

Geohazard Hiking on Cougar Mountain - Keeping Sane in COVID Times

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DRAFT – Comments welcome (tdoe@golder.com)

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Note for All Hikes

This trail guide accompanies a presentation given to the AEG Puget Sound Chapter on January 7, 2021. In addition to an overview of the geology and mining activity, the presentation includes lidar images of the trails with and without the trails superposed (no scale, sorry). It also has photos of the highlighted features and references to downloadable trail maps. The lidar was obtained from the Washington DNR Lidar Portal, which has all the available imagery. The 2016 King County lidar is very impressive showing detail down to the level of the trails themselves.

There are additional maps to a few hikes not discussed in the talk but well worth a try. These are:

- Lakemont Park: Exposures of Blakeley Formation including some coal clasts, the till-bedrock contact, and a lovely waterfall on bedrock. This hike has been added in this guide.
- Wilderness Peak Loop: rock falls and a lot of elevation gain to feel exercised!
- Newcastle Cross Town and Terraces Trails. These connect to the De Leo wall trails inside Cougar Mountain park. Good rock falls and an outcrop of spheroidally (paleo?) weathered Tukwila Formation.

General Health and Safety Notes

The Coal Creek Regional Wildland Park and the Coal Creek Natural Area are public gems worthy of our care. But using them is not without risk. Coal mine gasses and unstable ground are significant hazards for those venturing off trail. Unstable slopes of any kind should be viewed with caution. Wet rocks in creek beds can pose significant slip hazards. Finally, although COVID transmission risks decrease in the out of doors, most people mask up when around others on the trail. This is especially important as the these already popular trails have seen a surge in use during the pandemic. Masking around others not only reduces your risk, but it minimizes the discomfort of your fellow, masked, enjoyers of nature.

A final note, all trailheads have warnings about leaving valuables in cars. On the morning of January 5, I went arrived at Red Town Trailhead and found eight vehicles had smashed windows. There has been a spate of vehicle break-ins even at the most popular trailheads in the past month. It is hard to know how to avoid becoming a victim but leaving valuables at home or taking them with you on your hike is a better bet than leaving anything visible in your car.

Cougar Mountain Geologic Overview

The Issaquah Quadrangle map of Booth (and others, 2006) provides a very good summary of the geology, even though it covers only the eastern portion of the mountain. Cougar Mountain is part of a

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range of hills and low mountains within the Seattle Uplift. The range is informally-named the “Issaquah Alps”, which include Somerset hill and Hilltop, Cougar Mountain, Squak Mountain, and Tiger Mountain.

The Seattle fault, a south-dipping thrust, forms the north boundary of this range. The fault brings Eocene to Miocene volcanic and sedimentary bedrock to the surface in thrust contact with the younger Pleistocene glacial and non-glacial sediments that fill the Seattle Basin to the north. A north-dipping thrust fault, which is a splay of the Seattle Fault, bounds the south side of Cougar Mountain.

Structurally, the Newcastle Hills Anticline defines the structure of the mountain itself; however, the folding is not symmetric to the topography. The fold axis is very close to the southern edge of the mountain. The north limb covers most of the mountain where the bedding has a consistent attitude (north-northwest strike and 40-degree northward dip). The coals seams in the mines, which were very well mapped, are remarkably free of faults, folds, or other structural complexity (Tim Walsh, personal communication).

In addition to the bedrock, glacial till forms a thin veneer over much of the mountain. The lidar imaging clearly shows the overprinting of the north-south glacial sculpting on the west-northwest grain of the north-dipping bedrock.

Stratigraphically, Cougar Mountain has three main units. From south to north these are the Tukwila, Renton, and Blakeley Formations. The Tukwila Formation (mid-Late Eocene) consists of conglomeratic rocks derived from intermediate volcanic sources along with some clastic sedimentary rocks and thin tuffaceous layers. Overlying the Tukwila is the late Eocene Renton Formation consisting of continental fluvial sandstones, siltstones, and shales with interbedded coal seams. Renton also appears in a small area at the southern edge of Cougar Mountain, where they are steeply dipping and in fault contact with Tukwila Formation. Blakeley Formation shallow marine sedimentary rocks of Oligocene age underly the northern portion of the mountain. Road cuts along Newport Way west of Lakemont Boulevard provide the best Blakeley exposures. A small area of Miocene sediments and tuffaceous materials appears at the north edge of the mountain between I-90 and the Seattle Fault.

