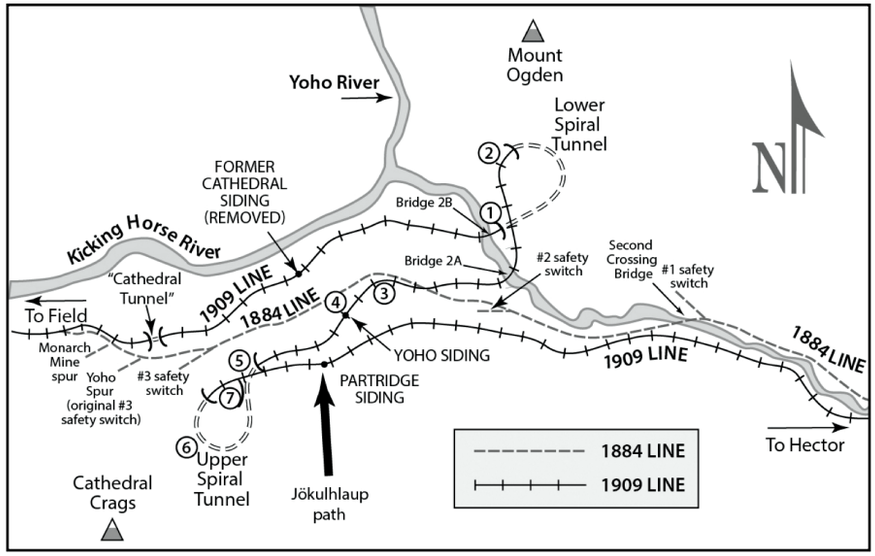


The Big Hill grade and the Spiral Tunnels. The circled numbers are keyed to the text below. The route of Highway 1 approximates that of the "1884 Line."

How The Spiral Tunnels Work

Eastbound from Field, a train climbs 5.5 miles along a 2.2 percent average grade (maximum 2.4 percent) to the lower portal of the Lower Spiral Tunnel in Mt. Ogden – known to CPKC as "Tunnel #2." This takes approximately 15 minutes. En route the train passes through the 131-foot long Day's Tunnel in Mt. Stephen, the concrete 492-foot long Mt. Stephen snowshed (map, p.10), the 179-foot long Cathedral Tunnel, and crosses the 225-foot long Kicking Horse River bridge 2B. The train then negotiates the 2,922-foot long Lower Spiral Tunnel, completing two-thirds of a circle **(1)** on an average grade of 1.62 percent. It emerges from the upper portal 52 feet higher, heading south **(2)**. After crossing Kicking Horse River bridge 2A, the track curves southwest. The train thunders by beneath the viewpoint on Highway 1 **(3)**.

West of the viewpoint, the train passes Yoho siding and goes out of view beneath a highway overpass **(4)** to the lower portal of the Upper Spiral Tunnel **(5)**. There are 1.7 miles of track between the two tunnels. The train negotiates the 3,255-foot long Upper Spiral Tunnel (known to CPKC as "Tunnel #1") within the lower slopes of Cathedral Crags on an average 1.66 percent grade, completing three-quarters of a circle **(6)**. It emerges eastbound from the upper portal 55 feet higher **(7)** and visible again from the viewpoint on Highway 1. The train is now paralleling the original railway grade, constructed in 1884. Between the old Cathedral siding and Partridge siding, (below and above the Spiral Tunnels), the railway line climbs 488 feet in 4.9 miles, at an average grade of 1.88 percent. Westbound trains reverse this sequence.

If placed portal-to-portal the Spiral Tunnels would create a shape much like a figure-eight. "Spiral" means that trains gain or lose elevation as they trace the figure.

As many as 30 trains pass through the Spiral Tunnels daily. However, there can be long waits between trains; so if you have the time, be patient. You can best appreciate the Upper Spiral Tunnel from the viewpoint at km 2.3 on the Yoho Valley Road. The road receives no winter maintenance. It is generally open from June to October.

*There are three levels of track on the grade east of Field. "Level one" is the 4.9 miles between Field and the Lower Spiral Tunnel. It crosses Kicking Horse River bridge 2B **(1)**, from where track leads to the lower portal of the Lower Spiral Tunnel, **(2)**. The upper portal of the Lower Spiral Tunnel is **(3)**. "Level two" is the 1.7 miles of track between the Spiral Tunnels **(4)**; including Kicking Horse River bridge 2A **(5)** and Yoho siding, out of view to the left. Photographer Byron Harmon was standing just above "level three," the section of track **(6)** east of the Upper Spiral Tunnel, including Partridge siding. CPKC employees sometimes refer to the three levels as Cathedral, Yoho, and Partridge, after their respective sidings (although Cathedral siding was removed in 2020). The straight-line distance between the camera and **(1)** is about 2,460 feet. The elevation difference is about 488 feet, whereas the distance along the track is about 4.9 miles – an average 1.88 percent grade.*

