DENVER & RIO GRANDE RAILROAD, SAN JUAN EXTENSION, WOLF CREEK TRESTLE
(Cumbres & Toltec Scenic Railroad, Lobato Trestle)
Crossing Wolf Creek at Milepost 339.78
Chama
Rio Arriba County
New Mexico

HAER NM-16
HAER NM-16

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

DENVER & RIO GRANDE RAILROAD, SAN JUAN EXTENSION, WOLF CREEK TRESTLE
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HAER No. NM-16

Location: Crossing Wolf Creek at Milepost 339.78, Chama, Rio Arriba County, New Mexico.

The Denver & Rio Grande Railroad, San Juan Extension, Wolf Creek Trestle is located at latitude: 36.95550, longitude: -106.54108. This coordinate represents the center of bearing of the north abutment of the bridge (east end by Denver & Rio Grande Railroad time table). This coordinate was obtained on December 6, 2010, using a hand-held GPS unit accurate to +/- 3 meters. The coordinate datum is World Geodetic System 1984. The Wolf Creek Trestle's location has no restriction on its release to the public.

Present Owner: Cumbres & Toltec Scenic Railroad (C&TS) Commission, a bi-state agency comprised of New Mexico and Colorado.

Present Use: Supports main line trackage of narrow gauge steam railroad with scheduled and unscheduled train service between Antonito, Colorado, and Chama, New Mexico.

Significance: The San Juan Extension (SJE) of the Denver & Rio Grande Railroad (D&RG), now known as the Cumbres & Toltec Scenic Railroad (C&TS), is a relatively unchanged survivor of the first years of railroad building in New Mexico. The Wolf Creek Trestle (Bridge 339.78) is also a survivor of the early years of Rocky Mountain railroad engineering. Further, its design by C. Shaler Smith is associated with the mainstream of American bridge building in the post-Civil War era. Construction of the bridge is unchanged from the early as-designed drawings. The D&RG SJE is listed in the National Register of Historic Places as significant in the areas of transportation and engineering, with the period of significance determined to be 1880-1967. This railroad is described as a major technological contributor to the western expansion and economic development of the United States. The Wolf Creek Trestle is listed as one of the structures contributing to the historic status of the railroad.[1]

Historian: Vernon J. Glover, 2011

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[1] Keith Hayes, AIA, Denver & Rio Grande Western Railroad San Juan Extension, National Register of Historic Places Registration Form, October 2005, Section 8, p. 58.

Project Information: The Louis Berger Group, Inc. (Santa Fe, New Mexico) under the direction of Richard K. Rotto, P.E., M.S. prepared this report for the C&TS Commission to be submitted to the New Mexico Historic Preservation Division, Department of Cultural Affairs, in consultation with the following: Blake Roxlau of the New Mexico Department of Transportation (NMDOT), Cultural Resources Bureau; Robyn Powell of the New Mexico Department of Cultural Affairs, Historic Preservation Division (SHPO); and Christopher H. Marston of the U.S. Department of Interior, National Park Service, Historic American Engineering Record (HAER).

Field Team: Acknowledgement and appreciation is extended to the field team charged with safely obtaining the field measurements of the fire-damaged bridge in winter conditions. Key team members included Douglas E. Kennemore, Jr. and John David Becker, responsible for rigging and maintaining the safety lines and the verification of measurements. Support team members included Andrew Peña and Calvin D. Sanchez. Richard K. Rotto, P.E, M.S. led the field team.

Historic Data: Vernon J. Glover, historian and principal author of the historic report, donated his services for the project. Twenty-one color 35mm images photographed in 1982 and 1984 of the Lobato Trestle by Bob Hayden were provided for use in this project. Historic images of the railroad were made available from the libraries of Vernon J. Glover and the Friends of the Cumbres & Toltec Scenic Railroad, Inc., a non-profit corporation located in Albuquerque, New Mexico, and dedicated to the preservation, restoration and interpretation of the C&TS Railroad.

