Amtrak Cascades 501 Derailment

DuPont, Washington December 18, 2017

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Preface

DuPont, Washington is a small town on Puget Sound. On December 18, 2017 it made the front page of many newspapers for a train derailment that occurred there.

I began this project because the derailment occurred on my birthday and I had time to look into it. Certainly the photos of the derailed train were intoxicating, but a lot of information was not published.

This project appealed because it required research and writing, both activities I enjoy.

Story of a Derailment

At 7 am on Monday, December 18, 2017 the Tacoma Peninsula[1] in Washington was typically dark and rainy. At 7:34 am the Amtrak Cascades 501 southbound train from Seattle to Portland derailed at DuPont, Pierce County, Washington. Of the twelve passenger cars and two locomotives, only the rear locomotive remained on the track. The cars separated from each other like pick-up sticks. All 77 passengers and 5 crew were hospitalized, three passengers died, 62 people were injured, the engineer was in hospital for five months. Eight individuals in highway vehicles were also injured. Damage was estimated to be more than $40.4 million.

The initial explanation, confirmed in July 2018 by the National Transportation Safety Board (NTSB), of the cause of the derailment was that the train was traveling too fast for the conditions. The train, traveling at 78 miles per hour, hit a curve posted at 30 miles per hour.

The train was the inaugural run of a revised Amtrak Cascades route. Beginning in the 1990s the Washington State Department of Transportation (WSDOT) addressed the problem of increasing highway traffic in the Tacoma area. They had already proved that adding highway lanes was a short-term solution at best. They turned to passenger rail as a transportation strategy that would have a longer operational life than highway lanes. A number of agencies and businesses worked together to create a rail plan. They took advantage of federal funding provided under the American Recovery and Reinvestment Act (ARRA) high-speed rail grants administered by the Federal Railroad Administration.

Since 1971 the Amtrak Cascades service has provided passenger rail transport between Vancouver, British Columbia and Eugene, Oregon. It provides four daily round trips between Portland and Seattle. The central idea of the WSDOT project was to increase the daily round trips to six. The project was named the Point Defiance Bypass Project because the central feature of the project was the bypass of the Point Defiance Line between Tacoma and Nisqually (east of Olympia). That route was a major freight route, and often slowed by a bridge (the Chambers Bay drawbridge) and a single-tracked tunnel (the Nelson Bennett Tunnel dug under Point Defiance in 1914). It was slow and passenger trains did not have priority over freight.

The bypass route, 14.5 miles long, followed existing track south from Tacoma to Lakewood, Joint Base Lewis-McChord, and DuPont, along the west side of Interstate 5. It joined the original BNSF main line at Nisqually before continuing to Lacey.[2] Old track was replaced by new, grade crossings and stations were upgraded.

Alas, the bypass route failed on December 18th on the first day of its operation. All the years of planning, the many involved agencies, and the hundreds of millions of dollars spent failed at a 30-mph curve left on an 80-mph track.

1. I also call this the Point Defiance Peninsula.
2. There is a passenger rail station at Lacey. Connection to Olympia is via bus.

The Train That Derailed

The trainset that derailed was composed of two locomotives and 12 Talgo passenger cars. Of these, only the rear locomotive was not damaged.

A *trainset* is a locomotive and carriages (rolling stock) coupled together to form a unified set of equipment. A typical Amtrak Cascades trainset seats approximately 250 passengers and typically consists of 13 train cars, including one baggage car; two business class (first-class) coaches; seven standard coaches; one bistro (cafe) car; one lounge car; and one service car that provides onboard electricity for the train.

It is fairly common for Amtrak to form a trainset with two locomotives, one in the front and a second in the rear. The front locomotive pulls the train. The rear locomotive may "push" the train; alternatively it may be present as insurance (should the leading locomotive fail) or because it is being relocated.

The leading locomotive was a Siemens Charger model SC-44 (WSDOT/WDTX #1402). This was a diesel-electric passenger locomotive designed and manufactured by Siemens Mobility for the North American market. The first production unit went into revenue service in late 2017. This locomotive was heavily damaged in the derailment. One report stated that it would be sent back to Siemens for repair, while the NTSB reported it as a total loss.

The rear/trailing locomotive was a GE Genesis model P42DC (AMTK #181). This was a passenger diesel locomotive produced by GE Transportation, a subsidiary of General Electric, between 1992 and 2001. This locomotive was not under power and was not damaged in the derailment.

The Talgo Series VI passenger cars destroyed in the derailment had been built to operate between Las Vegas and Los Angeles; the trainset was scheduled to enter service in early 2001, but was sold to WSDOT in 2003. It was renamed the Mount Adams when it was purchased by the state of Washington.

All the locomotives and passenger cars were built in America.

The NTSB's Factual Report states that all cars except the trailing locomotive were a total loss.

Post accident inspections and observations were completed the week of March 5, 2018, at the JBLM storage site.

All three deaths were in Talgo car AMTK 7504. That car stopped on the west side of the tracks, at the curve, near the trees. It had rotated 180° from its original direction of travel and came to rest with its rear left side on top of the AMTK 7554 and its front left side leaning against AMTK 7804. AMTK 7504 had been raked by a fully detached rolling assembly from a passenger train car (determined to be AMTK 7422), that assembly lay partially within the deformed left side of 7504.

Background: Geography

Tacoma, Washington is situated on the east side of Puget Sound. Tacoma is sited at the mouth of the Puyallup River, which drains glaciers on Mt. Rainier.

The area south of Tacoma and bordered on the south by the Nisqually River is a peninsula sometimes called the Point Defiance Peninsula. Its original vegetation was prairie and forest. Mt. Rainier rises on the east side. This is the location of the December 18th derailment.

Puget Sound

Puget Sound is an inlet of the Pacific Ocean and a long body of water pierced with many islands and peninsulas — what is often called a fjord. The Puget Sound area was extensively glaciated.

Puget Sound's southernmost city is Olympia, the capital of the state of Washington and the county seat of Thurston County. Its northernmost point is Deception Pass, a strait on the north end of Whidbey Island that separates it from Fidalgo Island.

Puget Sound's primary connection to the Pacific Ocean is the Strait of Juan de Fuca and the Admiralty Inlet. The former lies between Vancouver Island and the Olympic Peninsula, the latter lies between Port Angeles (at the northeastern corner of the Olympic Peninsula) and Whidbey Island.

The average depth of Puget Sound is 450 feet. Its maximum depth is 930 feet.

Puget Sound is the third largest estuary in the United States, after Chesapeake Bay in Maryland and Virginia, and San Francisco Bay in northern California.

Puget Sound was named by its first European explorer, George Vancouver, in 1792. Vancouver claimed the Sound for Great Britain, and named it after one of his officers (Lieutenant Peter Puget). In 1846 the sound became U.S. territory as part of the 1846 Oregon Treaty.

The first European settlement in the Puget Sound area was Fort Nisqually.

Mount Rainier

The mountain visually dominates the landscape to the east of Puget Sound. Its 25 glaciers are the sources of fresh water for the rivers that drain into Puget Sound, including the Puyallup River and the Nisqually River. At 14,411 feet, Mt. Rainier is the highest mountain of the Cascade Range of the Pacific Northwest, and the highest mountain in Washington State. It is an active stratovolcano and is considered one of the most dangerous volcanoes in the world.[3]

The mountain last erupted in 1894-95, when small summit explosions were reported by observers in Seattle and Tacoma.

3. Mount Rainier is considered a danger to sections of the Tacoma metropolitan area because it is at risk of creating massive *lahars* which may flow down the Puyallup River and destroy all structures in their path, if not entire settlements. A lahar is a violent type of volcanic mudflow or debris flow composed of a slurry of pyroclastic material, rocky debris, and water with the approximate density of wet concrete.

The current name was given in 1792 by the British explorer George Vancouver, who named it in honor of his friend, Rear Admiral Peter Rainier. This name was formally adopted in 1890 by the United States Board on Geographic Names.

Mount Rainier is 42 miles southeast of Tacoma.

Point Defiance

Point Defiance was never a military fort.

In the early 1800s the U.S. Congress saw a need to formally explore the Pacific Ocean. In 1836 they passed legislation authorizing such an expedition, the United States Exploring Expedition. Eventually Navy Lieutenant Charles Wilkes accepted an appointment to lead the expedition. A force of six ships and 346 men was organized and departed Hampton Roads, Virginia on August 18, 1838. They surveyed the Pacific Ocean and the South Seas, and eventually circumnavigated the globe. The Wilkes Expedition explored and mapped the Pacific, Antarctica, and the northwest coast of the United States.

In 1841 two ships of the Wilkes Expedition entered Puget Sound to map the bays and estuaries, the *Vincennes* and *Porpoise*. They dropped anchor in southern Puget Sound, near the mouth of Sequalitchew Creek and the Hudson's Bay Company's Fort Nisqually. Wilkes' crew proceeded to chart Puget Sound and name numerous landmarks.

The name “Point Defiance” appears on Charles Wilkes’s 1841 map of Puget Sound, which seems to be its first recorded use. A few years later, Wilkes’s 1849 personal account of the expedition described the strategic military potential of the peninsular geography for the young and westward-moving United States, stating that “the Narrows, if strongly fortified, would bid defiance to any attack.”

Point Defiance eventually came under the control of the federal military and remained an undeveloped federal military reservation until 1888 when President Grover Cleveland signed a bill granting Tacoma the right to use the 640 acres of Point Defiance as a city park. In 1905 the federal government formally granted title of Point Defiance Park to the city of Tacoma.

Now it is a neighborhood with a park, zoo, marina, and residences.

Commencement Bay

This is a deep-water bay on the eastern side of Puget Sound, at the mouth of the Puyallup River. It was named by Lieutenant Charles Wilkes of the United States Exploring Expedition in 1841. The city of Tacoma has grown up around it, prompted by the arrival of the Northern Pacific Railway in 1883 (the NP announced that Tacoma would be its terminus in 1873).

The Bay is angled northwest-southeast. It is bounded by Browns Point on the northeast and Point Defiance on the northwest. The east entrance to the bay is considered to be Dash Point (one mile northeast of Browns Point) while the west entrance to the bay is considered to be Point Defiance.

The Bay is about 2.5 miles in length. At its deepest, the bay is 570 feet.

The Puyallup River, as well as a few smaller creeks, is the main source of freshwater to the Bay.

The Port of Tacoma is located at the southeastern end of the Bay, it consists of eight that are the result of the infill and channelization of the Puyallup River Delta that started in the 1800s.

Point Defiance Peninsula

This peninsula is a plateau between the Puyallup River on the north and the Nisqually River on the south. Its western edge is Puget Sound. The peninsula gets its name from Point Defiance, which is located at its northwest corner.

The peninsula has an elevation of about 300 feet at its highest, way above the near sea-level altitude of the Puyallup River at Tacoma, the Nisqually River, and Puget Sound. The peninsula falls off sharply at its northern, western, and southern edges.

The drop at the Puyallup River challenged the railroad engineers to route the train line from the plateau down to the bay so that a large, heavy locomotive could safely traverse it. The drop at Nisqually River provided similar engineering challenges. Both of these grades created design challenges for modifications to the train alignment over the Lakewood Subdivision.

The peninsula was originally wooded with a swath of prairie. Many of the trees, Douglas Fir, were cut by early Europeans for lumber. The remaining trees were displaced by modern development, which at the same time provided the fir an environment in which to proliferate. By the late 1800s the prairie had begun to vanish, displaced by homes and roads.

The area was originally rich in sand and gravel left over by the last glaciation. Much of that sand and gravel has been mined, and so extensively that there may be only one mine left — it is located in DuPont.

This peninsula was the location of the December 18th derailment. The derailment happened at the drop from the south side of the peninsula to the Nisqually River.

Nisqually

The Nisqually River is fed by the Nisqually glacier on the southern side of Mt. Rainier. The river runs 18 miles to Puget Sound where it ends in a delta-estuary. The river is named for a tribe of Indians who still live along its shores in modern Thurston County.

The Nisqually River empties into the southern end of Puget Sound, approximately 15 miles east of Olympia. In 1971 its outlet was designated as the Nisqually Delta National Natural Landmark.

The Nisqually River forms the southern edge of the Point Defiance Peninsula. The name Nisqually is commonly applied to the area where highway I-5 crosses the BNSF Point Defiance Mainline.

Fort Nisqually

European occupation of the Puget Sound area began in 1833 when The Hudson's Bay Company of London, a vast fur trading enterprise chartered by King Charles II of England in 1670, established Fort Nisqually. The fort was a trading post, not a military project.

The site of the fort was chosen for its excellent ship anchorage, its convenience for overland travel, the friendliness of local tribes, and its prairies for grazing animals and growing crops.

The fort was originally built on the beach and plains above the Nisqually River delta in the present town of DuPont, on the south side of the Sequalitchew Creek. That location is now encompassed by the Home Course Golf Club[4]. When the fort's operations exceeded its capacity, it was rebuilt in 1843 at a new site, about a mile east of the original fort, closer to Edmond Marsh and Sequalitchew Creek. This new site was chosen because it was close to a water source and timber.

The 1843 fort was primarily a farming center, operated by the Puget's Sound Agricultural Company, a subsidiary joint stock company of the Hudson's Bay Company formed in 1840. The HBC also established farms in Cowlitz and Victoria. Cowlitz Farm specialized in wheat and other crops while Nisqually Farm specialized in livestock (sheep and cattle).

The fort and farm were closed in 1869 as trading profits declined; the property was bought by the U.S. government in accord with the 1846 Oregon Treaty. About 1933 the two remaining buildings were moved to Point Defiance Park and recreated as a historical museum, to present Fort Nisqually as it was in 1855.

Chambers Bay

This bay is located in the town of Steilacoom, south of Tacoma on the Point Defiance Peninsula. The Bay is fed by Chambers Creek which has three sources: Leech Creek, Flett Creek, and Steilacoom Creek (which drains Steilacoom Lake). The bay has a marina and an entrance to Puget Sound, which access is controlled by the Chambers Bay drawbridge. The BNSF's mainline railroad that traverses the Puget Sound shoreline along the Point Defiance Peninsula is subject to traffic interruptions when the bridge is open.

The Chambers Creek Estuary is the major estuarine feature between the Nisqually River and the Tacoma Narrows.[5] Restoration is envisioned as a way to benefit several fish species, including coho and chum salmon.

The Chambers Bay area got its name from Thomas McCutcheon Chambers, an Irish-born Presbyterian minister who married a cousin of Andrew Jackson and traveled to America in 1816 to serve as the overseer of Jackson's tobacco and cotton plantation. Chambers went to Olympia, where his sons set up donation land claims.[6] In the fall of 1847, Chambers and his family arrived in Steilacoom, taking possession of the

4. The Home Course, a public golf course planned to house the offices of the WSGA, PNGA, and USGA activities in the Northwest, was opened in early summer 2007. The original site of Fort Nisqually has been preserved next to the first green of The Home Course; it is surrounded by a black fence with a gate on the east side, overgrown with vegetation, and has a site marker monument set in the 1920s.

5. The Tacoma Narrows is a strait that separates the Kitsap Peninsula (on the west) from the city of Tacoma (on the east). The strait is 4.25 miles wide. It is famous because its original bridge collapsed shortly after it was opened in 1940, that bridge was nicknamed "Galloping Gertie".

6. The Donation Land Claim Act of 1850 was intended to promote homestead settlements in the Oregon Territory in the Pacific Northwest (comprising the present-day states of Oregon, Washington, Idaho and part of Wyoming). The law was a forerunner of the Homestead Act of 1862. Before the law expired on December 1, 1855, 7437 land patents were issued.

The Act permitted settlers on unsurveyed lands to select claims without regard to legal subdivisions. Each settler could have 320 acres of land, and married couples could claim 640 acres. Claimants were required to live on the land and to cultivate it for four years to own it outright; claims were granted at the federal land office in Oregon City.

property surrounding Heath's Creek, also known as Steilacoom Creek, through a donation land claim; the land actually belonged to the Hudson's Bay Company, who protested Chamber's presence, then backed down when threatened by Chambers brandishing a rifle.

Communities

Tacoma. Tacoma became the star of this story when the Northern Pacific Railroad chose Tacoma as its terminus on Puget Sound in July 1873. Tacoma had begun with a sawmill in 1852[7], that settlement was abandoned in the Indian war of 1855–56. The next settler was Job Carr who built a cabin in 1864, hoping to cash in on the railroad's anticipated presence. The city incorporated in 1875. The transcontinental link was completed in 1887, after which the city's economic activity boomed.

Tacoma has a deep-water harbor, Commencement Bay. By connecting the bay with the railroad, Tacoma's motto became "When rails meet sails". Commencement Bay serves the Port of Tacoma, a center of international trade on the Pacific Coast and Washington State's largest port.