Cougar Mountain was a major center of coal mining activity over a one century time span from the 1860s to the 1960s with the main heyday occurring between 1890 and 1925. The main areas of mining activity were centered on the Newcastle and Coal Creek town sites in the west and central part of the mountain, respectively. Smaller coal seams were developed from the east at the Queen No.1 mine and the May Creek Mine in the small area Renton Formation on the south side.

Hike #1: Sky Country Trailhead

Approximately 2.3 miles. Allow about 1 ½ - 2 hours.

What to See: Dipping beds of Renton Formation, source of Coal Creek at Klondike Marsh, mine shaft, sinkholes, sinkholes, sinkholes.

Navigate to the Sky Country Trailhead. This is the site of a post WWII air defense base, now integrated into the Cougar Mountain Regional Park.

From the north side of the parking lot, look for the Clay Pit Road. When Mutual Materials was in operation until about 15 years ago this road carried clay from the pit to the brick plant. You can see rejected brick being used for trail base here and many other trails.

First stop of interest is the outlet of Klondike Swamp. This appears on many of the old mine maps as the Klondike Hill reservoir. While originally human-made, beavers are currently doing the maintenance -- note their typical construction materials. Also note the dead trees which may have established themselves in the time between the maintenance handoff from the humans. King County has recently completed a new culvert, or "beaver deceiver", that maintains the drainage despite the beavers' efforts to block it (Lundahl, 2018).

Continue on to the clay pit. Along the right side of the road gullying exposes Renton Formation. Once you arrive at the clay pit note that this area is being reclaimed and try to not to avoid disrupting the planted vegetation. When it was operating the entire pit floor was a vast exposure of Renton Formation -- sandstones, siltstones, and clays, thin bedded and fluvial in origin. You can still see these rocks in gullies. Across the clay pit is a large dip slope exposure with three fracture sets. One continuous running straight up the slope and one perpendicular and truncated against the first set.

Backtrack along the Clay Pit Road and look for the Mine Shaft trail on the left. Take this trail a short distance to a grate-covered vertical shaft. This is one of three preserved mine accesses on Cougar Mountain. The opening here was for ventilation and unlike most other mine openings is a vertical shaft rather than an incline along the bedding. The other two preserved openings are the Ford Slope (Hike #3) and another air access along the Coal Creek Trail, across Lakemont Boulevard and just downstream of the Red Town trailhead.

Return to the Clay Pit Road and continue back towards the trailhead until you see Fred's Railroad Trail going off to the left. Take that trail a short distance to the By-Pass Trail and follow that to its intersection with the Cave Hole Trail. From here we will pass by numerous sinkholes that are developed over in the Bailey and Muldoon seams.

Continue on the Cave Hole Trail to its intersection with Nike Horse Trail. There are some well-developed sinkholes on the right as you make the turn. Follow the Nike Horse Trail back to Sky Country Trailhead.

Hike #2: Lower Washout Way and Primrose Loop

Approximately 3 Miles, Allow 1 ½ to 2 Hours

What to See: Erosion undermining slopes in till; shallow landslides in till, exposures of Renton Formation (lots of coal in the creek bed), Newcastle King Mine.

I recommend starting this hike where Forest Drive SE crosses Washout Creek. From Coal Creek Parkway (head east on Forest Drive SE passing on the left Somerset Drive SE and then Highland Drive SE. Shortly after Highland Drive, Forest Drive crosses Washout Creek. I suggest passing here, making a U turn when convenient and park on the westbound shoulder. There is room for a couple of cars to park. The trail is clearly marked with the blue City of Bellevue signs at the top of stairs leading down to the creek. You can also take this trail from the Coal Creek Trailhead on Coal Creek Parkway and take a side trip of the Lower Washout Way Trail. If you take that option, be aware one cannot turn left into the trailhead parking, so if you are coming from north (I-405) you will need to find a place to turn around and

approach the turnoff from the south. The city is redoing the sewer lines in this area, and the Coal Creek Trailhead may have some intermittent closures.

Assuming you are starting from Forest Drive, start hiking a short distance up the creek noting the excellent till exposures where the creek is undercutting of the steep slopes to make shallow caves. This is likely due to the stream action, but once a hollow gets started it may be aided by stress concentrations around the edges. The erosion creates overhangs, some of which are collapsed.

Go back downstream and take the underpass to the other side of Forest Drive. You can see more undercutting along the opposite side of the creek in the till.