Project Background: A fire of undetermined origin caused major damage to the superstructure of the Wolf Creek Trestle on June 23-24, 2010, initiating a stabilization project aimed at replacing all deck girders. The C&TS Commission sought funding to rebuild the trestle and was successful in securing a Federal Highway Administration (FHWA) Enhancement Fund Grant through the NMDOT. The FHWA/NMDOT consulted with the SHPO pursuant to 36 CFR Part 800, the regulation implementing Section 106 of the National Historic Preservation Act. The C&TS Railroad Commission and NMDOT also consulted with the SHPO pursuant to rule 4.10.12 NMAC, the regulation implementing the NM Prehistoric and Historic Sites Preservation Act. It was determined that Historic American Engineering Record documentation, including large-format photography, and video documentation, produced by the C&TS Commission, would be the most appropriate forms of treatment to mitigate the adverse effects of the project. A Memorandum of Agreement (MOA) was stipulated between the FHWA/NMDOT, C&TS Railroad Commission and SHPO. The Advisory Council on Historic Preservation (ACHP) was invited to participate in development of the MOA, but declined in January of 2011. A final copy of the MOA has been filed with ACHP.

Part I. Historical Information

A. Physical History

1. Date of Construction: 1883

2. Engineer: C. Shaler Smith (1836-1886)

According to the *Journal of Bridge Engineering*, C. Shaler Smith

> was one of the premier bridge builders of the post-Civil War period. He started his bridge building career under Albert Fink on the Louisville and Nashville Railroad. During the Civil War, he designed and built a powder factory for the Confederacy at Augusta, Ga. After the war, he formed Smith and Latrobe Co. and later The Baltimore Bridge Company with Benjamin and C. H. Latrobe. He worked closely with James Eads on the St. Louis Bridge and designed and built the long iron easterly approach to the bridge. He designed and built some of the major viaducts, swing, and fixed span bridges in the United States, Australia, and Peru, and finally innovative cantilever bridges over the Kentucky, Mississippi, and St. Lawrence Rivers.[2]

Smith's work in the Southwest is less well known. In addition to the Royal Gorge span, he designed two bridges on the San Juan Extension, described in this report. He also built a pair of iron viaducts in Johnson Canyon, Arizona, for the Atlantic & Pacific Railroad. These were located in a rugged canyon between Williams and Ash Fork.[3]

3. Original and subsequent owners: Denver & Rio Grande Railway (1871), Denver & Rio Grande Railroad (1886), Denver & Rio Grande Western Railroad (1921), Cumbres & Toltec Scenic Railroad (1970)

4. Builder: Keystone Bridge Company

5. Original Plans: Ca. 1880-1881 by C. Shaler Smith, Keystone Bridge Company; D&RG Railway as traced in 1973 by John Maxwell, mechanical engineer, deceased.[4]

6. Alterations and additions: No significant alterations or additions to the steel structure of the bridge have been discovered among company records or by visual inspection. See description section below for engineering orders affecting the timber deck and timbers.

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[2] Frances E. Griggs, Jr., "C. Shaler Smith," Journal of Bridge Engineering (March/April 2010), 196-209.
[3] Contract No. 84 between C. S. Smith, Edge Moor Iron Co., and Atlantic & Pacific R.R. Co., dated October 8, 1881; and Contract No. 85, Edge Moor Iron Co. and Atlantic & Pacific R.R. Co., dated October 8, 1881.
[4] Original plans are held in the estate of John Maxwell.

B. Historical Context:

The late 1870s brought railroads ever closer to New Mexico, approaching from Arizona and Colorado. The Southern Pacific (SP) was building as rapidly as possible across southern Arizona. Collis P. Huntington, one of four famous businessmen sometimes referred to as "The Big Four" of the transcontinental railroad, directed the construction of the SP. The ports of Galveston and New Orleans were among the company's goals.

The narrow gauge Denver & Rio Grande, promoted and built by William Jackson Palmer, extended southward from Denver through Colorado Springs and Pueblo, reaching El Moro and the coal mines in the vicinity of Trinidad, Colorado, in late 1876. From Cuchara (near Walsenburg), a line across La Veta Pass reached into the San Luis Valley of Colorado, from which the Rio Grande flowed southward into New Mexico. The valley formed a natural railroad route southward through which the D&RG intended to reach El Paso and Mexico City.