The presence of the Northern Pacific and the Great Northern developed the marshy wetlands of Tacoma into an extensive port and industrial area that included wharves, warehouses, and other transshipment facilities for handling goods between trains and ships.

Steilacoom is the oldest town in Washington Territory/State. It was founded by Lafayette Balch, a Maine sea captain, in 1851 and incorporated in 1854. It is located about six miles north of Fort Nisqually. Its earliest economy was based on the processing and export of lumber to San Francisco. However, the early plans for economic success did not materialize: Tacoma and Seattle had better ports and the terminus of the Northern Pacific Railroad was set at Tacoma.

In 1849 the U.S. Army founded Fort Steilacoom; it was the first military fortification built north of the Columbia River and was likely intended to establish a U.S. presence in the area and to protect American settlers. The Army leased the land from the British Hudson's Bay Company. The fort was deemed surplus and decommissioned as a military post in 1868. In 1871 Washington Territory repurposed the fort as an insane asylum, now the Western State Hospital.

Lakewood was first settled in 1833 and incorporated in 1996 (at which time it was the seventh largest city in the state). It was originally called The Prairie. There are several lakes within the city limits, including American Lake (the largest in area and named by Charles Wilkes) and Lake Steilacoom.[8] A number of small creeks flow through Lakewood, some of which drain into nearby Puget Sound. The largest of these, Chambers Creek, flows from Lake Steilacoom to Chambers Bay. In the late 1800s the area was developed with large stately homes and gardens, often used for summer retreats; a railroad from Tacoma carried summer visitors to the resort. During the 1920s, summer residents began to expand their lake cottages into year-round homes. Lakewood's economy is now highly dependent upon on the military bases in the area.

Claimed land was specified by legal description (township, range, section and fraction of section) or by natural features (metes and bounds), and was sometimes accompanied by a plat.

7. The sawmill was built by a Swede named Nicolas Delin. The mill was located at the head of Commencement Bay.

8. Steilacoom Lake is believed to have been formed behind the dam built on Chambers Creek to power the Byrd Mill (saw mill); the existing pond was converted into a large lake. Andrew Byrd built a grist mill in 1850, a saw mill in 1852, and a flour mill in 1855. A small community grew up around the mill on Chambers Creek.

DuPont. The earliest European contact was in 1792 when the area was mapped by Captain George Vancouver. The earliest European settlement was Fort Nisqually, a trading post of the Hudson's Bay Company, built in 1833 and moved in 1844; that post was closed in 1869 because of declining business, at which time it was bought by the U.S. government. In 1841 Charles Wilkes arrived with the United States Exploring Expedition; he anchored off Fort Nisqually. Wilkes eventually constructed what is now known as the Wilkes Observatory (of which nothing is left).

In 1906, E. I. du Pont de Nemours and Company purchased a 5-square-mile area for construction of an explosives plant. The site chosen for the explosives plant, on the south side of Sequalitchew Creek, had previously been the site of the original (1833) Fort Nisqually. The explosives plant was closed in 1976 after 67 years in operation.

The explosives plant was sited at the southern edge of the Point Defiance Peninsula because of the proximity of a beach and a creek, the beach to accommodate a wharf for the receiving of raw materials and the shipping of finished goods, the creek for freshwater and to power a hydroelectric plant.

DuPont was originally a company town, laid out and built by the explosives company and occupied by employees; it was complete by 1912. The town was located about one mile to the east of the actual explosives manufacturing area. Its main street is Barksdale Avenue (now Exit 119 on Interstate 5). In 1951 the company sold the town's property to the residents. DuPont, Washington, originally incorporated on March 26, 1912, was re-incorporated April 15, 1951.

Fort Lewis is a U.S. Army base located 9 miles south of Tacoma. It was established in 1917 with the passage of a Pierce County bond measure to purchase 70,000 acres of land to donate to the federal government for permanent use as a military installation. The fort began as Camp Lewis, named after Meriwether Lewis, and was located on the Prairie.

McChord Air Force Base. The area preceding the base was established in 1927 by a Pierce County bond measure for use as a public airfield, originally named Tacoma Field. The field was transferred to the federal government in 1938 and renamed McChord Field. It became independent of Fort Lewis in 1947 following the creation of the Air Force. It is currently the home of the 62d Airlift Wing (62 AW). It is assigned to the Eighteenth Air Force and is composed of more than 7,200 active duty military and civilian personnel. It is tasked with supporting worldwide combat and humanitarian airlift contingencies.

Joint Base Lewis-McChord was consolidated in 2010 from Fort Lewis and the McChord Air Force Base. The base, known as JBLM, became the largest military installation in the western United States. It is now the top employer in the region and creates a stable source of tax revenue for the local economies.

The base has increased in size and population throughout its existence. Its original footprint was limited to the east side of U.S. 99, now it has property adjoining Puget Sound. It is likely the single greatest cause for increased vehicular traffic, first on U.S. 99 and now I-5.

Background: Trains in Early Washington

Transcontinental railroads gripped the American imagination by the early 1860s. Eventually three were built: the northern route, the central route, and the southern route.

- The first transcontinental railroad was constructed between 1863 and 1869 over the central route by the Union Pacific Railroad and the Central Pacific Railroad; it connected Omaha, Nebraska/Council Bluffs, Iowa with San Francisco Bay, and crossed the Sierra Nevada.
- The second railroad took the northern route, from Chicago to Seattle, and was completed in 1873 — this was the Northern Pacific Railroad.
- The third transcontinental railroad took the southern route, from New Orleans to Los Angeles; it was completed in 1883 by the Southern Pacific Railroad and the Atchison, Topeka and Santa Fe Railway.

The Northern Pacific Railroad (NP) was chartered in 1864 by President Lincoln to connect the mid-west, Washington, and Oregon. It was awarded land grants totaling 60 million acres in checkerboard sections along a 40- to 80-mile-wide strip flanking the planned route from Minnesota to Puget Sound. The land grant stipulated that the company complete its transcontinental line by July 4, 1876, which it failed to do, consequently the NP forfeited some of its land holdings.

The NP had seven operating divisions, the western-most being the Tacoma Division. The Tacoma Division was headquartered in Tacoma, Washington and extended from Vancouver, WA to Seattle.

Washington was admitted to the Union as the 42nd state in 1889.

Two more transcontinental railroads were built to Washington:

- The Great Northern Railway finished laying tracks from St. Paul, Minnesota, to Everett in 1893 and ran a line from there south to Seattle, and on to Tacoma over tracks leased from the Northern Pacific.
- The Chicago, Milwaukee & St. Paul Railroad (informally, The Milwaukee Road) started in 1847 in Wisconsin. In 1905, the railroad, backed by Rockefeller interests, decided to build out its system to reach Puget Sound, and became the last transcontinental line to be completed in America. The Road created a 2,200-mile route (measured from Chicago) to Tacoma and Seattle, with the lines to the two Puget Sound cities splitting off at Black River Junction (near Tukwila). Trains crossed five mountain ranges — the Saddles, Belts, Rockies, Bitter Roots, and Cascades. Fifty-one tunnels were needed and a far larger number of bridges and trestles. All the gaps in the line from Chicago to Puget Sound were filled in only three years. On May 19, 1909, the last spike of the nation's last transcontinental railroad was driven in a low-key ceremony held just west of Garrison, Montana.

Trains first came to the Puget Sound area with the northern route of the transcontinental railroads. They opened the area to commerce with the eastern part of America.

Train Routes between Oregon and Tacoma

The initial route of the transcontinental railroad through Washington (built by the NP) was north from the Columbia River, along the east side of Puget Sound, to Seattle and Bellingham.

The starting point for the route north of the Columbia River (the first section of the railway's right-of-way in Washington Territory) was chosen as a point a few miles south of where the Cowlitz River enters the Columbia, a place now named Kalama. This was thought to be practical from a business perspective as it

was below the Columbia's ice line and the river depth there was about the same as at the river's mouth, thus allowing ships of equal weight into the area. Track laying began on March 19, 1871. By November track had reached Tenino, 65 miles north.

The train did not go to Olympia at that time. Olympia did not warrant a rail connection as it was still in its infancy: the first European settled the area in 1841, the town was incorporated in 1859, and the city was incorporated in 1882. The NP had considered Olympia as its terminus, but when Tacoma was so chosen, Olympia was bypassed altogether.

In July 1873 the NP Board announced its choice of Tacoma as its terminus. The summer before, NP officials spent a week touring Puget Sound in a steamboat looking at sites for a terminus. Various towns got into a bidding war over it. NP chose Tacoma because it was closer to the Columbia River and required the least amount of track to be laid.

From Tenino the track turned northeast and passed through what became Rainier, Yelm, and Roy before arriving Tacoma. This was the Prairie Line, laid in 1873, and NP's 4th subdivision. The 40-mile segment was completed on December 27, 1873.

Scheduled service began on what was known as the Pacific Division between Kalama and Tacoma in January 1874 via Tenino, Washington and the Prairie Line.

The Northern Pacific took a full 10 years, until 1883, to knit together a transcontinental line, and, until 1909, getting to Tacoma still required a train-ferry crossing of the Columbia River at Kalama.[9] On June 17, 1884, the first Northern Pacific Railroad train ran from Tacoma to Seattle. The long awaited transcontinental route from St. Paul, Minnesota was completed over Stampede Pass[10] on July 3, 1887.

Train Routes between Tacoma and Tenino

The Prairie Line, laid in 1873, became a development trunk for the growth of Tacoma, sprouting rail sidings to serve industrial and shipping facilities in what is now the warehouse and brewery district of the town. The line connected Tacoma and Tenino, Washington (Tenino is 12 miles south of Olympia). The name refers to the "burnt prairie" route across the Nisqually Delta from Tenino. It provided freight and passenger services. It was the Tacoma Division's 4th Sub-Division.

Grays Harbor is a large estuarine bay located on the Pacific coast 45 miles north of the mouth of the Columbia River, and at the foot of the Olympic Peninsula. Grays Harbor was first seen by a European on May 7, 1792 when Captain Robert Gray[11], an American merchant sea captain, entered it during the second of his two fur-trading voyages along the north Pacific coast. The harbor was named by British Captain George Vancouver, who had met Gray at sea and at Nootka Sound in September 1792. Settlement of the area began in the early 1870s. The forests attracted loggers from the east, and lumber quickly became the dominant industry. Railroads became the preferred way to move logs to mills and

9. The ferry crossing came to an end in 1909 when a Columbia River bridge was constructed at Vancouver, WA. The bridge provided the NP with a continuous rail line from Portland, Oregon to Seattle, Washington.

10. Stampede Pass, elevation 3,672 feet, is only used by trains; the nearest highway is I-90, a little over three miles to the east. Snoqualmie Pass is north. The pass was discovered in 1881 by a civil engineer for the Northern Pacific. The track over the pass relied on switchbacks. Stampede Tunnel (1.86 miles long) was completed in 1888 — by Nelson Bennett in an amazing effort. Bennett went on to dig the tunnel named for him under Point Defiance.

11. In 1790 Gray completed the first American circumnavigation of the world. He is most remembered for being the first to enter the Columbia River, which he did in May 1792 (after leaving Grays Harbor).

lumber to ships. The Northern Pacific Railroad was the first line to serve the Grays Harbor region. In 1890 the NP formed the Tacoma, Olympia & Grays Harbor Railroad (TO&GH) as a subsidiary. It built and acquired track between those three locations. The first portions of the Grays Harbor Branch were completed in 1892.

On May 1, 1891, the TO&GH completed a 24.7-mile-long branch of the Northern Pacific between Lakeview (a train station near modern Lakewood) and Lacey (4 miles east of Olympia), passing through the current Fort Lewis military base (established 1917). [This branch is believed to have passed through Nisqually. It may be the tracks that appear on old maps going through DuPont.]

The NP formed the 17th Sub-Division (American Lake Line) to include the line from Lakeview to Nisqually (11.7 miles). The American Lake Line was a branch line of NP's Tacoma Division, it originated as part of the Gray's Harbor Line. (American Lake is a large lake south of Lakewood, Pierce County.)

The route between Lakeview and Lacey (which sits between Olympia and Nisqually), part of the Prairie Line between Tacoma and Tenino, was used by occasional passenger trains until their cancellation by NP in 1956. Long-distance freight service was phased out in 1973, a few years after Burlington Northern acquired Northern Pacific, and the Prairie Line was abandoned south of Yelm in 1986. The rest of the line was abandoned in 2003, with the only remaining service to Fort Lewis operating on the American Lake Branch.[12]

The Point Defiance Bypass route was cannibalized from the Prairie Line where it ran from Tacoma to Lakeview and from the American Lake Line from Lakeview to Nisqually.

The December 18, 2017 derailment occurred on the old American Lake Line where it crosses Interstate 5, a divided highway, on an overhead bridge.

Point Defiance Mainline

The railroad line around Point Defiance was built in 1914 by the NP as a flatter alternative to the Prairie Line. This line, called the Point Defiance Line, was completed with double track in December 1914 which corresponded with the opening of Tacoma's new Union Station.[13] NP transferred it to BNSF (as successor to the NP), who sold it to Sound Transit.[14]

That mainline was routed through two tunnels which had been dug under Point Defiance: the Nelson Bennett Tunnel (the larger of the two, built in 1914[15]) and the Ruston Tunnel, a much shorter tunnel built in 1912 to provide access to a copper smelter owned by ASARCO.

Both tunnels were originally double tracked. A single track was installed through the tunnels in 1988 to accommodate double-stack container, auto rack, and Boeing airplane parts cars over 20 feet tall.

12. Per Wikipedia's article on the Point Defiance Bypass.

13. By June 1916 there was only one NP passenger train and one freight train using the Prairie Line. The Great Northern kept their traffic on the Prairie Line.

14. That BNSF sold the Point Defiance Mainline to Sound Transit has yet to be verified.

15. Construction may have started after 1900. Bennett was involved in the Fairhaven Land Company, which he formed in 1888 to develop the town of Fairhaven near Bellingham. The tunnel was incomplete when he died in 1913. His widow, Lottie Wells Bennett, completed it in March 1914, within contract time.

The Nelson Bennett and Ruston Tunnels accommodated two main tracks through the 70s, into the 80s, maybe the 90s too. But even for high-wide box cars and tri-level auto racks in the 1970s, only one track had clearance. So there was always a short stretch of interlocking/CTC[16] to single-track the trains with "high-wides."[17] The tunnels were single-tracked in the early 1990s in order to get double-stack clearance (then 22 feet above top of rail). The Ruston Tunnel was closed permanently with construction fill in 2011.

A third impediment to speedy train travel is the Chambers Bay drawbridge; the bridge is manually opened on demand. When open, it allows ship access between Chambers Bay and Puget Sound. The bridge was originally built 1913–1914 for the Northern Pacific Railway. In July 2017 a northbound Amtrak train derailed at the bridge. The bridge is raised on demand; in March 2018 the Coast Guard applied to change that schedule to remove the stationed bridge operator during the evening hours (due to minimal usage).

Another impediment to speedy train travel are the mudslides that occasionally cover the tracks. They were documented as early as 1921.

Aside from the tunnel, drawbridge, and mudslides. the Point Defiance route is congested with nearly 50 freight trains daily; these run at approximately 30 mph. Passenger trains must wait for an opening, and then travel at reduced speeds — the upside is the stunning scenery along Puget Sound.

The Point Defiance Line is back in service for passenger rail until the Bypass can be made safe. Run time between Tacoma and Olympia is currently 35 minutes.

Establishing a Railroad

For many people, trains are romantic objects. It is fascinating, if not thrilling, to read about how trains were extended across North America. It is worthwhile contemplating what it took to build a transcontinental railroad. The following is excerpted from a document (www.washingtonhistory.org/files/library/FGCitiesTowns.pdf) on the WashingtonHistory website of the Washington State Historical Society; it is a part of the Field Guide to the Hall of Washington History.

What it Takes To Build a Transcontinental Railroad

- FEDERAL BACKING, which can take various forms: congressional authorization, appropriations of funds per mile of track, and millions of acres of land grants.
- CAPITALIZATION unprecedented in scale, usually in the form of bonds sold to investors with federal land grants as collateral.
- MATERIALS in gigantic quantities, including millions of tons of steel and the timber from entire forests.
- THE ENGINEERING EXPERTISE needed to overcome all natural obstacles.
- THE PHYSICAL LABOR of thousands of workers.
- THE ORGANIZATION and management of the work force under pressures of time and over extensions in space comparable only to the operations of an army.

16. CTC is Centralized Traffic Control, a form of railway signalling that allows a centralized train dispatcher's office to consolidate train routing decisions, previously carried out by local signal operators or the train crews themselves. CTC is not a panacea.