*In the background you can see steep cliffs on the southwestern flank of Mt. Ogden. It was this terrain that deterred the CPR from "looping" the track into the Yoho Valley to reduce the grade. The lead locomotive of Train 301 derailed at bridge **(5)** in February 2019. (See pp. 124-27.)*

Helpers, Roadies, Robots, Slaves, and DPUs

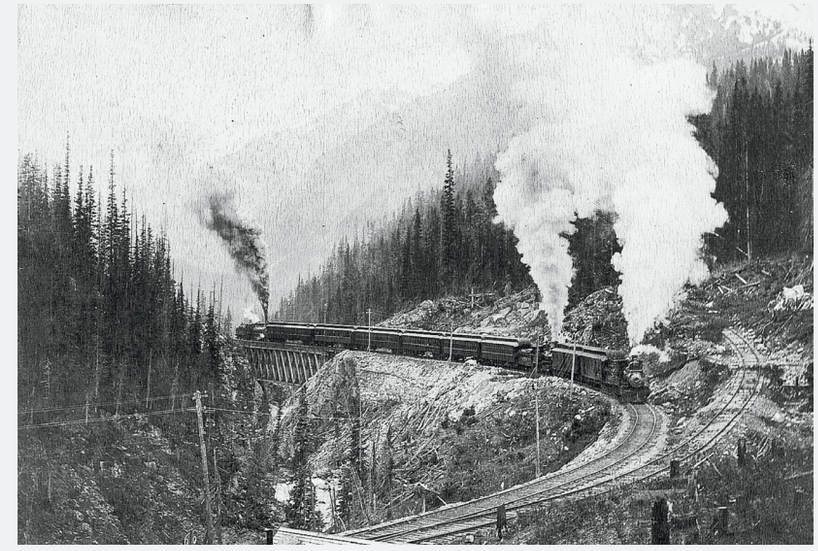
Locomotives added to a train specifically to assist with climbing or descending a grade are known as helpers in Canada, as pushers in the US, and as bank locomotives in the UK. CPKC no longer operates a helper locomotive fleet. Extra locomotives are only added to trains already underway as special duty or to assist when assigned locomotives break down.

Nonetheless, steep grades require that trains be assembled with multiple locomotives. Train crews have nicknames for these units, depending on where the engines are coupled. Road locomotives are those at the head end. The unit out front "rides point." In the steam era, an engineer, brakeman, fireman, and conductor usually worked as a team, assigned to a particular locomotive. As the number of locomotives and the frequency of traffic increased, this tradition ended, but the engineer assigned to a train would often arrange the road locomotives. For instance, he might have put a cleaner-burning unit on the point. Contemporary engineers may also arrange the lash-ups, but for different reasons – some locomotives have better sight-lines to the rear, making it easier for the crew to monitor the train. CP Rail removed cabooses from regular service in 1990. The conductor now rides point.

A largely forgotten detail is that, in the days of steam, helpers could prevent runaways on trains headed *uphill*, by holding a train on the grade if the road locomotive became disabled. With the advent of diesel-electric locomotives, helper units placed mid-train for the entire run through the mountains were first known as robots, then as slaves, and now as DPUs (distributed power units). These un-crewed units, first introduced in 1967, are radio-controlled from the point using a General Electric system called Locotrol. DPUs can be run in conjunction with the lead locomotive, or – depending on the age of the hardware – independently. From the 1970s to the 1990s, most of CP's DPUs were in the SD40-2 class; easily recognized as their windows were often covered. With the advent of the more powerful locomotives, it is now common to see only two or three units (typically SD70ACU, AC-4400CW(M) or ES44AC) assigned to mountain grades. Often, this is one or two road locomotives and one DPU mid-train or at the rear, or sometimes, one locomotive in each position.

"Desert Sand,"
Locomotive 7021, SD70ACU

Organizing the Help



This view from 1898 shows an eastbound passenger train of seven cars powered by three locomotives as it crests the Big Hill at the #1 safety switch. The roof of the switchman's house is in the foreground. The #1 runaway spur is to the right. A baggage car separates the road locomotive from the first helper. The rear helper is on the Second Crossing of the Kicking Horse River. The vertical steam plumes indicate a stationary train, held for the photographer. The fireman of the rear locomotive has just shovelled coal to produce the black plume. Getting this train going again on the 4.5 percent grade would have consumed a great deal of coal and water.