The Atchison, Topeka & Santa Fe Railroad (AT&SF), founded by Cyrus K. Holliday, had been built across Kansas into Colorado, arriving at Pueblo in 1876. At this time, the company was substantially involved in colonizing the farm country of Kansas and shipping cattle from Dodge City. Additional sources of revenue were necessary, and rail lines into the Rocky Mountains and south into Mexico were under consideration. Under vice-president (later president) William B. Strong and chief engineer A. A. Robinson, the next extensions of the company were organized. The stage was set for railroad construction into New Mexico. The year 1877 was occupied with surveying the route and gathering resources for the next cycle of railroad building.

RAILROAD WARS. The railroad battles for the New Mexico Territory began in early 1878 when interests in favor of the Southern Pacific caused the Territorial Legislature to pass legislation intended to keep the AT&SF and D&RG from building into New Mexico. These companies hurried their own attorneys to Santa Fe in response. Another law was passed, called the California Act, favoring the AT&SF and D&RG companies.

Activities on the ground followed soon after the actions of the legislature. Late in February, a hastily formed crew of AT&SF employees began work in Raton Pass just hours before a construction crew of the D&RG arrived to begin work in the same location. This conflict was resolved at the corporate level, and the D&RG crew withdrew within a few days.

In April 1878, the drama was repeated, this time at the entrance to the Royal Gorge near Cañon City, Colorado. This narrow notch in the mountains was the gateway to the Arkansas River valley, forming the most direct route to the booming metal-mining camp of Leadville. This camp would be a rich source of revenue to a railroad with freight flowing both inward and outward. The dispute went to the heart of each company's survival strategy and was not easily resolved. The courts became involved through litigation, and in December 1878 the AT&SF leased the entire D&RG railroad system and began operating its trains.

From December 13, 1878, to June 14, 1879, AT&SF forces graded a roadbed and laid track from Cañon City to Texas Creek, a distance of 22.30 miles. The narrowest part of the canyon presented a serious problem because the vertical rock walls left no room for a railroad bed alongside the river. AT&SF Chief Engineer A. A. Robinson brought in consulting engineer C. Shaler Smith to visit the area of concern. Together, they conceived the hanging bridge solution for the completion of the laying of track.[5]

TREATY OF BOSTON. Meanwhile, the litigation over the Royal Gorge continued, punctuated by court decisions and threats of violent take-over of the D&RG by partisan forces. The unstable situation lasted until March 27, 1880, when a series of agreements among the companies, known as the Treaty of Boston, was forced on the warring companies by investors, including Jay Gould. These agreements not only settled the Colorado controversy, but also assigned the future routes of each company. The D&RG was awarded the partially completed line from Cañon City to Leadville upon payment of its cost to the AT&SF. In addition, the D&RG was not allowed to build south of a point 75 miles south of the village of Conejos, Colorado, thus giving up its long-planned route toward Mexico. In turn the AT&SF was allowed to build down through New Mexico and beyond, but not to Leadville or into the San Juan Mountains of Colorado.

SAN JUAN EXTENSION. In spite of the on-going litigation and conflicts involving the Leadville line, the D&RG actively planned a route to the new mining districts of the San Juan Mountains. The line was known as the San Juan Extension of the D&RG. Contracts were let on November 21, 1879, for grading and bridging of a line from Antonito, Colorado, to the Animas River, about 175 miles by the most direct route. James A. McMurtrie was chief engineer during the building of the San Juan Extension.

The route selected followed the northern slopes and cliffs of the canyon of the Rio de Los Pinos (Los Pinos River). Through the use of curving loops following the contours of the land, the line climbed steadily on a gradient of 75' per mile (1.42 percent) beginning at a point west of Antonito. As the canyon narrowed, the railroad curved into side canyons as needed to maintain the steady grade. The line progressed rapidly, with builders using timber trestles to speed construction. In later years many of these areas were filled, and wood box culverts were used to allow drainage. Two short tunnels carried the route through narrow ridges. At Toltec Gorge the track was hundreds of feet above the river, which was in a narrow and rocky defile at that point.

Higher up, the grade of the stream and the railroad lessened. Cascade Creek joined the Los Pinos with a steep-walled, narrow canyon requiring a long and tall trestle to cross. The need to quickly complete the rail line meant that the chasm was spanned with a timber trestle, approximately 408' in length and 137' above the stream bed.