17. I think "high-wide" refers to train loads that may be excessively high and/or wide for the railcar and structures like bridges and tunnels.

Background: Pacific Northwest Treaties

Fueled by complementary desires for exploration and commercial profit, men of several nations sailed the waters of the Pacific Northwest. The outlines of the region emerged from their explorations and the territories they established amongst themselves by treaty.

Russia
Spain
Great Britain
U.S.A.

Early Explorations

The first European to see the Pacific Ocean was a Spaniard, Vasco Núñez de Balboa, in 1513. He had crossed the Isthmus of Panama, determined to find gold-rich kingdoms to plunder. Six years later he was decapitated in a power conflict, apparently not particularly well-liked. Before his death, Balboa had formally laid claim for Spain to all the shores washed by the Pacific Ocean. In this he was following the accepted international sovereignty practices of the day.

The Russians were the first Europeans to land[18] in the Pacific Northwest. In 1741 the crew of the Imperial Russian Navy ship *Saint Peter*, captained by Vitus Bering[19], saw Mount St. Eliasi[20] from Icy Bay, Alaska and landed in modern Alaska (at or near Kayak Island[21]). The Russian fur trade soon followed. By 1812, the Russian Empire claimed Alaska and the Pacific Coast of North America as far south as the Russian settlement of Fort Ross in Alta California (65 miles north of modern San Francisco). The Russian presence in mainland Alaska was limited to fur trappers and missionaries of the Russian Orthodox Church.

The Spanish initiated several maritime explorations from San Blas, Mexico to Alaska, beginning in 1774 and throughout the next 19 years. In 1775 a Spanish explorer reached Alaska at 58 degrees latitude (about Kodiak Island), this was Lt. Juan Francisco de la Bodega y Quadra whose ship *Sonora* was the only one of three that had set out to reach this latitude. A 1779 expedition entered Prince William Sound at 61 degrees latitude. A 1788 expedition returned to Prince William Sound before sailing west to Kodiak Island. Expeditions as early as 1790 explored Nootka Sound (on the west coast of Vancouver Island) and the Strait of Juan de Fuca.[22] In 1792 two ships circumnavigated Vancouver Island. Similar voyages

18. A Russian group had previously *seen* Alaska, but did not land: In 1732 Mikhail Gvozdev, Ivan Fedorov, K. Moshkov, and others sailed east on the *St. Gabriel* from Dezhnev Cape on the Chukchi Peninsula — the eastmost mainland point of Asia — to near the American mainland at Cape Prince of Wales, Alaska (65 degrees latitude, named by Captain Cook). They charted the north-western coast of Alaska and mapped their route, but did not land.

19. Bering was a Danish cartographer and explorer. He was also an officer in the Russian Navy. He died December 19, 1741 on his return to Russia. In 1728 he had concluded that Asia and America did not share a land border.

20. Mount St. Elias (18,008 feet) is the second highest mountain in both Canada and the United States; it is situated on the Yukon-Alaska border.

21. Kayak Island is at 59.9 degrees latitude.

22. The strait, which separates Vancouver Island from the mainland Olympic peninsula, was named in 1787 by the maritime fur trader Charles William Barkley, captain of the *Imperial Eagle*, for Juan de Fuca, the Greek navigator who sailed in a Spanish expedition in 1592 to seek the fabled Strait of Anián.

The Strait of Anián was a semi-mythical strait, documented from around 1560, that was believed (or hoped) by early modern cartographers to mark the boundary between North America and Asia and to permit access to a

continued until 1793. At most of their landfalls the Spanish performed ritual acts of sovereignty; their focus was establishing possession and control, not colonies, and blocking the same by other nations.

By 1795 the Spanish claimed a Nootka Territory which extended from Valdez in the north to Trinidad Bay (California) in the south.[23]

Captain James Cook of the British Royal Navy explored the Pacific Northwest coast, including Nootka Sound, in 1778 on his ship HMS *Resolution*. Cook had joined the Royal Navy in 1755. He made three Pacific voyages. He arrived Nootka Sound in March 1778 on his third voyage. After leaving Nootka Sound in April, Cook explored and mapped the coast all the way north to the Bering Strait. The northern most latitude reached was 70 degrees 44 minutes. His was the first charting of the majority of the Pacific Northwest coastline, closing the gaps in the Russian and Spanish explorations of the northern limits of the Pacific. He was killed in February 1779 in Hawaii while on the third voyage.

Cook collected furs from the local tribes in Nootka, these furs were sold at Macau, Canton in 1779[24], where they became increasingly valuable and suggested a profitable fur trade could be established. His published journals aroused English commercial interests. Captain James Hanna was sponsored by British partners located in China to test the waters (so to speak) for the viability of a fur trade between the Pacific Northwest and China. He arrived Nootka Sound in 1785, acquired 560 pelts by trading, and sold them in Macao for over 20,000 Spanish dollars. The immense success of that venture inspired an ongoing British fur trading industry.

By the late 1780s, Nootka Sound was the most important anchorage on the northwestern coast. Russia, Britain, and Spain all made moves to occupy it for good. The U.S.A. was a visitor.

In 1789 a series of commercial conflicts occurred in the area of Nootka Sound, these came to be known as the Nootka Crisis. The crisis revolved around sovereignty claims and rights of navigation and trade. Spain had previously established sovereignty according to the European practice of the day. Some years later, several British fur-trading ships entered the area to which Spain had laid claim. Spain seized the British commercial ships. Britain rejected the Spanish claims and used its greatly superior naval power to threaten a war and win the dispute. The conflicts were addressed by the Nootka Conventions of the 1790s.

Nootka Conventions of 1790s

Great Britain and Spain

There were three agreements between Great Britain and Spain which averted a war between the two empires over overlapping claims to portions of the Pacific Northwest coast of North America. The agreements eventually reduced to zero Spain's claims to territories north of the Strait of Juan de Fuca — the current border between Canada and America.

Northwest Passage from the Arctic Ocean to the Pacific. The true strait was discovered in 1728 and became known as the Bering Strait.

23. Valdez is in modem Alaska, Trinidad Bay is in modern northern California. In between was Vancouver Island, the Olympic Peninsula, Puget Sound, and the modern state of Oregon.

24. Cook himself had been killed in Hawaii in February 1779. James King took command of the *Discovery* , the companion ship to the *Resolution*, upon the August death of Charles Clerke of tuberculosis. The trip to Macau was part of the return to England via the Cape of Good Hope.

The basic issues were left unresolved. Britain wanted the border between the two countries set just north of San Francisco and Spain wanted it set at the Strait of Juan de Fuca. (That border was finally resolved by the 1846 Oregon Treaty — at the 49th parallel north.) In 1794, both nations agreed to not establish any permanent base at Nootka Sound, while ships from either nation could visit.

The primary negotiators were the British Navy officer George Vancouver and his Spanish counterpart Juan Francisco de la Bodega y Quadra.

First Nootka Convention, 1790
Second Nootka Convention, 1793
Third Nootka Convention, 1794

The Nootka Conventions undermined the notion that a country could claim exclusive sovereignty without establishing settlements — as Spain had done. Instead, claims had to be backed up with some kind of actual occupation, a physical presence.

1818 Treaty

Great Britain and U.S.A.

The two nations agreed to a boundary line at the 49th parallel north (in part because a straight-line boundary would be easier to survey than the pre-existing boundaries based on watersheds). Britain ceded all of Rupert's Land[25] south of the 49th parallel north and east of the Continental Divide, including all of the Red River Colony[26] south of that latitude, while the United States ceded the northernmost edge of the Missouri Territory north of the 49th parallel north.

Article III provided for joint control of land in the Oregon Country[27] for ten years. Both could claim land and both were guaranteed free navigation throughout.

The treaty resulted in a fierce struggle for control of the Oregon Country in the following two decades, with the Hudson's Bay Company undertaking a harsh campaign to restrict encroachment on its fur trading business.

The treaty ignored the Nootka Convention of 1794 which gave Spain joint rights in the region. The Convention also ignored Russian settlements in the region.

1819 Adams–Onís Treaty

Spain and USA

25. This was a territory in British North America that encompassed Hudson's Bay. Ownership was claimed by Hudson's Bay Company based on their 1670 charter from King Charles II of England.

26. The colony was set up in 1811 on land granted by the Hudson's Bay Company to Thomas Douglas, 5th Earl of Selkirk. It was 120,000 square miles in size. Douglas envisioned establishing a colony of Scottish people, whom he transported in groups. The colony had a rocky history.

27. Oregon Country was a region with vague borders, whose ownership was disputed for decades. It was mostly composed of land north of the Columbia River (42°N latitude), south of 54°40′N latitude (Russian Alaska), east of the Pacific Ocean, and west of the Rocky Mountains. *Oregon* was the American term for the region; the British called it the *Columbia District*.

This treaty ceded Florida to the U.S. and defined the boundary between the U.S. and New Spain. The boundary applicable to the Pacific Northwest was the 42nd parallel north, which is now the boundary between the states of Oregon and California.

1824 Russo-American Treaty

Russian Empire and USA

Parallel 54°40′ is a line of latitude above the equator between the 54th and 55th parallels that forms the southernmost boundary between the modern U.S. State of Alaska and the Canadian Province of British Columbia. The boundary was originally established as a result of tripartite negotiations between the Russian Empire, the British Empire, and the United States, resulting in parallel treaties in 1824 and 1825.

The Russo-American Treaty of 1824 established the boundary between Russian Alaska and overlapping British and U.S. claims at the latitude 54°40′ north. It stated that no American settlement would be established on the coast or adjacent island north of 54°40′, and no Russian settlement would be established to the south; Alta California, Mexico was outside the purview of the treaty.

1825 Anglo-Russian Treaty

Russian Empire and Great Britain

This established the boundary between Russian Alaska and British claims at the latitude 54°40′ north. No British settlement would be established north of the line, no Russian settlement would be allowed south of the line. Russian rights to trade in the area south of that latitude remained.

1846 Oregon Treaty

Great Britain and USA

This treaty set the boundary between the United States and British North America along the 49th parallel north from Minnesota to the Rocky Mountains. The region west of those mountains was known to the Americans as the Oregon Country and to the British as the Columbia Department or Columbia District of the Hudson's Bay Company. The exception to the 49th parallel was Vancouver Island, which was retained in its entirety by the British.

The treaty provided for joint control of that land for ten years. Both countries could claim land and both were guaranteed free navigation throughout.

The 1846 Oregon Treaty heralded the end of the Hudson’s Bay Company in Washington and Oregon Territories. The HBC relocated their headquarters from Fort Vancouver on the Columbia River (built in 1824) to Fort Victoria on Vancouver Island (built in 1843). They left Fort Nisqually on the southeastern shore of Puget Sound, originally built in 1833.

The Puget's Sound Agricultural Company (a subsidiary of the Hudson's Bay Company) retained the right to their property north of the Columbia River, and were to be compensated for properties surrendered if

required by the United States. This enterprise was headquartered at Fort Nisqually. In 1863 it was bought out by the U.S. Government.

Post International Treaties

The earliest explorers, the Russians and Spanish, were sidelined by various treaties. Eventually Great Britain and the U.S.A. remained in contention for the northwest.

Russian Alaska became a U.S. state: In 1867 Russia sold Alaska to the U.S.A. The United States created the District of Alaska on May 17, 1884, and the Territory of Alaska on August 24, 1912. The State of Alaska was admitted to the union on January 3, 1959.

Great Britain got Vancouver Island and the mainland of modern Canada north of the 49th parallel. The U.S.A. got the land south.

The Colony of Vancouver Island was formed in 1849. The Colony of British Columbia was formed in 1858. The two were amalgamated in 1866 as the United Colonies of Vancouver Island and British Columbia. The Colony of British Columbia joined Canada in 1871.

The U.S. portion of the region was organized as Oregon Territory on August 15, 1848, with Washington Territory being formed from it in 1853. Oregon became a state in 1859. Washington became a state in 1889.

The places in the derailment story are located in Pierce County, Washington. This county was formed in 1852. The county seat is Tacoma.

Latitude

Latitude is one of two elements in a geographic coordinate system, the other being longitude. Latitude measurements have been important additions to maps since the earliest days. The measurement of latitude and longitude is important to both cartography and navigation, in particular to provide safe and accurate ocean navigation.

Essentially, latitude is the vertical position of a location relative to the equator. More technically, it is the angular distance of a location on the earth's surface north or south from the equator.

Latitude is measured in degrees. Since ancient times degrees have been subdivided into 60 minutes, and minutes into 60 seconds; a decimal fraction can be added to the seconds. This is based on the geometrical division of a circle into 360 degrees. Degrees of latitude are also expressed as a decimal number with six decimal positions, e.g., 35.123456.

Latitude is expressed as a number relative to the equator, either above (north) or below (south) the equator. This relationship is expressed in two ways: (1) by the inclusion of "N" or "S" in the number or (2) the inclusion of a minus sign to indicate south. Examples:

a) 47° 36′ 35″ N (for Seattle, WA) or 22° 54′ 30″ S (for Rio de Janeiro, Brazil)
b) -22° 54′ 30″ (for Rio de Janeiro, Brazil)
c) 35.123456 °; the number is unsigned, and is assumed to be a latitude above the equator

A circle of latitude on Earth is an abstract east–west circle connecting all locations around the Earth (ignoring elevation) at a given latitude. Circles of latitude are often called *parallels* because they are parallel to each other. Thus latitude is often referred to as a parallel, e.g., the 71st parallel north.

A latitudinal distance of 1 degree mapped on the earth's surface is the same length regardless of where it falls on the earth: about 69.2 statute miles (based on dividing the circumference of the earth by 360). Well, almost the same: A degree of latitude by a pole covers about 1% more distance than a degree at the equator.

Background: Roads for Horses, Cars, and Trains

The 2017 train derailment occurred at a location where the train tracks were crossing a highway. This very location had previously been a dirt road for horses and a paved road for cars. The train tracks had been added in 1891.

Military Roads

The earliest roads on the Point Defiance peninsula were "military roads." In the 1850s the U.S. Army built a network of Military Roads to connect military posts. The roads were funded by the War Department and their construction was managed by military officers. But the roads were not exclusively for military use, they were much used by settlers from the east. Travelers walked, rode horses, and drove wagons.

The first road was planned by the U.S. Congress to begin construction in 1853, between Fort Walla Walla (east of the Columbia and Snake Rivers) and Fort Steilacoom, a distance of about 235 miles; the road was desired for the fall group of immigrants from the Mississippi Valley. Captain George McClelland was tasked with much of the work, in which he failed spectacularly, mostly by doing nothing and spending all the authorized money in unknown ways. (Fort Steilacoom was the U.S. Army headquarters for the Puget Sound District and the center of road building in the region.)

In 1856–57 a road was opened between Fort Vancouver[28] and Fort Dalles, Oregon. It was a wagon road.

In 1857 a road was built from Fort Vancouver to Fort Steilacoom. It passed through Olympia and Fort Nisqually. Mail and passengers were carried by four- and six-horse stages.

Road construction was halted by the Civil War.

In 1858 construction began on the road from Fort Steilacoom to Fort Bellingham, it was completed in 1860. It was described by the topographical engineer as a military necessity whose "completion would induce settlement along the shore of Puget Sound." This road connected with the Fort Vancouver road.

In 1858 work began on a road between Fort Benton, on the Missouri River, to Fort Walla Walla on the Columbia River, a distance of 633 miles. This was the greatest of all road projects in Washington Territory.

Highways

There have been three generations of automobile highways:
1) the Pacific Highway (1913–1926)
2) U.S. 99 (1926–1968)
3) Interstate 5 (1968–)

28. Between 1853 and 1879 the Vancouver Barracks were known as Fort Vancouver. The Barracks, built in 1849, were a U.S. Army base located adjacent to the real Fort Vancouver, which had been built in 1824 by the Hudson's Bay Company as a trading post and their regional headquarters. The Oregon Treaty of 1846 caused the HBC to leave Fort Vancouver and move their headquarters to Fort Victoria on Vancouver Island. The military road of 1856–57 connected the Vancouver Barracks with Fort Dalles.

Highways were upgraded to accommodate more and faster automobiles and trucks.

The construction of each highway caused some portion of the previous highway to be destroyed. This was certainly true on the Point Defiance peninsula. The www.pacific-hwy.net website has maps of the old highway alignments.

Pacific Highway

In 1913 the Washington State Legislature designated the Pacific Highway between Vancouver and Blaine as part of the state's first connected state highway system. They selected a route that would connect the main cities of Western Washington: Vancouver, Olympia, Tacoma, Seattle, Everett, and Bellingham. The highway was originally envisioned as a "national auto trail"; by 1923 it had extended to San Diego in Southern California.