You will soon see trail sign noting a spur to SE 59th St going off to the left. Just down stream there is a large slope failure in the till the extends to the top of the slope just to the edge of the trail. This mass failed in November 2019. Vegetation has begun to obscure the surface, but it should still be clear.

Continue down Washout Creek until the trail takes a left turn over a bridge. Continuing straight takes one on a spur trail to SE 57th St. As you cross the bridge you go up a stairway to a platform from which the trail takes a left turn. Look straight from the platform, the railing is clearly comprised of newer wood, as the trail used to go straight here along the topographic contour until a shallow slide took out the slope and some sewer pipes. The trail now goes over the top of the slide. A short way further there are some log fences on the right where you can look down into Washout Creek. During winter month you can see Renton Formation along the creek bottom where it has been sculpted into pools and waterfalls. The till-bedrock contact was just downstream of the last bridge crossing.

The Lower Washout Way Trail ends with its intersection at the Coal Creek Trail at the bottom of the slope. As an option and can turn right, cross the Washout Trail bridge, and look up the creek to a waterfall, which is visible in winter when the leaves are down. Our main route goes left on the Coal Creek trail and in a short distance you should notice the trail covered in sand. This sand comes from a slope failure above not far from where we peered down into Washout Creek. The lidar shows a small retention pond, though the failure appears to be in the glacial material. On your return you can look at the head scarp, but one should be very careful. A safer way to get a closer look would be to follow the sand to its source from below. This failure occurred in November 2019. Over the summer of 2020 it partly revegetated, but fresh sand on the trail in this winter suggests more material is washing out of the slope.

You will cross a bridge over Coal Creek, and start climbing soon reaching the Primrose Loop, which goes off to the left. This loop takes you back down to creek level, and you soon see excellent exposure of Renton Formation, mostly sandstones, in the creek bottom and the north wall of the creek. While you are still on the south bank of the creek, keep your eyes out for a steeply dipping coal (or carbonaceous rock) layer crossing the creek on the left. There are numerous spots along the creek for picnicking or contemplating nature along this stretch of the creek. This trail was heavily redone and reopened several years ago. Admire the handiwork of the bridge builders!

You will pass Sandstone Falls on your left, and then cross the creek and start climbing up from the creek bed. At the top of the section of stairs, you can look across the gorge to the site of the Newcastle Mine, one of the smaller and later operations. It was not nearly as big as the Newcastle mine operations that underly the south slope of Coal Creek's gorge to the south of here. With some imagination you might

make out the portal. Be satisfied with that view as bushwhacking is not recommended especially with methane-emitting mine openings. This is Scalzo Creek, named for the mine operator. The creek sometimes flows very red in winter, possible from iron-fixing bacteria that like the abandoned mine environment.

The mine clearly extends under later-built housing developments. Harvey Manning (1985), who was the late force behind Cougar Mountain's preservation, describes the opening of a forgotten air shaft in a suburban backyard.

Early - and now replaced - trail signs described the operation as the Scalzo Mine. There is little evidence of the mine today except for some waste rock, a set of mine car wheels embedded in a now-mature tree, and a lot of coal in the creek bed. The mine accessed the Primrose Seam (highest seam stratigraphically) via a rock tunnel cut into the slope. From there it spread east and west into mine workings in the coal. The coal exited the mine at the rock tunnel portal and then went by cable (?) to the top of the south slope of the creek gorge where it was sorted and graded in bungers and prepared for transport to Seattle. As you climb the south wall of the Primrose Loop you pass by a pond that was part of farm, likely run part time by a miner and his family. Turn right when you reach the Coal Creek trail and look for a small road with a chair across it on the right. This follows the access to the mine's surface operations and affords a nice look into the gorge at its end. The view gives one an appreciation of the trouble the operator went to getting the coal up to the bunkers, of which no trace remains.

Continue back on Coal Creek Trail back to Lower Washout Way Trail. Turn right to return to your car if you parked on Forest Drive or go straight if you parked at the Coal Creek Trailhead.

Hike #3: Red Town and Coal Creek Falls Loop

Approximately 3 Miles, Allow 1 ½ to 2 Hours

What to See: Ford Slope, rockfall in Tukwila, Coal Creek Falls, sinkholes.

If there is a classic Red Town hike, this is it! Red Town was one of three neighborhoods in the mining community of Coal Creek centered here, the others being Finn Town and Rainbow town. This was the terminus of the railroad which took coal and passengers to Seattle along a grade that today supports much of the Coal Creek trail. The 2020 edition of "The Coals of Newcastle, A Hundred Years of Hidden History" is an excellent account of the town, its life, and its work.