At Los Pinos, the tracks made a final climbing, curving loop approach to Cumbres Pass. Here the character of the railroad changed entirely. The railroad followed the mountainside around Windy Point, dropping down a steep grade of 216' per mile (4 percent) along the canyon of Wolf Creek. The railroad route followed the “west” side of Wolf Creek and crossed it on a tall trestle between steep canyon walls at a point just before it joined the Rio Chama (Chama River). Again a timber trestle was used to bridge the gap. This span was 310' in length and 100' above the stream bed.

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[5] Robinson letter dated January 25, 1907, in Engineering News 57, no. 8 (February 21, 1907): 217.

The track followed the Rio Chama through a narrow canyon to a point where the grade lessened and the valley opened out enough to permit building a railroad terminal and crew change point. Chama was chosen as the site for a locomotive roundhouse and servicing facility for two reasons: it was about half-way along the route to the Animas River, and it was at the foot of the steepest grade along the line. Both main line and helper locomotives would be serviced there. The track from Antonito to Chama was completed on December 31, 1880. The line was placed in operation on February 1, 1881.

As the railroad was being built to Chama and beyond, C. Shaler Smith was engaged in designing steel trestles for the Cascade and Wolf Creek crossings. The earliest date on surviving drawings is November 20, 1880, with subsequent annotations dating to January and February 1881.[6] Later engineering department documents state that the Wolf Creek Trestle was built in 1883.

The Cascade Creek Trestle was not constructed until 1889, as several of its deck girder spans had been used on other routes of the D&RG.

The San Juan Extension was completed to Durango on July 27, 1881, and to Silverton on July 8, 1882. The D&RG lines became the chief means of transportation both into and out of the San Juan Mountain mineral empire. Wagon roads, trails, and short line railroads spread out from the terminals and stations of the D&RG into the mining districts. The country west of Chama was rich in pine timber and coal. A lumbering district developed, operating on government and private lands and the Jicarilla Apache reservation. Railroad logging ended in the late 1920s. Coal mining in the vicinity of Amargo and Monero employed hundreds of miners from the earliest years of the railroad. Even as domestic use of coal for fuel diminished greatly over time, the railroad's locomotives continued to burn coal and do so up to the present. Lumber and coal shipments persisted to the very last days of the railroad's freight operations.

As the years passed, railroad traffic dropped off from its pioneer highs. Mineral traffic rose and fell with the markets and the politics of the country, such as the enactment of the Silver Purchase Act of 1893 that resulted in a significant loss of revenues from mineral traffic.[7] Even at reduced traffic levels, the San Juan Extension, known as the Fourth Division of the D&RG, remained the main outside connection for the mountain towns and mining camps. Sheep and cattle were moved by rail to and from their mountain grazing grounds as seasons changed. To this, shipments of ores, coal, lumber, and supplies for mines and towns were added.

The continuing growth of the D&RG system within Colorado and across Utah required the capital investment that might have gone back into the San Juan Extension. The small locomotives and wooden cars of the 1880s continued in use well into the twentieth century. Although many of the early timber bridges were replaced with fills and small culverts, the

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[6] Drawings MC-004-L-1 through L-9, Wolfe [sic] Creek & Cascade Creek Viaducts, D. & R. G. Railway, tracings from originals in D&RGW Engineering Department by John Maxwell in 1973, Sheets L-1, L-2, L-3, L-4.

[7] Arthur Ridgway, Denver & Rio Grande: Development of Physical Property in Chronological Narrative (Denver: Denver & Rio Grande Railroad, 1921), 49. In November 1893, the United States Government banned the purchase of silver for coinage. Many silver-producing mines shut down, and the towns and industries supported by mining lost a large part of their business as a result.

two steel trestles were found adequate for their work, and modifications were limited to the timber decks.

The installation of heavier rail across the San Juan Extension and subsequent use of heavier locomotives ca. 1917 - 1929 did not require physical changes to the two steel trestles, although restrictions were placed on the double-heading of the heaviest locomotives.

The D&RG entered receivership in 1918 due to debts it incurred from its funding of the Western Pacific Railroad (WP). Following two years of government control during World War I, a new company, the Denver & Rio Grande Western (D&RGW) assumed operation of the railroad on July 31, 1921. New financing resulted in the purchase of heavier locomotives and extensive rebuilding of cars and facilities.