From Olympia to Puyallup, the highway followed the Old Military Road alignment.

In 1914 the town of Sherlock, a Northern Pacific Railroad stop east of the Nisqually River, became Nisqually.

In 1915 Steilacoom Blvd, which was part of the Old Military Road between Fort Vancouver and Fort Steilacoom, became a part of the Pacific Highway.

In 1916 over three miles of the highway were paved with concrete as part of the first project under the new Federal Aid Program. A year later, the highway was paved from Olympia to Tacoma. Brick paving was used from Auburn to Everett.

By 1923, the entire road had been improved.

In 1923 the highway was designated State Road 1 (Primary State Highway 1 after 1937), but retained its name as Pacific Highway.

U.S. 99

In 1926 U.S. 99 was established as part of a national highway system. It was originally created from the Pacific Highway with the addition of some bridges. Over time newer roadways bypassed and shortened older sections.

The route through Washington was completed in 1930. By 1941, most of the original Pacific Highway had been widened to four lanes.

Unlike California and Oregon, much of the former route of U.S. Highway 99 in Washington exists as local roads and regular city streets:

Lakewood	Pierce County	South Tacoma Way, Pacific Highway SW
DuPont	Pierce County	Old Nisqually Road, Old Pacific Highway SE
Nisqually	Thurston County	Martin Way
Lacey	Thurston County	Old Pacific Highway SE, Pacific Avenue

Interstate 5

In 1956 interstate highways were defined by an act of Congress. In 1968, U.S. 99 was removed from the system entirely. The last portion of Interstate 5 opened on November 14, 1969.

On the Point Defiance peninsula, the highway is divided with at least two lanes in each direction.

In the DuPont area, I-5 has four exits:

116 Mounts Road and Nisqually Road SW
118 Center Drive, DuPont
119 Barksdale Avenue, DuPont-Steilacoom Road, and Clark Road (JBLM)
120 Joint Base Lewis–McChord

Interstate highways are subject to a number of standards, including:

a) at least two 12-foot lanes of traffic in each direction
b) median width is specified, as is the nature of the median
c) shoulder widths are specified
d) maximum grade
e) controlled access: points of entry limited to interchanges with grade separation. (There are several exceptions to this rule.) Interchanges should be spaced one mile apart in urban areas and three miles apart in rural areas.
f) specified vertical clearance for overpasses
g) speed limits at the maximum allowed by local law
h) mile markers
i) exits are numbered
j) signage specifications
k) no at-grade railroad crossings

The highway congestion that presumably encouraged this train project was north of JBLM, and began at Fife (north of Tacoma). There is also a backup to the south of the base, where I-5 narrows from 4 to 3 lanes in each direction.

Rail Roads

See also Background: Trains in Early Washington.

The first railroad in the area was the Northern Pacific Railroad, which built its transcontinental route to Tacoma. In 1873 it built the Prairie Line (as the 4th sub-division) between Tacoma and Roy-Tenino. In 1891 NP built the American Lake Line (as the 17th sub-division) from Lakeview to Nisqually. In 1914 the Point Defiance Line was built by the NP (as the 3rd sub-division), this route went around the peninsula; in 1970, it was transferred to Burlington Northern Santa Fe after BNSF was formed from the NP and other railroad companies.

These rail roads have been realigned somewhat to adapt to the highways and now the Point Defiance Bypass project.

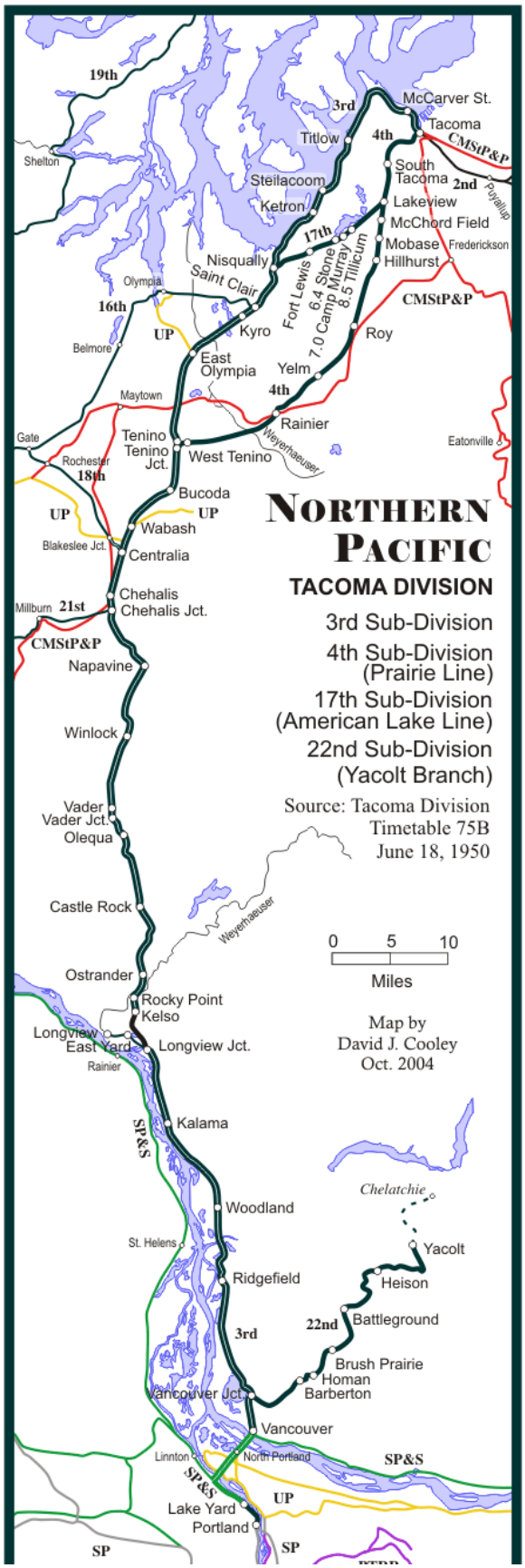

Fig. 1. Map of NP routes in the Tacoma Division in 1950, south to Vancouver, WA. The CMStP&P was The Milwaukee Road.

What the map above shows clearly is that the route was and is intended to connect Tacoma with Oregon, not Olympia. The Yelm to Tenino line is now a paved 14-mile long footpath; the corridor was acquired by Thurston County in 1993.

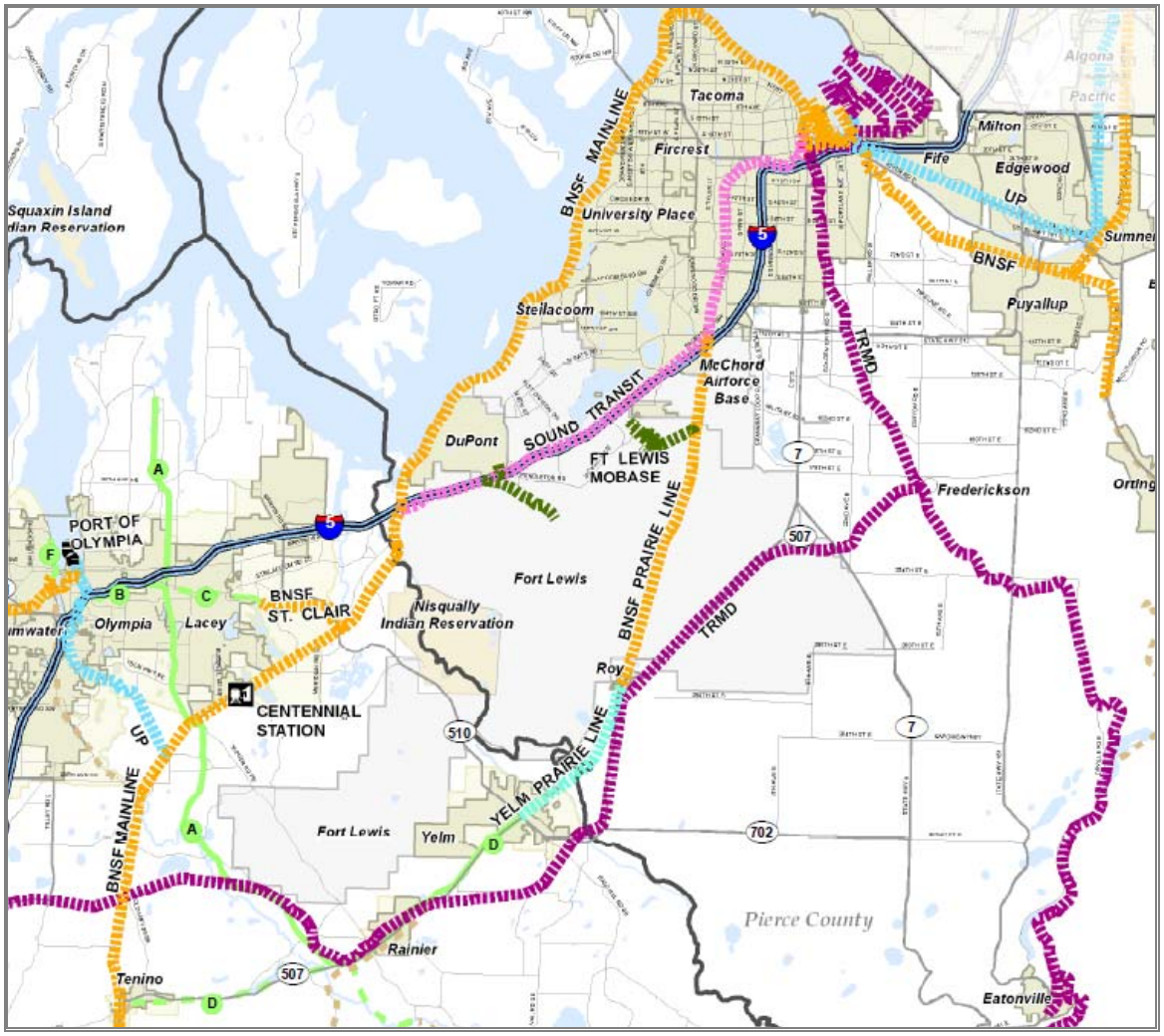

Fig. 2. Excerpt of 2004 map of rail lines in Pierce and Thurston Counties by Thurston Regional Planning Council

From Lakewood to DuPont the rail road is on the north side of I-5. It is at the south side of DuPont that the track is carried to the south side of I-5 on two bridges over the highway (built in 1936). Trains have to slow to safely make the curve onto the bridges.

The alignment from Tacoma to Nisqually constitutes the new Lakewood Subdivision.

From Tacoma to DuPont all rail road crossings are at grade.

It is the rail bridges over I-5 in DuPont that are central to the derailment. I-5 was constructed as a divided highway, with each direction over-crossed by one rail bridge. The west-most bridge, over the southbound I-5 lanes, was built in 1936 to cross U.S. 99; it is described as "Pony/through plate girder bridge."

Fig. 3. 2011 map of alignments of U.S. 99, I-5, and the train tracks (dashed line) at DuPont

The derailment occurred at milepost 19.8 on the Lakewood subdivision.

Conflict

In the beginning were the military roads. The NP's Tacoma Division of rail roads was begun in 1873 and completed in 1914. The Pacific Highway was established in 1913, on the Point Defiance peninsula it generally followed the military road between Fort Vancouver and Fort Steilacoom; by 1917 that highway was paved. U.S. 99 was established between 1926 and 1930, in the DuPont area it generally replaced the route of the Pacific Highway.

The growth of the military bases strained the highways. Fort Lewis was established in 1917, McChord Field in 1938, and the JBLM in 2010.

I-5 was completed by 1969.

The issue relevant to the 2017 derailment is the use of the American Lake Line to carry heavy freight between the BNSF mainline at Nisqually and JBLM; beginning in 2003, the American Lake Line was the only rail route to JBLM.

The southbound American Lake Line descends the south side of the Point Defiance peninsula at DuPont, merging with the NP's 3rd sub-division at Nisqually (79 feet elevation per a topo map). The elevation at Lakewood is 262 feet, the elevation at DuPont is 249 feet, the elevation just east of the derailment is about 220 feet. The distance between the intersection of Center Drive and I-5 and the mainline rail road at Nisqually River is about 2.25 miles.

The curve in question is just over 8 degrees and lies at the foot of 4 miles of a 1.4% descending grade southbound. A second calculation came up with a 1.6% compensated grade.

There was no conflict between a highway and the American Lake Line (ALL) during the years of the Pacific Highway and U.S. 99. But I-5 was placed on the same slope as the rail road, and the tracks were routed over each highway direction on a bridge. Presumably this was done to accommodate the great weight occasionally carried by freight trains to JBLM. Trains had to traverse the slope, and cross I-5, at a

slow speed, set at 30 mph. The engineering may have made sense when the only rail traffic was freight, but it added a perhaps unnecessary complication when 80 mph passenger rail was planned.

There is a second location for possible difficulties relating to train speed: the intersection of the ALL and the BNSF mainline just east of the Nisqually River. This intersection is at the Nisqually Road SW (Old Pacific Highway SE), which road seems to cross the tracks overhead on a bridge. The mainline here is double-tracked, the ALL adds a third track which merges at Nisqually Station. The mainline continues double-tracked past Centennial Station at Lacey. The section between the DuPont I-5 overpass and the junction with the current BNSF mainline near Nisqually also has near a 30mph speed limit.

Background: the Project

The Point Defiance Bypass project was conducted by several agencies. Such complex, overlapping responsibilities are fairly common for today's passenger rail.

The project posed significant engineering challenges. The difficulty was increased by the grades to be overcome at both the north (Tacoma) and south (Nisqually) sides of the Point Defiance Peninsula.

To summarize responsibility: The WSDOT initiated the Cascades High-Speed Rail Capital Program. They hired Sound Transit, a public agency, to handle the route planning and (re)development. Amtrak is the Cascades service operator, as a contractor.

The Players

Nine agencies were involved in the Bypass project.

Amtrak
WSDOT
ODOT
Sound Transit
Federal Railroad Administration
Tacoma Rail
BNSF
ENSCO
National Transportation Safety Board

In addition, the Washington State Transportation Commission provided a guiding policy.

Amtrak

Amtrak is America's privately-held public national passenger rail operator. It is commonly confused by its private ownership and reliance on public funds.

The Amtrak Cascades service is jointly owned by the state transportation departments in Washington (WSDOT) and Oregon (ODOT), with Amtrak running the service as a contractor and maintaining responsibility for day-to-day operations. The Cascades service extends from Seattle to Portland with northern connections to Vancouver, British Columbia and southern connections to Eugene, Oregon. Amtrak Cascades train service began in 1994. Amtrak Cascades is funded by ticket sales and sponsorship by WSDOT and ODOT.

The PDB project was intended to increase Amtrak Cascade service. A new Amtrak station in Tacoma (called the Tacoma Dome Station in Freighthouse Square[29]) was built to connect the service from Seattle through the Bypass.

Washington State Department of Transportation – WSDOT

WSDOT is a cabinet-level agency reporting to the Governor and headed by the Secretary of Transportation.

29. Freighthouse Square was originally a Milwaukee Road facility.

WSDOT is responsible for building, maintaining, and operating the state highway system, including I-5 in Pierce County, and for the state ferry system.

The Bypass route is a key feature of the Cascades High-Speed Rail Capital Program, which is a project of WSDOT.

The idea for the Bypass route originated at WSDOT in 1993. Making it happen has taken 25 years of work. First, someone had to come up with money to do it. (Sound Transit got there first.) Then, it took getting BNSF, Tacoma Rail, Sound Transit, WSDOT, Amtrak, City of Tacoma, City of Lakewood, Pierce County, and Port of Tacoma to all agree. There was also consideration of restoring the original NP line between Lakeview and Tenino for Amtrak service, but that was dismissed for several reasons.

The essential idea of the Bypass project was to be able to increase the number of Cascades roundtrips between Seattle and Portland from four to six. While the Bypass route is only ten minutes shorter than the Point Defiance Line, a more important benefit is the huge increase in reliability (from traffic and weather problems that are not present inland).

WSDOT states their responsibility for the Amtrak Cascades service includes: train operations management and reporting; budgeting; performance tracking; construction project management and reporting; local, regional, state, and national program coordination; working with the freight rail partners that own the railroad tracks; public outreach; and marketing activities.

WSDOT completed an upgrade of the rail corridor for reliability by May 2017. In the area between Nisqually and the Columbia River, they installed new track, 33 turnouts and switches at 12 control points.