This hike does not include anything from the area downstream and across Lakemont Boulevard from the trailhead; but, if you are new to Cougar Mountain, the trails and explanatory displays are excellent. A short hike takes in a lovely waterfall cascading down a face of till to the bedrock contact, a sealed airway access, remains of mine and train operations, and the cinder mine, which contains the fused remains of spontaneously combusted coal wastes.

There are three places to see coal in place. One is on one the other side of Lakemont where you can see it on a vertical slope along the northeast bank of Coal Creek and visible from the interpretive loop trail. A second is along the Bagley Seam Trail, which follows a cut along the strike of the coal seam, but mostly you will see small shards of coal. Third, and best kept secret,

is on the small creek that passes under the parking lot from the east side where the Military Road Trail starts. You can take this trail a short distance, and some 30 yards or so after it starts climbing away from the creek bed, look for a convenient spot to work your way back to the creek. On the north bank under some ferns, you should be able to find a coal-sandstone contact. The coal seam crosses the creek a little upstream of here. The water in the creek is not deep, even when it is flowing strongly, but wear waterproof footwear to stay dry, or visit this seam at the end of the hike when you do not mind having wet feet.

After leaving the coal seam, take the Wildside trail from the parking lot. In a short distance you will reach the Bagley Seam Trail, which we can take if you have seen the Ford Slope already or continue the Rainbow town trail and turn left to walk past the Ford Slope, which about 1905 and took advantage of electrification and modern pumping to modernize the mining operation and allow to tap deeper parts of the coal seams that required pumping of the water. There is an excellent exhibit here. Just beyond the Ford Slope portal on the left is the foundation of a fan house for ventilation. It is tempting to ascribe the tilt of the concrete slab to mine subsidence, but Eva Lundahl in her "14 Shorter Trail Walks in and Around Newcastle" states this was the site of some post-mining detonation practice.

Continue up to the Red Town Trail on either the Bagley Seam or Rainbow Town trails and turn right. Shortly before you reach Coal Creek, you imperceptibly cross the Renton-Tukwila contact. After crossing the creek, the Red Town Trail becomes the Indian trail, which soon makes a left turn, the straight path being the Marshall's Hill Trail, which continues to the De Leo wall, a southwest facing cliff of Tukwila rock with views. As you follow the Indian trail over a well-graveled section of former quagmire, you are crossing a low divide between the Coal Creek drainage to a marshy area which is the source of creeks draining into to May Creek on the south side of Cougar Mountain.

Before reaching the Quarry Trail, a low outcrop of Tukwila looks like a big jumble of rocks. This outcrop was called a quarry by Harvey Manning, the late and well-beloved leader of efforts to preserve Cougar Mountain, because that is what it appeared to be to him. The "Quarry Trail" refers to this site. But there is strong evidence to suggest this is not a quarry but a natural rock fall. Among the evidence arguing against a quarry being here is the absence of any signs of blasting such as half-round blast holes or shattered rock. Furthermore, it does not appear the rock is in dimensions appropriate for any practical use, which is the goal of blasting in a quarry – not too big and not too small. Furthermore, most of the rock appears to still be at the site.

There are three parts of this outcrop. One is the back wall, which is formed from a vertical fracture and where the rock is intact and in place. The second on the left (north) side of the outcrop there are several blocks in a diamond-shaped wedge that have displaced from the back wall and one another but are still in their original relative positions. The rest of the site consists of blocks that have displaced from the back wall and are mostly no longer in contact with their original neighbors.

Some preliminary work on the fractures and bedding partings suggests that this rockfall, if we can call it that, did not fail due to gravity alone. It needed some help. We do know that earthquakes trigger rockfalls and experience from the 2008 Sichuan earthquake not only were there rock falls, but some boulders and material was “ejected”, that is, it went airborne (Yuan and others, 2010). A terrifying thought indeed! There are other rock falls in the Issaquah Alps. Two are on Cougar Mountain, one on the southeast side along the Whittaker Wilderness Trail and the other on the southwest side near the De Leo Wall, along the City of Newcastle’s Terraces Trail. Both have sources in cliffs of Tukwila Formation, but they differ from the quarry site in that the slopes are steeper, and the cliffs are taller, so the rock fall material has moved some ways downslope. In addition to these Cougar Mountain rockfalls, Tiger Mountain has talus caves, where the rock fall blocks, again in Tukwila, are the size of small buildings and the gaps between the blocks are large enough for a human to crawl through. The Tiger Mountain caves are reminiscent of the famous talus caves of Pinnacles National Park in California, where the rock falls were caused by earthquakes on the adjacent San Andreas Fault.