Over time, the most demanding environment for the Wolf Creek Trestle was the dynamic loading of the passing steam locomotives and their long trains. Prior to 1917, the San Juan Extension trackage was a mixture of light rail of 40 and 45 pounds-per-yard weight, with token mileages of 50- and 52-pound rail. It was not until 1917, following the laying of 70-pound rail on the steeper west side of the pass, that the Class K-27 locomotives of 1903 appeared on Cumbres Pass. In 1922 and 1923, 70-pound rail was laid all the way from Antonito to Durango. From that time forward any class of narrow gauge locomotive was allowed on the line (see Table I below).

Table I: Locomotives of the San Juan Extension

Original Class	New Class	Wheel Arrangement	Date in Service	Weight Engine Only	Total Weight Engine and Tender
60	C-16	2-8-0	1880	30 tons	55 tons
45½	T-12	4-6-0	1883	23 tons	48 tons
70	C-19	2-8-0	1881	37 tons	64 tons
70	C-17	2-8-0	1887	35 tons	62 tons
—	C-18	2-8-0	ca. 1917	36 tons	63 tons
125	K-27	2-8-2	ca. 1917	70 tons	110 tons
—	K-28	2-8-2	1923	78 tons	127 tons
—	K-36	2-8-2	1925	95 tons	143 tons
—	K-37	2-8-2	1928	95 tons	154 tons

The heavier rail across the line was the necessary precursor to the use of the 2-8-2 locomotives on the San Juan Extension. Concurrent changes to the Wolf Creek Trestle included pier stone masonry repairs and closer spacing of the massive deck timbers.

The advent of the heavier locomotives of the 1920s required the application of operating restrictions on the Wolf Creek and Cascade trestles. The following rules are taken from D&RGW Alamosa Division Time-Table No. 125, Takes Effect Wednesday, June 1, 1949, Special Time-Table Instructions.

> 9-D. K-36 and K-37 engines must not be double-headed over bridges 319.95 and 339.78, Sub-Division 11.
>
> 9-F. When second engine is used on trains of over 35 cars on Sub-Division 11 between Antonito and Cumbres, second engine must be cut into train.

By 1960, the rules had changed slightly in content, as noted in D&RGW Pueblo Division Time-Table No. 169, Takes Effect Sunday October 2, 1960, Special Time-Table Rules.

> 19-C. K-27, K-28, K-36, and K-37 class locomotives must not be double-headed over bridge 319.95 and K-36 and K-37 class locomotives over bridge 339.78, Sub-Division 11.
>
> 19-D. In operating three locomotive trains out of Chama eastward use two locomotives on head end of train and one locomotive on rear end of train, just ahead of caboose, or drovers car, if used.
>
> 19-F. When second locomotive is used on trains of over 1400 adjusted tons on Subdivision 11 between Antonito and Cumbres, second locomotive must be cut into train.
>
> Trains must not be doubleheaded on descending grade movements Cumbres to Alamosa, Cumbres to Chama, Chama to Gato and MP 443 (just west of Falfa) to Carbon Jct., except that in snow service trains may be doubleheaded when authorized by Chief Dispatcher.

Traffic for the San Juan Basin oil and gas field increased substantially around 1950 and continued for well over ten years. In the mid 1960s, however, all forms of traffic decreased and the line began to suffer from "deferred maintenance," to use a favorite railroad term. The last revenue freight trains ran in 1968. The D&RGW applied to the Interstate Commerce Commission in late 1967 requesting permission to abandon the narrow gauge lines, except for the Silverton Branch. Public hearings were held in 1968, the ICC gave its approval, and the railroad was subsequently abandoned effective December 29, 1969.[8]

In the meantime, a movement to save all or part of the D&RGW narrow gauge lines for posterity had grown within the states of Colorado and New Mexico. Events moved rapidly, and both state legislatures acted to create their respective Railroad Authorities. Funds were appropriated jointly for the purchase of the railroad from Antonito to Chama, as well as nine locomotives, maintenance equipment, and over 130 items of rolling stock. On September 1, 1970, the D&RGW delivered the first of three long strings in engines and cars to the infant Cumbres & Toltec Scenic Railway (C&TS). Locomotive 483 was steamed up, and the first train movement took place that day.[9]