WSDOT awarded a contract to Siemens USA to manufacture 8 new Siemens Charger locomotives for the Cascades. The order was part of a larger joint purchase between Illinois, California, Michigan, and Missouri. These locomotives were delivered to WSDOT in Summer 2017 and went into service in late 2017. The additional locomotives will enable two additional runs to be added as part of the Point Defiance Bypass project and will replace the six EMD F59PHI locomotives leased from Amtrak. One SC-44 locomotive was heavily damaged in the December 18, 2017 derailment on the Point Defiance Cutoff.

WSDOT owns three of the Talgo original trainsets[30]. Amtrak owns two of the original trainsets and all the locomotives (though these are being phased out with new WSDOT locomotive purchase). Oregon owns two trainsets.

The Talgo Series VI trainset destroyed in the derailment had been built to operate between Las Vegas and Los Angeles; it was renamed the Mount Adams when it was purchased by the state of Washington.

Oregon Department or Transportation – ODOT

This agency is partnered with WSDOT on the Amtrak Cascades service. Their involvement on the PDB was likely minimal.

WSDOT and ODOT sponsor and manage the Amtrak Cascades service through a Memorandum of Understanding.

30. A trainset is a locomotive and carriages coupled together to form a unified set of equipment. A typical Amtrak Cascades trainset seats approximately 250 passengers and typically consists of 13 train cars, including one baggage car; two business class (first-class) coaches; seven standard coaches; one bistro (cafe) car; one lounge car; and one service car that provides onboard electricity for the train.

Central Puget Sound Regional Transit Authority – Sound Transit

Central Puget Sound Regional Transit Authority (aka Sound Transit) is a public transit agency[31] serving the Seattle metropolitan area. Sound Transit plans, builds and operates express bus, light rail, and commuter rail services. They serve the urban areas of King, Pierce and Snohomish counties. Sound Transit was founded September 17, 1993. It is governed by an 18-member Board of Directors made up of elected officials from member jurisdictions and the state Secretary of Transportation.

ST began planning a regional mass transit system; the plan named "Sound Move" was approved by voters in November 1996. In response to continued population growth, ST proposed a plan built on Sound Move, called Sound Transit 2, or ST2. Those investments were presented to the region's voters in November 2007 and were defeated. ST2, in a somewhat modified form, passed in November 2008. ST3 was approved by voters in November 2016.

Sounder is ST's commuter rail service. It is currently composed of a North Line (Everett–Seattle) and a South Line (Lakewood–Seattle). It plans a future service between Lakewood and DuPont as part of ST3. The South Line was included in the original Sound Move plan approved in 1996, the first train began operation December 1999. The North Line began service in December 2003.

Sounder commuter trains are owned by ST, operated by BNSF, and maintained by Amtrak. ST is responsible for the tracks. Sounder will use different track than Amtrak between Tacoma and Lakewood on the Bypass route.

Sound Transit acquired the whole Bypass corridor from BNSF in 2004, as a 99-year lease. Consequently, ST owns the tracks known as the PDB.

WSDOT contracted with Sound Transit to deliver the track and signal work for the Bypass, including: upgrading crossings, bridge rehabilitation and construction, and retaining wall construction. This work included constructing a new second track adjacent to Sound Transit's existing main line between South Tacoma (66th Street Bridge) and Lakewood (Bridgeport Way) and installing new rails, ties, and ballast on Sound Transit's existing track between Lakewood and Nisqually with associated signal and PTC safety systems.

The tracks known as the Point Defiance Bypass (PDB) are owned by Sound Transit. The tracks were previously owned by BNSF and were used for occasional freight and military transport. They are expected to continue to be used that way.

Tacoma Trestle: In 2008 voters approved the ST2 Transportation Plan, a part of which was to replace the existing wooden single-track trestle in Tacoma (built by Milwaukee Road) with a double-track concrete structure. Work on the trestle began in 2013 with design. In 2013 Sound Transit was awarded a $10M U.S. DOT TIGER Grant[32] to help advance the construction completion date from 2023 to 2017; Sound Transit will provide 71% non-federal match for this project whose total cost was estimated as $54.74 million. In their 9-21-2017 status report, ST claimed

> As owner of the new track and signal improvements from Tacoma to Nisqually, Sound Transit must test, commission, and certify that the improvements are safe before beginning revenue service.

31. In the United States, a transit district is a special-purpose district organized either as a corporation chartered by statute or as a government agency.

[32] TIGER grants are discretionary grants made by the U.S. DOT. TIGER is the Transportation Investment Generating Economic Recovery grant program.

The trestle and related train platforms were planned to service Amtrak's Cascades and Coast Starlight trains, and adjoin the new Freighthouse Square passenger terminal.

Sound Transit plans to construct a new railroad maintenance facility to service Sounder commuter trains at its expanded Century Yard facility in the City of Lakewood. The building will contain maintenance bays, materials storage areas, offices, and facilities for employees.

Tacoma Rail

Tacoma Rail is the city's short line freight railroad; it is one of three operating divisions of Tacoma Public Utilities and is municipally owned. It handles all of the responsibilities of any common carrier railroad, including track inspection and maintenance, locomotive maintenance, customer service, and administration. It has locomotives and track that provides key freight connections for customers in the greater Tacoma area. It serves 65 customers on 204 miles of track. The Bypass route in Pierce County from Port of Tacoma to Nisqually is managed by Tacoma Rail. Their Lakewood Subdivision has trackage rights over Sound Transit Line between DuPont and South Tacoma. Interchange for all traffic is with BNSF at DuPont.

Until recently, the tracks and line of the bypass were part of Tacoma Rail's regular freight routes. The railroad had used the route for 13 years, running twice weekly from DuPont to points further north.

Tacoma Rail bought the Prairie Line from BNSF in 2003.

Tacoma Rail was formerly Tacoma Belt Line Railway.

BNSF Railway Company – BNSF

BNSF Railway (originally Burlington Northern Santa Fe) is a freight railroad, the largest in North America.

BNSF was founded over a period of years by consolidations of independent railroads, including Atchison, Topeka and Santa Fe Railway (often called the "Santa Fe"), and Burlington Northern Railroad. The Burlington Northern Railroad had been formed in 1970 as a consolidation of several railroads including the Northern Pacific Railway.

In 1977 the Milwaukee Road filed for bankruptcy; it abandoned its Pacific Extension (Montana, Idaho, and Washington) — its transcontinental service to the West Coast — and what was left merged with Soo Line Railroad, a subsidiary of Canadian Pacific Railway. Much of its Washington trackage continues to be used by multiple railroads, including BNSF.

BNSF owns track and locomotives throughout the USA. It previously owned the Bypass route. They continue to hold the dispatch responsibility over the full route. BNSF owns trackage rights on the Bypass route.

Trackage rights is an agreement between railroad companies in which the owner of tracks grants another railroad company some use of them.

ENSCO

ENSCO provides engineering, science and advanced technology solutions to the aerospace, avionics, national security, and rail industries. Their headquarters are in Springfield, Fairfax County, VA where they must enjoy direct contact with federal government customers.

Rail customers include Amtrak and BNSF. Rail technologies include track inspection, track data management, vehicle track evaluation, rail safety and security, and train control safety. It is theorized that ENSCO helped with testing the track on the PDB.

Federal Railroad Administration – FRA

The FRA is an agency of the U.S. Department of Transportation. It was created in 1966 to:

a) promulgate and enforce rail safety regulations,
b) administer railroad assistance programs,
c) conduct research and development in support of improved railroad safety and national rail transportation policy,
d) provide for the rehabilitation of Northeast Corridor rail passenger service, and
e) consolidate government support of rail transportation activities.

Federal Railroad Administration reviewed work throughout the duration of the contract between WSDOT and Sound Transit.

National Transportation Safety Board – NTSB

The NTSB is an independent agency of the federal government. They are responsible for determining the probable cause of transportation accidents, promoting transportation safety, and assisting victims of transportation accidents and their families. Their focus is on safety, which is in keeping with their name.

They performed the official analysis of the derailment. That analysis is incomplete as of 9-1-2018.

The Accident ID for the derailment is RRD18MR001. A number of documents have been published on their Docket Management System. The NTSB Docket System is accessible at https://dms.ntsb.gov/pubdms/search/document.cfm?docID=464934&docketID=61332&mkey=96974

An Executive Summary and Preliminary Report were published on the NTSB website at https://www.ntsb.gov/investigations/Pages/RRD18MR001.aspx and https://www.ntsb.gov/investigations/AccidentReports/Reports/RRD18MR001-prelim.pdf . It was published on 1-4-2018.

I found some documents to be especially helpful:

- Individual interviews
- Human Performance Group Factual Report
- Operations and System Safety Group Factual Report
- Locomotive Event Recorder Group Factual Report
- Survival Factors / Crashworthiness Group Factual Report [has a detailed description of where the individual train cars ended up and the nature of their damage, not for the faint of heart]

The NTSB's website explains:

> Safety recommendations are the most important part of the Safety Board's mandate. The Board must address safety deficiencies immediately, and therefore often issues recommendations before the completion of investigations. Recommendations are based on findings of the investigation, and may address deficiencies that do not pertain directly to what is ultimately determined to be the cause of the accident.

Washington State Transportation Commission – WSTC

The Washington State Transportation Commission (WSTC) provides an open public forum for transportation policy development. It reviews and assesses how the entire transportation system works across the state and issues the state's 20-year Transportation Plan. The WSTC also sets tolls for state highways and bridges and fares for Washington State Ferries.

The WSTC is a seven member body of citizens appointed by the Governor for six-year terms. The Secretary of the Washington State Department of Transportation and a representative from the Governor's Office are ex officio members of the WSTC.

The WSTC had no direct involvement in the PDB project, but must have been an observer, silent or otherwise.

The WSTC conducts its public outreach program primarily through meetings held in both Olympia and localities throughout the state each year. These meetings are viewable on live webcasts; agendas are available in advance.

The WSTC's 2007 rail study, "Statewide Rail Capacity and System Needs Study" is a fascinating view of freight and passenger rail in Washington with policy recommendations. It is published on their website at http://wstc.wa.gov/Rail/RailFinalReport.pdf

Roles and Responsibilities

The following information is excerpted from a presentation made in July 2018 to the NTSB.

Agency	*Roles and Responsibilities on the Bypass*
Sound Transit	• Owns and maintains the Bypass • Construction administration of capital improvements on the Bypass
BNSF	• Dispatches all trains
Amtrak and Talgo	• Operate and maintain passenger trains and employs staff on trains
WSDOT	• Grant administration of capital improvements • Administration and oversight of operating funds • Contributes funding for track and signal maintenance

FRA	• Grant manager for ARRA program (includes Bypass work)
	• Approved (working with WSDOT)
	  ◦ Project management plans
	  ◦ Finance plans
	  ◦ Environmental assessments
	  ◦ Preliminary engineering plans
	• Accepted final design plans
	• Provided grant oversight for construction

Funding

A number of websites provide funding figures, but these do not agree with each other!

The state spent $58.92 million from the stimulus bill on eight new locomotives, specifically for the Cascades service.

The bypass project began in 2006 and was funded by grants administered by the Federal Railroad Administration under the terms of the 2009 American Recovery and Reinvestment Act (ARRA).

The ARRA money came with a hook: it had to be spent, in its entirety, by September 30, 2017.

ARRA funds for transportation infrastructure included highways, passenger rail, and Amtrak.

The WSDOT website states:

- Washington state is delivering nearly $800 million in federally funded rail corridor improvements using American Recovery and Reinvestment Act (ARRA) high-speed rail grants administered by the Federal Railroad Administration. The Point Defiance Bypass is one of those ARRA-funded projects.
- Project budget - $165.3 million.

President Obama's 2009 stimulus package gave the bypass the boost it needed, providing much of the funding for the $181 million project and accelerating the completion date from 2019 to 2017 (a deadline mandated by the federal grant).

I found no finer cost breakdown.

Sound Transit's ST2 Plan included funding by local taxes, federal grants, and fares.

It's been suggested that mitigating the 30-mph curve could be submitted to the FAST Act. That is the Fixing America's Surface Transportation Act which was signed in 2015 by President Obama. The FAST Act authorizes $305 billion over fiscal years 2016 through 2020 for surface transportation infrastructure, including trains.

Schedule

The availability of federal money provided a jump start to this project. The requirements of that money set an end date which ultimately proved deadly.

Deficiencies

Three things are generally held responsible for the derailment:

a) The presence of the 30-mph curve at DuPont, after several miles of 80-mph track.
b) The engineer failed to slow the train in advance of the 30-mph curve.
c) Positive Train Control (PTC) was not in effect.

PTC was originally planned to be operative on the Cascades service and on the Bypass route. However, its installation was not completed in time for the inaugural run. It should be recognized that PTC may not have slowed the train and prevented the derailment.

To this day the WSDOT is betting on PTC to eliminate the risk of the 30-mph curve. They are holding firm on their back log of projects, avoiding the inevitable disruption that funding a replacement of the 30-mph curve will cause.

Complexity

The project had a number of objectives and requirements, not all of which were complementary or compatible. It is my theory that decisions that might have eliminated the 30-mph curve, were not made in favor of a competing plan.

Public Information

My complaints largely center on lack of public information. Project documents cannot be found on WSDOT's website as of 9-1-2018. There is no evidence that board meeting agendas or minutes were ever published. The WSDOT seems to rely on "news" to inform the public.

I would like to see each WSDOT project have a Project Information Officer who is tasked with acquiring/writing and publishing a standard set of documents.

Risk Management

I saw no evidence of risk management in the planning of the rail projects. *Risk* is defined in ISO 31000[33] as the effect of uncertainty on objectives. This practice begins with identification of all things at risk and the sources of risk, analysis of them, and plans to prevent and/or mitigate each one. The 30-mph curve at DuPont should have been on such a report as well as the status of PTC.

Note that the lack of the phrase "risk management" from NTSB documents is more a matter of vocabulary. They refer, instead, to "safety":

> NTSB accident investigations have revealed that, in numerous cases, safety management system (SMS) or system safety programs could have prevented loss of life and injuries.

They do say: "Manage Risks to Ensure Safety."

The NTSB interviewed two men with Sound Transit, who managed a risk management program, although they do not call it that. Refer to that interview for details, also my synopsis.

Given the retention of the 30-mph curve, mitigation measures should have included several high-visibility low speed zone ahead signs and extensive engineer training. Neither were done. Note that the engineer was interviewed on 1-17-2018 in his home by the NTSB. He stated that the slow-speed-ahead sign that was posted two miles north of the 30-mph curve was of no value to him, as he would not start slowing that far away from the curve; instead he was looking for a control point CP 18.96, that he saw during his training runs, but did not see on December 18. I subsequently learned about signals which are used to direct engineers. Their role in the hands-on training is not clear, nor is their presence on the timetable known.

The interviews state that the timetable was incomplete. That would certainly be a factor in the cause of the derailment. I found no indication that engineers are allowed, even encouraged, to review and approve a timetable before it goes into service.

33. ISO 31000 is a family of standards relating to risk management codified by the International Organization for Standardization. The ISO is an international standard-setting body composed of representatives from various national standards organizations.

One might suspect that the project's chosen method of risk management was no accountability.

Lack of Accountability

Given the many agencies involved in the Bypass project, lack of accountability is not a surprise.

With no one in charge, finger-pointing by the participating agencies is inevitable.

Given the lack of public information, it is impossible for the public to monitor discussions, decisions, and actions by the various agencies. Without that information, the public is unable to evaluate the absence of risk management. Without that information, the public is unable to recognize a lack of accountability.

It seems likely that AARA did not require continued public information or accountability.

Adversarial Management Style At Amtrak

On April 3, 2016 there was a collision of an Amtrak train with maintenance-of-way equipment near Chester, Pennsylvania; the train derailed, two people died, and 39 train occupants were injured. In that case the NTSB found that Amtrak's management of safety and compliance resulted in a culture of fear and a normalization of deviance from safety rules: "In this accident, investigators found a labor/management relationship so adversarial that safety programs became contentious issues at the bargaining table, with the unions ultimately refusing to participate in two out of three programs. ¶ By focusing solely on compliance and punishment, Amtrak missed opportunities to improve safety through established top-down safety management principles. And, they shut down the reporting of valuable safety information from their employees."

It seems likely that that situation was not resolved one and a half years later. And that it may have influenced the training as well as the operation of the train on the day of the derailment.

Dysfunctional Safety Culture at Amtrak

Some people have accused Amtrak of having a dysfunctional safety culture, including the Chairman of the NTSB, Robert L. Sumwalt. Given the fact that the 501 train derailed, Amtrak surely has some responsibility. A number of people have written about this, which you can find readily online. They consider the long history of Amtrak accidents as evidence. On December 17, 2017 The Oregonian published an article titled "Amtrak's safety record criticized before derailment." That article:

> The board [NTSB] warned as recently as November that safety lapses throughout Amtrak have contributed to crashes, with its chairman saying the railway's safety culture is "failing."