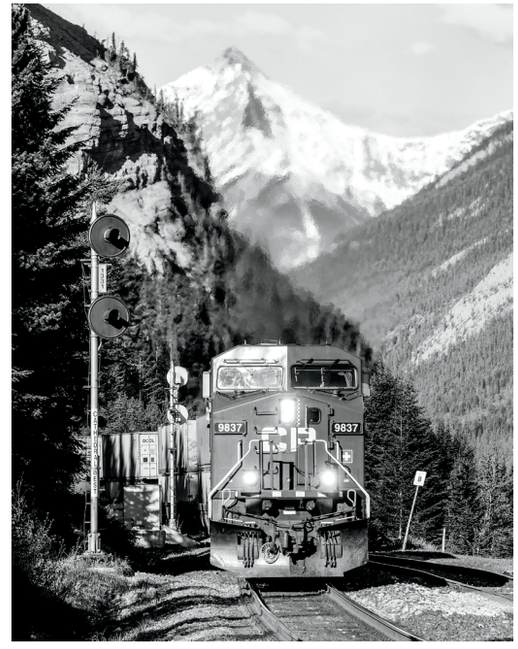
Eastbound trains of five cars or more required a road locomotive at the front and at least one helper locomotive to the rear on the Big Hill. During the first two decades of operations, the CPR coupled the rear helper ahead of the caboose. A helper consumed 7 tons of coal on the round trip up and down the Big Hill. The fumes and smoke made life unpleasant for the conductor and rear brakeman in the caboose, but the arrangement created a far more serious hazard.

If the coupling ahead of the rear helper locomotive disengaged, or if the road locomotive lost power, the rear helper could ram through the cars ahead. Once this lesson had been learned the hard way – fortunately on a freight train – it became practice to couple the rear helper behind the caboose. When air brakes became the norm, the brakes on the rear helper were linked to those on the road locomotive, allowing its engineer to have some control over the rear helper. The CPR often split passenger trains of more than five cars to avoid the dangerous necessity of having to add a second helper, mid-train. If the yard marshall did add a helper there, he often placed a baggage car or mail car ahead of it to protect the forward passengers and crew, as in the above photo.

Two AC4400CW locomotives, 9836 assisted by 8549, power an eastbound intermodal "stack" train up the Field Hill, 1 mile east of Partridge siding, June 1, 2008. The sign indicates mile 125.7 of the Laggan Subdivision, as measured from Calgary. 9836 was delivered to CP in 2004. 8549 was in the first batch of AC4400CWs, delivered in 1998. These units, and the one pictured below, will be among the last of their model to be converted to AC4400CW(M), or otherwise rebuilt or retired.

AC 4400CW locomotive 9827, heads a westbound freight about to cross the Blue Creek bridge east of Wapta Lake. The locomotive has just pulled through the "Hector Dip" – so named for the old siding that was nearby. This uphill on a downhill (vice-versa for eastbound trains) requires that a locomotive engineer pay close attention to the power requirements and train speed. As you can see, the head end of the train is climbing while, 20 cars back, the consist is descending.

This creates tremendous forces of compression and stretching along the train, stressing the drawbars that connect the cars. The Hector Dip is not an intentional track feature, designed to compensate the grade. (See p. 103.) It is a relic from the hurried original construction, yet to be remedied – perhaps because it impedes the speed of trains about to descend the Field Hill.



Eastbound locomotive 9837, an AC4400CW delivered in 2004, passes the old west switch at Cathedral in this 2008 photograph. The train has just exited the Cathedral Tunnel. The mileage from Calgary (133.1) is given on the signal mast. CP removed Cathedral siding in 2020. With a length of 5,921 feet, it was too short for meets of trains that now routinely top 10,000 feet in length. CPKC retains a short backtrack at Cathedral, used for equipment storage and for cutting out cars flagged by the hotbox detector at Yoho siding (see p. 105). Locomotive 9837 was among the longest-serving of its model with CPKC. Mt. King in the Van Horne Range provides the backdrop.

2022, hydrail locomotive 1002 entered service. This was a reconstructed GP-38 intended for yardwork. In December 2022, CP announced that locomotive 9517, an AC4400CW built in 1997 (CP's oldest of that model), and that had been in storage for more than five years, would be the core for hydrail unit 1003. With solar-powered hydrogen production plants in Calgary and Edmonton, CPKC has plans to put more hydrail locomotives into service.

In 1998 CP Rail purchased 4, SD90MAC-H and 61, SD9043MAC locomotives, built by EMD, and numbered 9300-9303, and 9100-9160. The SD9043MAC generated 4,300 horsepower, while the MAC-H generated 6,000 horsepower – the most powerful diesel locomotive that CP would ever run – and, at $4-million, the most expensive. Railfans called them "Big Macs." These units all proved problematic, guzzling fuel and spending months at a time "shopped out" for repairs. CP scrapped the MAC-H units in 2010, and rostered the SD9043MAC fleet in 2012 and then put it up for sale. With no takers, in 2019 the railway contracted Progress Rail to rebuild 58 of the units – along with 2 acquired from Union Pacific – as the SD70ACU, at 4,500 horsepower, and numbered 6644, and 7000-7059.

Railfans celebrate these units, as 15 of them have striking paint; five honour the Canadian Armed Forces. Locomotive 7021 (photo, p. 72) was painted "Desert Sand" to honour veterans of Iraq and Afghanistan. Ten SD70ACU units bear CP's traditional livery of Tuscan red, gray, and gold. In 2021, CP purchased another 40 SD9043MACs from the Union Pacific Railroad, intending to convert them into SD70ACUs. It costs