, this is essentially a bedrock controlled drainage with bedrock at or near the surface. This means that the stream is still down cutting/ degrading rather than aggrading.

	Soil Map Unit	Acres	%	Landslide Potential
4D	Blachly sicl, 0-30%	80	0.3	Low
33	Kirkendall sil, 0-3%	257	1.0	None
38F	Milbury-Bohannon-Umpcoos, 50-80%	6,292	25.5	M-H
44D	Preacher-Blachly, 12-30%	563	2.3	Low
44E	Preacher-Blachly, 30-60%	899	3.6	L-M
45E	Preacher-Blachly-Digger, 30-60%	54	0.2	L-M
46D	Preacher-Bohannon loams, 3-30%	1,731	7.0	Low
46E	Preacher-Bohannon loams, 30-60%	1,291	5.2	L-M
46F	Preacher-Bohannon loams, 60-90%	7,986	32.4	M-H
48	Quosatana sil, 0-3%	46	0.2	None
50D	Remote-Digger-Preacher, 12-30%	58	0.2	Low
50E	Remote-Digger-Preacher, 30-50%	34	0.1	L-M
58F	Umpcoos-Rock-outcrop, 70-99%	4,432	18.0	High
24OF	Digger-Bohannon, 30-60%*	35	0.1	L-M
24OG	Digger-Bohannon-Umpcoos, 60-90%	36	0.1	High
241 G	Damewood-Bohannon-Umpcoos, 60-90%	223	0.9	High
305E	Honeygrove grcl, 3-30%	42	0.2	Low
31 1E	Preacher-Bohannon, 3-30%	95	0.4	Low
31 1G	Bohannon-Preacher-Damewood, 60-90%	2	T	M-H
312F	Preacher-Bohannon, 30-60%	216	0.9	L-M
314E	Preacher-Blachly, 12-30%	23	0.1	Low
325E	Orford grsil, 3-30%	49	0.2	Low
325F	Orford grsil, 30-60%	34	0.1	L-M
35OG	Preacher-Bohannon-Digger, 60-90%	125	0.5	M-H
437G	Digger-Umpcoos-Rock-outcrop, 60-90%	52	0.2	High
	Totals	24,654	100.0	

*Soil map unit numbers 24OF through 437G are in Douglas County, the rest are in Coos County. Some of the same map units were mapped in the two counties but were not combined in this table.

Background Information in the TPCC

Beginning in the mid 1970's, the BLM developed and implemented a land inventory system called the "Timber Production Capability Classification" or TPCC. (Handbook 5251-1, Timber Production Capability Classification, BLM Manual Supplement, Oregon State Office, Coos Bay Edition, May 1986). The original inventory was completed in the mid 1970's, and second generation mapping was completed in 1987. This classification system required an "on the ground" inventory that mapped the capability of all Coos Bay District lands to produce timber. The inventory criteria relied heavily on soil characteristics and associated vegetative types.

Primary emphasis was placed on the capability of a given site to produce timber on a long term (multiple rotations) non-declining basis. A basic premise of the system recognized that not all sites have the same capability to produce timber. (Note: site index also projects what a site is producing or has produced, but it does not address future production or site degradation or enhancement). Another important premise of the TPCC is the recognition that management activities can have a significant impact on whether or not a site can continue to produce a non-declining supply of timber.

This system has extrapolative value to forests in general. As part of the TPCC mapping process, general forest management prescriptions, i.e., logging systems were developed and attached to each TPCC mapping unit. The purpose of these prescriptions is to maintain long term soil productivity by minimizing soil compaction, soil erosion and displacement, landsliding, nutrient depletion, and other adverse impacts on soils. For example, the symbol FGR means Fragile Gradient Restricted. FGR2 soils are shallow to moderately deep and gravelly or rocky, they usually have steep gradients (G), ie 75%+ slopes, and management practices are restricted (R) to protect long term soil productivity.

On the Coos Bay District, the fragile gradient class was further sub-divided into FGR1, those sites that are

moderately fragile, FGR2, sites that are highly fragile, and FGNW, sites that are so fragile (steep, shallow, rocky soils that are prone to landsliding when disturbed) that they are withdrawn from the District's timber base, i.e., they are unsuitable for producing timber in the long term. The TPCC maps along with soil maps are a good representation of the current condition of soils in the subwatershed. TPCC mapping was not done on private lands, but as this subwatershed has about 64% Federal ownership (BLM), the majority of the subwatershed has been inventoried using the TPCC system.

The Tioga Creek subwatershed has a total of 24,678 acres. The BLM manages 15,806 or 64%, total private acres are 8,872 or 36%. There are 206 acres of Rock Outcrop and 2,317 acres of FGNW for a total of 2,523 acres that are unsuitable for timber production on Bureau lands in the subwatershed. These are scattered primarily throughout the central and and particularly the southern part of the subwatershed, and they make up a combined total of about 16% of Bureau lands, or 10% of the subwatershed. There are 4,652 acres of FGR2 lands that make up 29% of the Bureau managed lands in the subwatershed. The rest of the Bureau managed lands, about 55%, in the subwatershed are mostly FGR1 and a small amount are mapped as non-fragile. FGR1 lands occur predominantly on 50 to 70% slopes and have soils that are moderately deep (20-40"), deep (>40"), and some shallow (<20"). They are typically gravelly loams and/or skeletal soils (>35% rock) to clay loams. It is expected that private lands would have similar percentages of these TPCC classes.