The Essential Conflict Between Passenger Rail and Freight Rail

The passenger rail accidents from overspeed happen on freight rail tracks. Freight was the first use of rail transport, and routes were constructed across the country. Passenger transport came later, and has historically been operated on the freight lines. But this relationship is no longer working. The essential problem is that the freight lines were built for slow-moving trains, while the passenger train speeds are being increased to what we now call "high-speed rail." These high-speed passenger trains tend to run into difficulties on freight rail lines, difficulties like sharp curves. The solution is what has been avoided for decades: separate passenger rail tracks.

NTSB Interviews

Between December 19, 2017 and March 2018 the National Transportation Safety Board (NTSB) conducted a series of interviews with people who were key to the project or the operation of train 501. The interviews were transcribed and published on the NTSB's website, on their Docket System. This document summarizes those interviews to different degrees of detail, you are advised to read one or more for clarification.

NTSB Docket System
https://dms.ntsb.gov/pubdms/search/document.cfm?docID=464934&docketID=61332&mkey=96974
The Accident ID for the derailment is RRD18MR001. The derailment interviews are identified by: Group F - DuPont as part of the names of the docs.

Group E- Exhibit 1 49 CFR Part 270, System Safety Program; Final Rule
Group F- Exhibit 1 Witness Interview DuPont Engineer
Group F- Exhibit 2 Witness Interview Sound Transit Managers
Group F- Exhibit 3 Witness Interview Washington DOT- Safety Manager
Group F- Exhibit 4 Witness Interview Washington DOT- Rail Manager
Group F Exhibit 5 Witness Interview Sound Transit Rail Activation Team - DuPont, WA
Group F-Exhibit 6 Witness Interview Road Foreman- DuPont
Group F-Exhibit 7 Witness Interview Road Foreman 2- DuPont
Group F-Exhibit 8 Witness Interview Lead Service Attendant DuPont
Group F-Exhibit 9 Witness Interview Division Superintendent DuPont
Group F-Exhibit 10 Witness Interview Conductor- DuPont
Group F-Exhibit 11 Witness Interview BLET Local Chairman- DuPont
Group F-Exhibit 12 Witness Interview Assistant Superintendent- DuPont
Group F-Exhibit 13 Witness Interview Conductor Qualifier -DuPont
Group F-Exhibit 14 Accident Witness Interviews-DuPont

The interviews were led by Mr. Ryan Frigo, an investigator with the NTSB, who directed the conversation and posed questions. He was a delicate interviewer, avoided accusations, tried to lead the interviewees to talk about the details that concerned him. He stated his role is to understand the process, identify possible problems in that process, and propose improvements to the Board.

As I read the interview transcripts, I could not imagine that the interviewees were able to go through the interview experience, knowing the train derailed, without weeping.

There are other documents in the Docket Ssytem, look for the word "DuPont" in the title. Note that the NTSB combined their investigation into the DuPont derailment with an accident at Cayce, South Carolina.

Exhibit	*Date*	*Subjects*
1	1-17-2018	Amtrak Engineer, Steve Brown engineer training; chronology and experience of Dec 18, beginning with train switch in Seattle — or why the train was late. At DuPont southbound he was looking for a visual cue of how far away he was

Exhibit	*Date*	*Subjects*
		from the curve, and never saw it.
2	3-15-2018	Sound Transit Officers, Salah Al-Tamimi and Robert Taaffe system safety and safety management at ST. Taaffe works for Al-Tamimi who reports to the CEO. Mentioned risk; they have a Fire and Life Safety and Security Committee for each project. Also a Design Safety Security Committee. Discussion of how uncomfortable risks are escalated. "What was unique about this particular project is that it was a WSDOT design." They keep committee minutes. For the Bypass project they followed the MIL Standard 882E, a military standard. They do a hazard analysis and risk matrix. Also discussed overspeed derailments. Taafe: 2.8 percent grade at milepost 3 [a 2.85 grade is considered rather severe]. The overspeed derailment concerns were about at grade crossings re the base [JBLM]. There was a discussion of a curve, apparently there is a rating for an overspeed derailment. A reference to PHA [Preliminary Hazard Analysis (mandated by OSHA)]. "And with that particular line item, when this project initially started and with had [sic] our first PHA workshop in 2014, FRA required PTC to be in play, operational, at the end of 2015. So the expectations were from all of our parties that PTC was going to be operating on the Point Defiance Bypass, and as we all know that was then pushed out until the end of this year." Even with PTC operating, they would have adjusted their evaluation, because PTC is not that reliable, "we would still have to rely on the operating engineer. We'd have to operate on signs, standard operating procedures, our grade crossings, to mitigate that hazard." The curve was rated a 1(d) hazard without PTC. It was an undesirable hazard that was accepted. NTSB wanted to know why. Taaffe: . . . "the uniqueness of this project is that we can only rely on the design, the super-elevation of curves, the grade crossings and warning times, making sure they're adequate for the speeds of the trains. But when it came down to operating the train at the operational speeds, unfortunately we were not involved in that. My group is not involved at that." Only Sound Transit had a PHA. Apparently Sound Transit had no contractual responsibility for operating hazard analysis. The NTSB: we talked about how the location at 3.1 meets the requirements of the FAST Act, which is the speed limit reduction and it's the speed reduction of greater than 20. And so that's actually in the timetable as a location where a crew member would have to, you know, be in contact with the engineer prior station, not less than one mile prior to that location. We talked about how it wasn't in place for 19.8. NTSB's Mr. Frigo pressed on, stating that Sound Transit performed the only hazard analysis, did anyone who had to sign off on documents notice? Mr. Taaffe replied that the PTC piece was a separate project unrelated to the Bypass project. Frigo acknowledged that Sound Transit had defined the hazard at the curve, and that the FAST Act was prompted by overspeed derailments in curves.

Exhibit	*Date*	*Subjects*
		The Tacoma Trestle was a separate project. "That did not have an impact on the operating environment or the certification of the Point Defiance Bypass." Regarding the December 18 accident, PTC wasn't required. Al-Tamimi : "The powers that be made a decision that this is the alignment that you have." They could not have addressed all the problems. ST did a 60% constructability review; they did not evaluate operational aspects. "The main principle of hazard mitigation is practical." ST owns and maintains the tracks. Interesting interview, there were discontinuities between ST and WSDOT and Amtrak. Al-Tamimi: "I just want people to remember how complicated this thing is. You've got too many parties and we try to work together . . . This one is -- really makes it really complicated."
3	1-17-2018	WSDOT Safety Manager, Mike Rowswell Hazard management process and safety certification. He worked on the Siemens locomotives, there were multiple issues. Crossings are one of the biggest hazards facing trains. He was not involved in certification of the locomotive. He did not visit the mockup of the loco that was set up in California, his boss attended. Rowswell did not mention attention to engineer's visibility. As of the date of the interview, the hazard management list had not been approved; it had been reviewed and tentatively approved and there are no substantive issues remaining. Rowswell stated that all reviews and approvals had been done, everything was "uploaded into the system", what remained was documentation, which was more of a formality; they used a system like SharePoint, called PDMC. He was asked if there were regular reports on the design review process; he did not see any. Some discussion of division of responsibility between WSDOT, Sound Transit, and FRA. [In this interview I see the focus on the locomotive as perhaps obscuring the hazard of the curve.] The PHA listed overspeed derailments as a risk, it received an unacceptable rating, the mitigation was PTC and the timetable, it was signed off as complete — but it was not, and there was no exception to that. "At that time it's possible that everybody assumed PTC would be in effect." Sound Transit signed off on it. Overspeed or curves is an operational hazard. Rowswell did not know of any regular project meetings hosted by FRA. WSDOT had meetings. The only ongoing meeting about project safety was the PHA meeting. A lot of meetings did not have formal agendas. [Apparently meetings were different for projects involved managing a grant, than for strictly internal projects.]
4	1-16-2018	WSDOT Rail Division Manager, Jason Biggs + 4 High level overview of the project and collaboration among the players. WSDOT prepared itself for federal funds, which became available under ARRA. WSDOT got about $800 million. They were required to demonstrate a benefit for the funds, they claimed 10 minutes time savings, 2 additional round trips, and

Exhibit	*Date*	*Subjects*
		88 percent reliability. For most projects on the corridor, WSDOT's role was grant administration oversight. the PDBypass project was made up of a series of 20 separate projects. Track B is where the curve is; ST administered the construction. ST is the owner of the rail from Nisqually through Tacoma. ". . . there's only one piece of actual right of way that WSDOT, at the end of the day, owns, and that's the station at Tacoma. Every other piece of the ARRA agreement, we were working closely with either BNSF or Sound Transit to make improvements on their existing line or a line that they owned." Biggs did not participate in a review of ST's hazard analysis doc where it addressed the curve. [I previously guessed that the project lacked risk management, but I was relying on news articles. The interviews make it clear that ST had one.] Some discussion of setting the Dec. 18 date. Tacoma Rail provided a qualified pilot to educate Amtrak's engineers. Page 41 begins a discussion of the curve, speed reduction, and the FAST Act. ST had noted that northbound at milepost 3.4 was a FAST Act requirement, "It seems everybody missed the requirement on this end at 19.8 [southbound], and I was wondering whether WSDOT had heard of that, if they were aware of that requirement generally" The answer was no, our role is not to operate trains, we don't have a qualified engineer on our staff. ARRA award timeline: they applied 10-2009, funding awarded 2-2010. [At this point, it seems that WSDOT is off the hook for the derailment, while ST is on.] [a discussion of the implementation of PTC on Track B, the curve] "And then ultimately it's dependent on the Amtrak back office servers being operational so that we can finalize the testing of the PTC implementation, the interoperability testing. And so, you know, at this point it would be still dependent on that, knowing that Amtrak's back office isn't operational yet." Apparently Amtrak never discussed this with WSDOT.]
5	12-21-2017	Sound Transit Rail Activation Team (5) The leader, Mr. Frigo, asked ST for an overview of the project and a condensed timeline of the past year. [See below for excerpted text.] Part of the difficulty for the interviewees is that some of the relevant work had been done in the 2012 timeframe and was done differently than comparable work done in 2017–8. Mr. Frigo asked about the curve and the restrictions that had been placed on the southbound route. Apparently Sound Transit did not interact with Amtrak, that fell to WSDOT. The major concern with the Amtrak testing in November was clearances running through the stations, for each of the three consist types. Sound Transit was a contractor to WSDOT, who was the grantee. On the service between Tacoma and Lakewood, ST owns the equipment and contracts with BNSF for train crew and dispatch. ST contracts with Amtrak to "maintain on speed." The alignment has a different contractor. This holds from TR Junction to Nisqually. A the end Frigo asked the group if they had any idea how the accident could have been prevented. The only answer was to the effect that at that time it would only be speculation.

Exhibit	*Date*	*Subjects*
6	12-20-2017	Amtrak Road Foreman of Engines[34], on the Job Training, Charles Beatson He oversees the training of all engineers. Regarding the new Bypass segment, he helped Road Foreman Chris Bradasich and Road Foreman Josh Thompson in Seattle, who were taking the lead on it. There were two agencies involved in the territory concerned, one was Sound Transit and one was Tacoma Rail. Sound Transit goes to Lakewood, and Tacoma Rail goes from Lakewood to Nisqually. He was asked if the 20-mile stretch of territory was challenging to learn, he replied "not very challenging." He thought the part of the territory from TR Junction to Lakewood was probably the more complex part, what with the signals, grade crossings, and "infrastructure." "Beyond Lakewood, or beyond CT Rail, it's just straight, single main line, and there's not much to it. It's a few grade crossings, a few singles with, as we know, a very sharp left-hand curve at the end." Beatson was asked "What we learned here is that most of the qualifying runs took place during the night because track work was being done during the day, so they had to squeeze in the qualifying runs during the nighttime only. What's your thoughts about that?" Beatson replied: "I'm not sure if that's the reason we were doing on nights, you know, what was going on during the day. I can't comment. But my thoughts on night running: Typically, I don't like that. I don't like training on nights. However, on this territory, I was rather surprised. It's actually very well-lit at night because it follows the freeway all the way from Lakewood, anyway, to DuPont, to Nisqually. I was surprised at how visible everything was to me. So, in a way, my concern about running -- learning on night, I had no concern by the time I was done with it. . . . On a clear night . . . it was absolutely fine." Beatson said about the engineer Brown: "A very conscientious engineer. He loves his job. He was excited to get into the engineer training program. It's all he's ever wanted to do from being a small boy, and he was a very, very -- he was very competent. He is very competent, I should say, and very keen, loved the job and loved nothing more than being an engineer. And I had no reservations about him at all." Beatson had phoned Brown in the AM of December 18 and gave him the same briefing that he would give to any other engineer. "I said, okay, remember what we talked about. Remember about this curve particularly, and then slow down early, take your time, be careful. And we talked about other things on the routes. And he said, yup, okay, understood." Beatson considered the curve to be significant and an area of concern. There was discussion of distraction in the locomotive cab. Beatson said the controls are fairly straightforward, standard. One distraction might be the location of the switches for the headlights. Another the radio. Another the presence of someone else in the cab. the cab environment, the screen displays.

34. The Road Foreman of Engines is the official charged with overseeing the safe and efficient operation of locomotives

Exhibit	*Date*	*Subjects*
		A discussion of the role of the conductor to call out to the engineer about speed restrictions. The conductor is required to call out certain speed restrictions itemized in the FAST Act. "This curve actually does qualify under the FAST Act, but that hadn't been yet included in a documentation to the conductors to call that one out. But during the training, we made sure everyone was aware of that curve." A discussion of the advanced speed sign/board, engineers won't start braking 2 miles out, which is where the BNSF advanced speed boards are placed, they will instead rely on mileposts. Beatson said the 2 mile distance was appropriate for a 1.9% downhill grade to begin braking. He talked about how the UK uses a magnetic device placed on the track that activates a cab audio device to alert the engineer. This is not commonly in use in the USA. All "we" have is painted signs and colored flags to remind the engineer, these signs and flags can have fallen down or be in the wrong place. The engineer does not have a secondary reminder. He stated there is no PTC "anywhere", especially the Seattle Subdivision. He said there was a signal at the curve, signal number 19.7 [this may be the southbound]. Where was the signal relative to the curve? "I believe it's right at the beginning of the curve. Excuse me. There is also another signal just prior to that at 18.8. So, yeah, so there was a signal at 15.6 or I said 15.5 -- I believe it's 15.5. There's a signal at 17. And then there's another signal at 18.8, and that is the approach to the signal on the curve. "So, basically, 18.8, that signal there, which is an absolute signal, that one would be only a mile from the curve, and that would be, shall we say this, if you brake at that signal, that would be too late. You want to be braking between the two signals, between 17 and 18.8, which is where the speed board would be, actually . . . "
7	12-19-2017	Amtrak Road Foreman Seattle, Chris Bradasich His role on the Bypass project was to qualify engineers on the territory. The Bypass is a 20.6 mile new alignment,
8	12-19-2017	Amtrak Lead Service Attendant, Karen Blackmer She had just started working for Amtrak, December 18 was her first day on the train. She worked the bistro car. She was in the closet, where she had gone to grab a snack, when the derailment happened. She was "bumped around." There were no passengers in the car, just the other attendant Eileen [Eileen Trainer per news story]. Karen phoned 911 with her personal phone. They got out of the car (by exiting the door at the northern end) and walked away. One of the firemen told her to get in the ambulance and head to the hospital; she did.
9	12-21-2017	Amtrak General (Division) Superintendant, Kurt Laird relationship between Amtrak and WSDOT
10	12-20-2017	Amtrak Conductor, B. Tanner Lingafelter His sole train employment has been at Amtrak, he became a conductor in 2014.