The rock blocks at the quarry are on a gentler slope, so they have not moved as far as Cougar Mountain’s other rockfalls, and some groups of blocks have remained relatively intact. An assessment of displacements between the blocks may yet show there has been vertical motion, which would indicate that accelerations may have exceed 1g in an earthquake. So much for arm-waving.

Before leaving this topic, another hypothesis to be explored could be glacial plucking with much transport away from the outcrop.

Spend some time here and form your own opinion!

After a long and contemplative visit to the “quarry” continue a short distance on the Indian Trail and take a left turn up the Quarry Trail. Work your way through the switchbacks up to the intersection with the Coal Creek Falls Trail. Turn left and descend back to Coal Creek and what is perhaps Cougar Mountains greatest natural wonder. Coal Creek Falls. Snoqualmie it is not, but it still a quite satisfying especially in winter when flows are strong. Like the quarry, the falls rest on a base of Tukwila Formation.

Continue on Coal Creek Falls trail to its terminus at Cave Hole Trail. Somewhere on this leg you again imperceptibly crossed the Renton-Tukwila contact. On the lidar image you can see sinkholes around the end of the trail somewhere back in the blackberries, but there is no need to go looking for them, because you will see a sinkhole or two close to the trail as you descend back towards Red Town. Look for some small exposures of sandstone in the roadbed. The Cave Hole Trail makes a right-angle left turn and passes more sinkholes, which are clear in the lidar image, as it approaches the Red Town trail to take you the short distance back to the trailhead.

Hike #4: Lakemont Gorge and Lewis Creek Loop

Approximately 2 Miles, Allow 1 to 1 ½ Hours

What to See: Blakeley Formation, Till-Bedrock Contact, Waterfalls

The best place to see Blakeley Formation is on the Newport Way roadcuts west of the Lakemont interchange on I-90. Newport Way parallels I-90 on the uphill, south side. But the roadcuts are not a great place to hike so we will focus our attention on nearby Lakemont Gorge, which is an impressive ravine on the north side of Cougar Mountain.

The starting place for this hike is either Lakemont Park, whose entry is on Village Park Drive just off Lakemont Boulevard just south of the Lakemont shopping center, or the shopping center, which has a bridge from its parking lot, over the ravine and into the park.

Once in the park work your way around the retention basin and baseball field to the start of the nature loop trail, which has the emblematic blue-green Bellevue trail sign on a vertical post. After a short distance you can take either of the unmarked forks of the nature trail loop, though the left fork gets you more directly to the start of the Lewis Creek Trail which takes you down into the gorge.

When you reach the creek, the trail takes a right but there is a lovely view of glacial boulders as you look up the creek, as shown in the introductory slide of this hike. If you go around the corner up the creek just a short distance you can see a nice exposure of Blakely formation.

In a short distance you will come to a bridge across Lewis Creek. On your left before you cross the bridge is more exposure of Blakely as well as glacial till. After you cross the bridge, look to your right across the creek to see a bedrock surface in the creek bed and the glacial till in the creek bank showing that this is the till-bedrock contact. We are a little more than half a mile into the hike at this point.

As you work your way downstream enjoy the natural setting, some slope failures in the walls of the gorge, and the creek with its rock bed and small waterfalls. Also note the impressive effort that went into building this trail! After you to walk down a very well-constructed staircase, note some iron-stained weathered material in shallow slope failures across the creek.

You will soon reach the creek crossing. As you cross the bridge note some shallow failures in till on your left just downstream, and then start your climb out of the gorge.

The next trail sign as you approach the rim points to 175th Pl. SE to the right. if you are in a hurry you can turn right here and go back to Lakemont Park. But for a slightly longer walk you get a nice waterfall by continuing continue straight ahead. You reach this lovely waterfall, cascading down the bedrock surface at about approximately 1.2 miles into the hike at this point.

As you continue along the creek above the waterfall you will approach a pedestrian bridge that crosses the creek. A trail goes off to the left, but you will continue straight and take the bridge to your right. When the trail ends at a street, turn right towards the cul-de-sac and look for the paved continuation of the trail on the left with the Bellevue trails sign directing you back to Lakemont Park. Work your way around the ballfield and retention basin to return to the parking.

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