Exhibit	*Date*	*Subjects*
		The interview began with an account of December 18th. The day began with missing info. After loading the passengers: "And then we actually ended up running into mechanical issues before we could -- left, we -- our Siemens Charger engine was having problems talking to the P42 on the rear of our train. So we ended up having to call for the Siemens tech, who actually rode over with the switch crew who brought our train across. Luckily, it was right there. And they determined that it was an MU issue between the P42 and the Siemens Charger engine, they had some form of communication issue. So our -- their solution that Siemens came up with was to disconnect the Siemens Charger engine from the train set by pulling the MU cable, and having the Charger do the push-pulling and have the P42 provide HEP. And that's what we did." Outside of Lakewood he's working on a report. No calling out speed restrictions. "And while I was in the middle of working on that and trying to keep an eye out the window to keep on where I was, the whole world turned upside down. Next thing I knew, I was thrown across the room from the table I was sitting at and thrown into the corner of the closet. And Helario came flying into me, and the world went dark and I could taste dirt. And Helario and I are bouncing off each other. And then it all came to a stop." He got passengers off the train. Helario could not walk. "I can't get you out of the train because we're up in the tree; you're going to have to wait for EMS to come get you." "I'm not sure about that zone right there, but portable radio cannot reach Centralia North [dispatcher] at that spot. They cannot hear us on portable radio." The loco is in the middle of I-5. You get a sense of how the train belongs to the conductor, who is getting passengers off the train and herding them to a safe area, contacting Centralia North and the EMS; the medics want to send him to hospital because he hurt his back, but he doesn't want to leave "his train." He describes a training session: "We only went as far down as -- we started at CP[35] Tacoma at the station, and we'd go as far as the final intermediate before you enter Nisqually. I think it's 21 -- sorry -- it's like 21.9 or something, on the final intermediate. We come in on -- it would be an approach medium. It's an approach restricting to a restricting. We had been stopped there on the hill before we come in, into Nisqually. You could see the Seattle Sub and the Nisqually crossover right there. And then you -- we'd go back, and we'd go back and forth, back and forth, back and forth. And we did it at multiple different speeds. But every time, we'd come south, it was always every time approach medium to an approach restricting to a restricting." [I think he was saying the train went south and then backed up in the north direction.]

35. "CP" is a control point, often the same number as a milepost.

Exhibit	*Date*	*Subjects*
		"And the big thing, the big focus of the night was the permanent speed restriction that we're supposed to call out when we drop from 79 miles an hour to 45 going northbound. It's required in the Sounder timetable number 2. " "we -- when going south, that curve there at 19.6, we were, again, working on colors[36] all night long. We were given a verbal Form C by the dispatcher that there was no slide fence and he had indications that the hill had been moving. So, again, we came in on an approach medium to an approach restricting to a restricting. And then we went out onto the Nisqually, and then came back. But every time we were at restricted speed, all the way until we got up to about 19.6 and then took off." Q. So you had one night out there? A. I had one night out there. Q. And what was the signal line-up again coming into 19.6? A. An approach medium to an approach restricting to a restricting. So an approach medium is essentially you're going to be coming down -- they want you at 40 by the next signal. The approach restricting be prepared to pass the next signal at restricted speed. And then at restricted speed, you need to be prepared to stop, terms D, essentially . . . Essentially, be prepared -- within half the range of distance you need to be able to stop. And in an excess of 20 miles of hour, you cannot be at an excess of 20. And so at no point in any of my training trips have I ever ran on pure greens." [This may be a reference to green-colored signals.] Some discussion of his training. Sounds bare bones and inadequate. There was no conductor trainer. And so many people were on the train that it must have been hard for anyone to learn what they needed to know. He described his training as "rushed and inadequate." One problem with the 501 was that there was only one conductor, it really needs an assistant conductor. Without the AC, the C has to deal with tickets and passengers AND look out the window for milepoint clues. There was no AC apparently because Amtrak was short handed. Its standard method of placating conductors was to pay them for two jobs — their conductor job and the assistant conductor job.
11	12-2017	Brotherhood of Locomotive Engineers and Trainmen (BLET) Local Chair, David Estes His work history included training and jobs as conductor and engineer. He has "been working exclusively on the Seattle to Portland service for longer than I can remember." BLET was involved in the training and qualifications on the Lakewood Subdivision. "But everybody's thought, at least that had operated on it [the Lakewood Sub], was that it's relatively simple but there's -- you've got to be careful at the curve

36. By "colors" he is referring to the train signal system which uses red, green, and yellow colors to tell the engineer what to do, either stop, proceed, or use caution.

Exhibit	*Date*	*Subjects*
		going into Nisqually over I-5 bridge and going down the hill. ¶ I mean, a lot of people were worried about us coming up the hill out of Freight House Square because of wheel slip and the weather conditions out here, but the railroad itself didn't seem that -- it still doesn't seem that complicated." Hands-on training on the new locomotives didn't begin until November, until WSDOT released them to Amtrak. Before that there was only manuals, the engineers could not operate the locos. At the same time BNSF and Sound Transit would not give access to the Lakewood Sub, citing conflicting operations and track work from Lakewood south. BLET adhered to the spirit of cooperation, and adapted to the limited availability of the Charger locomotives and the route. "We ended up with a fairly tight and aggressive qualifying schedule, which I personally had to do." With regards to the night-time training in November: "I was determined to see the railroad from the head end every time we switched, you know -- when we got to Nisqually, I switched ends and we'd walk in the ballast to the other end, and we -- you know, I was able to view the railroad till we got to TR Junction." "I explained to them, operationally from an engineer's perspective, you know, going from 79 to one of these new control -- we don't know the signal progression . . ." and after a few night runs . . . "And then like I said, we hadn't really -- I mean that was, I think, somewhat similar, but not, you know, not identical." Details of the November night training. "This is Sound Transit's first attempt to put out a timetable." It did not have the FAST Act's requirement for the conductor to call out the curve to the engineer. "And like I said, the biggest problem with this, was, like I said, and that's for the conductors to deal with, is that they weren't given the exposure on the head end." Some discussion of the presence of a qualifying conductor in the cab. "Especially on a new territory, I fully expected to have somebody sitting over there, several people for a number weeks." Was his presence a distraction? He claimed there were lots of factors to the derailment, but it was "absolutely 100 percent PTC-preventable." Training could not have prevented it, more training "would not have eliminated the inherent risk of that curve going from 79 to 30 on mountain grade." "But the restricted speed was south of the curve. The restricted speed was at the very bottom of the hill the nights that I -- we were issued that. So we, you know, we went from 79 to 30, got it up to 42, down to the bottom of the hill at Nisqually, and that's where the slide activity was and that's where the restricted speed was. It wasn't on the curve."

Exhibit	*Date*	*Subjects*
		". . . we have and a relatively light train, we were able to -- I mean I'm trying to -- we're able to easily slow down to 30, get across the I-5 bridge, kind of come out of dynamic, and the grade there being 1.8 percent, it actually picked up fairly well. Then just go into full dynamics, set a little air, and the train would just -- I mean I think the first couple of times we were little more cautious but realized, okay, now we're slowed down three-quarters of a mile before the restricted speed. So it was a relatively simple area. It was just that bottom, so it really didn't impact the slow down, the normal slow down for that curve in any way, shape or form." "And going north, it was the same thing. You come around -- you'd take the Nisqually signal northbound. You'd get up to speed. You'd slow down, you'd get around that little pocket, and then, you know, once you clear it, you're back up to track speed."
12	12-19-2017	Amtrak Assistant Superintendent, Road Operations, Jeff Greenwell Discussion of the training and the planning of logistics. His involvement was primarily operational readiness. Asked about the challenges, he replied "I would have to say that one of the main setbacks would be not having the rail available to us until we were so close to having to have the service operational. If we could have had another, you know, couple of months to get that done, it would have been great. I would have to say, you know, from an outlook perspective, having new service, new route and new locomotives all at one time made it a bit difficult as well." Sound Transit had not used the route since January of February 2017. So the rails had rust, there were concerns that the signals would not work properly or that there would be issues with crossings.
13	1-16-2018	Amtrak Conductor Qualifier, Garrick Freeman He was present on 501 as a trainee conductor. He was injured in the derailment, and was interviewed at Mirabella Rehabilitation Facility, Seattle. He was riding the head end (front cab) to familiarize himself with the route, he had no operational responsibility. He recalled clear skies and no rain at the time of the derailment. "We didn't use the windshield wipers as I recall." Discussion of the written materials he had and how he got them. He thought they were inadequate. Freeman complained about the inconsistent signal system nationwide. A separate news story stated: Freeman "suffered multiple broken ribs, a fractured clavicle and serious internal injuries." He sued Amtrak.
14	12-18-2017	Witness interviews done at Madigan Hospital and other locations. Interviewers spoke with passengers and one crew member, no one noticed anything unusual. Interviews by NTSB and Washington State Patrol. Several passengers reported the train shaking. Included in the interviews was Steven Brown, Amtrak engineer.

Project History

This history is from interview 5 with members of Sound Transit, copied from the interview transcript https://dms.ntsb.gov/public/61000-61499/61332/616783.pdf

Mark Johnson, Project Director, Sounder Capital Program, spoke:
"I understand you're interested in the last year, but to understand the complexity of the project and the component parts that allowed for the ribbon cutting on the 15th of December and the start of revenue service on the 18th, we need to go back, really, into the late '90s and the early 2000s, and maybe even prior to that. The state had an interest in establishing a rail corridor off the Point Defiance route that BNSF has had for quite a long time, because of constrained speeds on that route, because of the swing bridge that would stop train traffic, because of the single track tunnel through Point Ruston. So the planning for this goes way back. In 2003, Sound Transit began purchase of what was then called the Lakeview Subdivision from BNSF. And that was after a couple years of negotiation. . . . We began that purchase, completed -- it was done in a series of component pieces. We completed that, I believe, in 2005 or 2006 . . . .

We had established a project as part of Sound Move, approved by the voters in 1996, that was called the Lakewood Extension, and that was to provide service between Tacoma Dome Station and Lakewood, with another stop in South Tacoma. That project eventually was broken into two pieces because part of it -- the majority of the track miles was pretty clearly defined. We had purchased the right-of-way by that time. Our design was completed. That was called the Upper Lakewood project. I think it involved about 7 miles of track. And it was completed, but the connecting piece between those improvements and Tacoma Dome Station was very challenging; it was the D to M Streets project. So those two became two separate projects with their own budgets.

The D to M project. . . involved rethinking a crossing of Pacific Avenue, South Tacoma Way at 26th Street and Tacoma, and ended up with a decision by the board to more than double the project budget so that we could grade separate that crossing. That was constructed, I think, maybe, starting in 2010 when we completed the M to Lakewood project, and then in 2012 we completed construction of the segment called the D to M Street project.

At that point we were in a position to begin our own train service between Tacoma Dome Station, South Tacoma, and Lakewood Station as far as we planned to extend service. Both of those stations had already been built in years previous and they were actually being used as part of our transit system because they had parking associated with them and they had bus service. So they -- there was usefulness, but they didn't have train service until 2012.

So in 2014, we purchased what's called the Reservation Junction Rail from the city of Tacoma, from Tacoma Rail. And that produced -- that created a situation in which we had ownership from TR Junction where our rail joins the BNSF main line, all the way to Nisqually Junction, and it was a inner-connected route. The southern portion of it though was, under FRA classification, excepted track and the only service running on it was freight service, BNSF military trains serving the base and then Tacoma Rail, to whom the freight easement had been granted, or sold, by BNSF. And the speed limit that they operated on was 10 miles an hour.

So we then initiated the -- actually, I should say the state initiated design work on the upgrades for the track from -- adding double track from 66th Street bridge to Bridgeport Way, for which we had already installed double track crossings that we filled in there. And then we -- then their design improved the track to Class 4 standards from Bridgeport Way down to Nisqually Junction.

That design was done by WSDOT using a consultant, HDR. And Sound Transit then, under our construction and maintenance agreement, agreed to bid that project and to administer construction of that project and then to, with appropriate approvals, to accept ownership of that since we owned the right-of-way and to operate that for the benefit of Amtrak service. And there's a operating agreement between Amtrak and Sound Transit that governs the terms of that.

I . . . want to touch on the relationship of the Tacoma Trestle Project to the improvement of the entire trackage there. And that is, WSDOT's improvements were funded, of course, by American Recovery and Reinvestment Act funds. And those improvements included the Point Defiance Bypass track and signal contract that we bid and administered construction of, but they also included improvements in the Tacoma Dome Station area.

And initially WSDOT intended to construct all of those improvements themselves. There would be a crossover between Track 1 and Track 2 located between East C and East D Street that include a new south platform and then, of course, the station, the construction of the station which they went ahead with.

However, due to constraints and construction, just the areas available for construction, Sound Transit ended up agreeing to three things. Early on, we agreed to construct a platform extension that would serve the lengthy Coast Starlight long distance train that Amtrak runs. And the reason we agreed to that is that WSDOT and the city of Tacoma were absolutely at loggerheads about that train blocking East D Street, in particular. It's a pretty significant arterial in Tacoma and it's immediately adjacent to the western edge of our platforms there. So we agreed that instead of having that platform for the Coast Starlight extend westward across the street, we would instead construct a platform extension as part of our project, which was replacement of the Tacoma Trestle. And that agreement was reached several years -- it was before I became project director.

Then in the course of analyzing how those projects would be constructed, the WSDOT projects and our Tacoma Trestle project, we realized that the control of the site needed to be under one contractor. So we agreed to take into our Tacoma Trestle contract, by change order, WSDOT's crossover between East C and East D Street and the south platform. So we ended up administering construction for that, the entirety of that work and, of course, again accepting ownership of all of that.

The challenging part of this was that the Tacoma Trestle project had no relationship in its schedule to the schedule that WSDOT was on for delivering the ARRA funded work. And so it has been a challenge for all of us to manage completion of the passenger facilities in the time frame required for WSDOT and Amtrak while recognizing that our own facilities that are not necessary to Amtrak operations, they're still being constructed. And so that project won't reach substantial completion probably until second quarter of 2018, as a project.
. . .MR. FRIGO asked "Did Sound Transit raise any concerns during the design review process on any of the track speeds that were presented by WSDOT? "

MR. JOHNSON: I think it's probably helpful for you to understand that at the time that WSDOT was conceiving of this project to upgrade these tracks, Sound Transit had no plans to ever run south of Lakewood Station. So our involvement in design from that perspective would be solely related to, if you're going to go outside our right-of-way, you're going to have to acquire additional property.

You need to comply with the track standards that we have. Your design of signal equipment needs to integrate with components that we already use. That kind of compatibility and interface sort of question

would be the thing that we would have some say in. But in terms of design, per se, WSDOT and it's consultant would know what the requirements of the Amtrak trains were for the Cascades that they own and they would be making designs that would serve those. And we imagined that we would never be running on that, so we didn't have a particular interest in preserving, for example, some aspect of our operation -- well, it didn't exist down there. And all of our operations on the Lakewood Subdivision are at lower speeds than the 79. We don't exceed 60 on that, on that route.

[Some discussion of the Lakewood Corridor, which had some passenger rail that was being upgraded, and the southern portion, whose rail ties were replaced, which did not have passenger service but did have freight service and military trains, which continued through construction.]
. . .
MR. JOHNSON: I think it's -- this is Mark Johnson. I think it's important to establish right at the beginning that Sound Transit has not had an interface with Amtrak in terms of preparing a track for readiness. Instead, our agreements have been with WSDOT, who has a relationship with Amtrak.

It's also important, as I mentioned, that because the line was kept in service for freight, that there were a series of stages, I think 11 stages, of various improvements and cutovers that all were tested and safety certified as an interim measure. So we have an overall safety certification process, which is not completed at this point because the Tacoma Trestle is not complete. And then we have a series of interim safety certification checklists that have been checked and signed with the, you know, with the necessary exceptions and work-arounds that are then retired.

MS. MITCHELL: So I want to interject here if I may. This is Jodi Mitchell. We do have a safety and security certification verification report for what we refer to as Point Defiance Bypass and that includes the territory from 66 to Nisqually Junction. That document, we have that document. It is complete and signed off.

Just to clarify what Mark was getting at is the work of Tacoma Trestle, which is still underway, any elements that were related to the Amtrak start of service, those items have been safety certified and/or perhaps safety certified with an exception. And an example to that would be -- this is just an example, what we refer to as the south platform. It has an east access ramp, is what it's called, and there's a handrail on that ramp. The contract documents would call for, just for talking purposes, a metal handrail. We installed a wood handrail. That would be an exception. You could still safety certify it with an exception.

So the segment from 66 to Nisqually Junction has been safety certified.

[There followed a discussion of the timetable, that did not address southbound milepost 19.8, shortly before the curve.]
. . .
Stacey Thompson, FRA asked: The reason FAST Act wasn't in on the 19.8 southbound was because you guys didn't operate over that and you had no plans of operating over that territory past Lakewood. Is that correct?
MR. DOYLE: This is Weylin Doyle. That's correct.
[Regarding the speed drop from 79 to 30, Amtrak was not in communication with ST.]
Weylin Doyle: we would not expect Amtrak to direct us to respond to the FAST Act. We would expect that Amtrak would respond directly to the FAST Act completely independent of any of our input since they're the operator on that section of track.

My Conclusions

As of September 21, 1018, the NTSB has not commented on the cause(s) of the derailment or recommended actions to prevent a recurrence.

a) Many groups and individuals were involved at different times and in different capacities. The project was complicated.
b) People tended to cooperate and collaborate with individuals in different organizations, and not notice the rest of the activity.
c) Hand-offs seem to have been through third parties, and perhaps informal.
d) The project evolved over time. For example, the Tacoma Trestle was added towards the end. The route to Nisqually was not part of the original concept.
e) There was no central documentation. Perhaps lots of privacy issues, e.g., Siemens, IDOT (Illinois), WSDOT, Sound Transit, etc.
f) There is lots of evidence of inadequate training.
g) Engineers don't get much information about the route other than advanced speed boards. They have to rely on training. Ditto for conductors.
h) The electrical-mechanical problem that the Siemens Charger locomotive (#1402) had before leaving Seattle may have contributed to the braking failure. Assuming there was a braking failure.
i) The train had only one conductor, there should have been two — a primary and an assistant conductor.
j) Amtrak is responsible for the inadequate training and train staffing levels. Sound Transit failed to realize that using PTC to mitigate the risk of the curve failed when PTC was not installed prior to December 18.
k) The December 18 date forced many groups to compress their normal schedule, especially the training schedule. They all tried to cooperate with each other and just make it happen. They would have all benefitted from more time.
l) There was no overarching project manager. It could have been WSDOT (it was certainly their project) or Sound Transit.
m) The union chairman stated that only PTC could have prevented the derailment at the curve.
n) The timetable lacked the FAST Act requirement to call out the milepost in advance of a low speed zone for the southbound route.
o) Seat belts might be nice.

NTSB Public Meetings

The NTSB held public meetings July 10–11, 2018 at their offices in Washington DC; this was titled "Investigative Hearing: Managing Safety on Passenger Railroads." These meetings were subject to live webcasts which were archived for 90 days. Both live and archived webcasts are available online at http://ntsb.capitolconnection.org/#

The meeting included witnesses. These are named in the Group A records on the NTSB Docket System, https://www.ntsb.gov/investigations/SitePages/dms.aspx .

Some of the documents in the presentation are included in the Docket System in Group D. In particular, the Preliminary Hazard Analysis document that was the subject of questions about the curve hazard risk mitigations.

My Observations

a) There was a similar accident in 2013 on a Metro-North train in the Bronx. Apparently whatever lessons were learned from that never made it to Puget Sound.
b) The roles and responsibilities chart lacks a bullet for coordination of safety requirements for each partner. Mr. Ronald Pate, ST, said the safety requirements were included in each separate agreement (with the different partners).
c) ST manages projects by committee. There is no overarching project manager (PM).
d) NTSB was not impressed with ST's safety certification plan.
e) One interviewee stated PTC on occasion fails: It is electronic, based on systems, subject to maintenance and failing parts. Currently they have discovered the antennas all need replacement. There are also software and mechanical items that can fail.
f) Mr. Sumwalt asked Mr. Robert Taaffe, ST, about the PHA. Sumwalt's point is that items 1 and 2 mitigations were applied with, but the remaining measure, the PTC, was not in place. "If you don't have all in place, how . . . You still had an unacceptable level of risk."
g) Dr. Bella Dinh-Zarr, NTSB, was concerned about the grandfathered Talgo equipment. It apparently is the only equipment that has been grandfathered. Someone stated the Talgo cars were grandfathered through the end of their life. They had been strengthened, yet failed in several ways during the derailment, 62 people were injured and 3 were killed. Dr. Dinh-Zarr made the point that the actual injuries should be compared with the anticipated injuries.
h) Mr. Michael DeCataldo, Amtrak, could not answer Mr. Sumwalt's question about what hazard analysis did Amtrak do re: the Lakewood Subdivision, and in particular the curves.
i) Mr. Sumwalt commented on the engineer's remarks about peripheral vision problems while sitting in the cab. Is anyone aware of similar concerns re: the Siemens Charger locos? No response.
j) Mr. Earl F. Weener, NTSB, addressed safety. He commented that Amtrak has daily responsibility for **safety of operations**. Who is responsible for the **safety of the equipment**? The FRA has regulations that govern design and operation, they say the maintenance contractor is responsible — that would be Amtrak. He then asked about the **safety of design process**, who had the responsibility for starting the conversation about the mitigations needed for the curve; dead silence, then "that's what I was afraid of. So nobody is responsible for the mitigation, or at least the potential identification, of that curve as problematic as it turned out to be."
k) The interviewees spoke confidently about their roles and responsibilities, but the NTSB noted gaps in the safety procedures.

Glossary

These definitions may help you better understand the NTSB interviews.

Term	*Definition*
alignment	The route of a particular rail track. This is carefully designed to accommodate limitations of trains (such as going uphill) and construction and operation costs.
at-grade crossing	The surface where the rail and roadway (or pathway) cross at the same level.
ballast	Material selected for placement on the roadbed for the purpose of holding the track in place.
bypass	A track that goes around other rail facilities (bypasses them) or provides a more direct route between two points. A bypass may be as simple as a track that goes around a small yard, or may be as significant as a complete route revision.
cab	The control room of a locomotive housing the engine crew and their control consoles.
Centralized Traffic Control	An electronic system that uses remote controls to change signals and switches along a designated portion of railroad track.
conductor	A crew member responsible for oversight of a passenger train, in particular for operational and safety duties that do not involve actual operation of the train. He is also responsible for the actions and safety of the crew, and for reporting any condition that interferes with safe train movements.
consist	The number of rail vehicles forming a train. When referring to motive power, consist refers to the group of locomotives powering the train.
continuous welded rail	Rails welded together in lengths of 400 feet or more. When a train rolls over CWR, there is little=to-no sound, in contrast with jointed rail which produces a clickety-clack sound.
crossover	A set of turnouts connecting multiple tracks. A crossover allows a train to move from one track to another. A power crossover may be controlled by Centralized Traffic Control.
derail	A safety device on the track strategically located that when positioned, intentionally guides runaway rolling stock off the track to protect against collisions. A power derail may be operated by Centralized Traffic Control.
dispatcher	The individual who plans and controls the movement of trains, buses, paratransit vehicles or other transit services.
division	The portion of the railroad under the supervision of a superintendent. This is a “political” or administrative unit.
double track	Two sets of main line track located side by side, most often used for travel in opposite directions.
engineer	A crew member responsible for driving the train. This person operates the locomotive. The engineer’s immediate management supervisor is the road foreman of engines – the official charged with overseeing the safe and efficient operation of locomotives.

Term	*Definition*
gauge (gage)	The distance between the inner sides (gauge sides) of the heads of the two load bearing rails that make up a single railway line. More simply: the distance between the two rails of a rail track. The rail separation must consistently match the wheel separation of the vehicles intended to run on them. Each country uses different gauges for different types of trains. However, the 1.435 mm (4 ft 8 1⁄2 in) gauge is the basis of 60% of the world's railways; this is often referred to as Standard Gauge. Narrow Gauge is used in locations where (1) there is not enough space for Standard Gauge or (2) tight curves cannot be accommodated by Standard Gauge.
geometrics	An engineering term that refers to the design of the tracks. Track geometry is three-dimensional geometry of track layouts and associated measurements used in design, construction and maintenance of railroad tracks.
grade crossing	The area along the track where a roadway or pathway crosses.
grade separated	Crossing lines of traffic that are vertically separated from each other (e.g., a roadway that goes over a railroad track). Separation eliminates delays from cross traffic and improves safety for all modes.
HEP	Head-end power. This is the electrical power distribution system on a passenger train. The power source, usually a locomotive (or a generator car) at the front or 'head' of a train, provides the electricity used for heating, lighting, electrical, and other 'hotel' needs.
inductive system	A type of train protective system that utilizes magnets mounted beside the rails and on the locomotive, the magnets cause data to be transmitted magnetically between the track and locomotive. Such a system can automatically apply the train's brakes.
junction	An intersection of railroads where trains may move from one branch to another.
locomotive	A rail transport vehicle that provides the motive power for a train. It is used to pull or push railroad cars, and does not carry passengers.
mainline	A railroad's primary track that typically extends great distances, usually carrying both freight and passenger trains.
meet	The location where two trains traveling in opposite directions pass one another. Additional tracks and/or crossovers may be needed near these locations so that trains can maintain speeds and schedule reliability.

Term	*Definition*
milepost	Each railroad has its own style of milepost and its own way of numbering mileposts. For some railroads, milepost features on a rail network identify a given point on a subdivision relative to the distance from the subdivision's origin. Mileposts allow train crews to determine their exact location along otherwise nondescript stretches of geography. They are also used to define the limits of speed restrictions. Mileposts have numbers which usually reflect the distance between two points in miles, sometimes with one or more decimal points. These numbers may have been accurate when the milepost was established (and reflected the surveyor's accuracy), but may have become inaccurate when the post is moved. As devices for knowing where you are, the accuracy of the milepost number is not that important.
PTC	Positive Train Control. A conceptual system designed to automatically stop a train before certain accidents occur, including excess speed derailments. It relies on electronics, GPS, antennas, radios, and computers. There is no one-size-fits-all design, there is no plug-and-play interoperability.
rail	Modern track uses hot-rolled steel rails. Rail is graded by weight over a standard length. Rails are produced in fixed lengths and need to be joined end-to-end to make a continuous surface on which trains may run. There are two methods of joining rail: (1) jointed rail is bolted together using metal fishplates, (2) continuous welded rail is made by welding lengths together by utilizing flash butt welding to form one continuous rail.
rail yard	A system of tracks within defined limits designed for storing, cleaning and assembling consists of rail cars.
railroad car	Refers to any item of hauled rolling-stock, whether passenger coaches or freight cars.
railroad tie	The part of the track, often wood or concrete, where the rails are spiked or otherwise fastened.
right of way	The horizontal and vertical space occupied by the rail service.
shortline	Shortline is a term commonly used to refer to railroad operators providing local, often customized freight rail service where larger railroads can no longer serve economically.
siding	An auxiliary track located next to a main line that allows a train to move out of the way of an oncoming train. Sidings are also used to store trains or to add/subtract rail cars.
signals	North American railroads use a signal system to advise the locomotive engineer. Signals are mounted vertically on a pole in the right-of-way, there may be two or three signals on any given pole, depending on the railway. Each signal can project each of three colors. the position of the signal on the pole has meaning as does the color of the signal. At it simplest, a red signal means stop, a green signal means proceed, a yellow signal means caution (it often precedes a red signal). Of course, it is more involved than this!

Term	*Definition*
single track	One set of main line track. Only one train can operate on a section of single track at a time. Sidings are often used to accommodate the need to temporarily hold other trains.
speed restrictions	See below for lengthy explanation.
subdivision	A subdivision is a smaller portion of a division. A subdivision is typically a crew district or a branch line. Most mainline subdivisions were around 100 miles, as that's about the distance a crew would cover in a day during the steam era, and about how far the engines could go before servicing. Today's diesels can operate much longer distances without requiring servicing or refueling.
switch	The component of a turnout consisting of switch rails and connecting parts providing the means for making a path to transfer rolling stock from one track to another. The switch may be thrown manually or electronically
territory	A geographical region reflecting the organization of the operational administration of the railroad.
timetable	The running schedule of a particular train. This is a type of traffic control. Essentially, it specifies where each train should be at a given time. The train timetable contains train timing — from its departure station to its termination station. Halting time for the train at stoppages along the way are also mentioned in the timetable. It enables the synchronization of trains in a territory.
track	The structure consisting of the rails, fasteners, railroad ties (sleepers, British English) and ballast (or slab track), plus the underlying sub grade. It enables trains to move by providing a dependable surface for their wheels to roll upon. The overwhelmingly dominant track structure worldwide consists of flat-bottom steel rails supported on timber or pre-stressed concrete sleepers, which are themselves laid on crushed stone ballast.
trackage rights	An agreement between railroad companies in which the owner of tracks grants another railroad company some use of them.
train	A form of transport consisting of a series of connected vehicles that generally runs along a rail track to transport cargo or passengers. Motive power is provided by one or more separate locomotives.
trainset	A group of rolling stock that is permanently or semi-permanently coupled together to form a unified set of equipment (the term is most often applied to passenger train configurations). A trainset is commonly a locomotive and carriages coupled together to form a unified set of equipment.
turnout	A track arrangement that connects tracks, allowing trains to move from one to another set of tracks.

Speed Restrictions

These are worth understanding if you are studying the interviews. Now, we are not in training to be train operators, but understanding what went wrong on the 501 is worth a few more details. I found these

details on a Facebook page “Ask a Trainmaster”. The author, A. J. Smith, graciously gave me permission to quote him.

There are two basic types of speed restrictions: permanent and temporary.

Permanent speed restrictions for any given subdivision or line are included in the employee timetable. The timetable shows the maximum speed, for both freight and passenger trains, along every section of track, with clear guidance about exactly where the maximum speed changes by milepost.

Permanent speed restrictions are usually marked by wayside signs. At the start of a permanent speed restriction, there will be a sign that indicates the maximum track speed for both freight and passenger trains (if there are two numbers of the sign, the higher applies to passenger, the lower to freight. At the end of the speed restriction, there will be another sign. Speed restrictions apply to the entire train, so the trailing edge must clear the end of the restriction before the locomotive engineer can increase speed.

Now, temporary speed restrictions are a whole different ballgame. When a crew reports for duty, they will receive a set of documents pertaining to their assigned train. This documentation will include information from the dispatcher identifying, by milepost, all temporary conditions to be aware of, including work zones, temporary road crossing signal outages, and temporary speed restrictions. One of the most important things a crew must do upon receiving their train documentation (which also includes detailed information on their train consist, such as a detailed list of railcars by position in train and the location of any hazmat cars), is to sit down and review it carefully, and together, as part of their job briefing. (A “job briefing” is like a huddle in football; before every play, or every new task or move, the involved team goes over the game plan, who is going to do what, what are the risks and safety considerations, what are the temporary factors that must be considered; these huddles need to happen before any new task is undertaken, or if something has changed that affects the current task.) So, the crew is going to go over all identified temporary speed restrictions during their job briefing, before they ever leave the building and climb aboard their train.

Whenever possible, temporary speed restrictions will be marked by wayside signs (if this is not the case, it will be specifically noted in the train documentation provided by the dispatcher at the outset; such a situation requires extra attention on the part of the crew). A temporary speed restriction warning sign will be placed two to two-and-a-half miles before the temporary speed restriction begins. The crew should communicate out loud between them when they observe these warning signs. This warning gives the locomotive engineer plenty of time to slow the train down before entering the temporary speed restriction. (If, for some reason, the crew does NOT see the warning sign as expected, they need to report this to the dispatcher and slow the train in anticipation of seeing the temporary speed restriction sign at the beginning of the restricted speed section of track (this sign looks different than a permanent speed restriction sign). As with permanent speed restriction, there will be a (typically) green rectangular sign at the end of the temporary speed restriction. Again, the entire train must clear the restricted speed section of track before the locomotive engineer can increase speed.

It is possible that a temporary speed restriction will be put into effect AFTER a crew has departed the terminal with their train. In this case, the dispatcher will provide all of the details to the train crew via radio. Railroads have their own special forms to record all of this information in the cab, but the process generally entails the dispatcher giving the guidance, the train crew copying it down on the form, repeating it back word-for-word, getting the dispatcher’s initials and time, and signing the form. Depending upon the exact circumstances that have called for the unplanned temporary speed restriction, this is the type of situation in which the maintenance of way team may not have been able to put temporary speed restriction and warning signs in place yet.

Status of Positive Train Control (PTC)

The Seattle Transit Blog of June 30, 2018, by Peter Johnson reported:

Sound Transit will implement positive train control (PTC) on all Sounder trips by the end of 2018, according to Sound Transit Director of Systems Engineering Peter Brown.

According to Brown, Sound Transit is currently commissioning PTC on new Bombardier cars that were delivered in 2018; those cars will enter revenue service in August. Systems testing and debugging is currently underway with older vehicles. Sound Transit is also working with WSDOT and Amtrak to make all passenger vehicles that run on the BNSF track interoperable with the PTC system.

Brown said that, when errors do occur, they are due to faulty GPS antennas or a bug in the PTC software. The antennas were shipped defective. The system's contractor, Wabtec, will replace the antennas at their own expense. The software error, which causes a false positive and triggers braking, is not unique to Sound Transit; all other railroads that use Wabtec PTC also have the problem. Wabtec will release a new build of PTC that will address the error in early August.

"PTC is a complex system in the early stages of deployment, and we expect reliability will improve with time," Brown said.

Meanwhile, WSDOT announced this week that they are targeting completion of the PTC work — and therefore a return of Cascades trains to the Point Defiance Bypass — this fall, a little ahead of the Federal deadline. System tests along the bypass, and crew training, are underway this summer.