Within a few years, the summer passenger business of the C&TS grew enough that occasional double-headers were needed eastbound from Chama. The C&TS timetables

[8] John B. Norwood, Rio Grande Narrow Gauge (River Forest: Heimburger House Publishing, 1981), 242-243.
[9] Doris B. Osterwald, Ticket to Toltec: A Mile by Mile Guide ® for the Cumbres & Toltec Scenic Railway, 2d ed. (Lakewood: Western Guideways, Ltd., 1992), 22.

contained restrictions similar to those of the D&RG, prohibiting more than one locomotive at a time on the Wolf Creek and Cascade bridges.

Railroad operations continue to the present day with K-36 class locomotives as the regular motive power.

Part II. Structural/Design Information

A. General Description: The Wolf Creek Trestle is a six-span, steel deck girder trestle supported on five steel bents. The overall length is 310' made up of five 54' spans and one 40' span. The tallest bents are 77'-0" in height.

1. Character: The distinguishing characteristic of the Wolf Creek Trestle is the absence of longitudinal bracing from bent to bent, as well as the joining of the six spans with girder flange splice plates (gusset plates) with a sliding expansion joint at one abutment and a pinned connection at the other. This design is uncommon among North American bridges and may be unique to the Wolf Creek Trestle and the related Cascade Creek Trestle of the D&RG.

2. Condition of Fabric: The steel structure is apparently complete and has not been substantially modified from its condition as initially built. Significant girder damage occurred in the June 2010 fire. The wooden deck was approximately 90 percent destroyed in the fire.

B. Construction:

The Wolf Creek Trestle is a six-span, open deck steel superstructure consisting of two girder lines 10' apart and braced with intermediate cross-frames trussed together with diagonal bracing. It has an overall length of 310'. The supporting substructure consists of two stone masonry abutments and five slender trestle bent frames. Each trestle bent frame has two battered legs braced together with intermediate horizontal struts and rod cross-bracing for lateral support. The leg and strut elements are slender built-up box sections made up of two channels laced together with lattice bracing. The longitudinal support for the bridge and bents is provided solely by the superstructure girder splice plates between each span and the anchor bolt connection to the fixed abutment (southern end). The bridge decking is comprised of closely-spaced heavy timbers in the form of oversized cross-ties supporting the running rails, guard rails and cantilevered walkway on the east side of the bridge. Battered stone masonry rigid gravity abutment walls support the ends of the bridge. Girder ends bear on an abutment seat roughly 2'-4" wide. The girders are positioned with a 4" gap between the ends of the girders and the abutment back wall. The southern abutment wall (towards Chama) is relatively short in height compared to the taller northern abutment (towards Cumbres). Individual stone masonry piers support each leg of the bent. The stone masonry piers constructed into the steep canyon slopes have a truncated pyramid-like geometry. Repairs to the masonry and replacement with concrete have occurred from time to time.

MATERIAL. A recent chemical analysis identifies the building material as phosphorized mild steel.[10] Historical sources, on the other hand, suggest that the material may be a form of wrought iron: "Wrought iron was extensively used in bridge and building construction prior to 1890, but since 1900 structural steel has entirely taken its place on account of being about 20 percent stronger, and also lower in price…."[11] The bridge material is referred to as "steel" for the purposes of this report, but further evaluation may be appropriate.

GIRDERS. The main structure consists of two main I-beam configuration plate girders comprised of five 54' spans and a 40' span. Girders are approximately 46" high and 10" wide and consist of a 46" x $^3/_8$" web plate and a built-up flange top and bottom comprised of multiple 10" x $^3/_8$" cover plates (four plies thick at midspan). The flange-to-web connection is made with 4" x 4" angles, one on each side of the web, top and bottom. On the exterior side of the girders, vertical stiffener angles are spaced at 5'-3" intervals to stiffen the web for shear. At each end of the girder, two pairs of 4" x 4" vertical angles are used as bearing stiffeners. All elements are joined by rivets at specified spacing, typically 3" on-center. Rivets in the flange-to-web angle connection are staggered in each leg. The two girders' lateral bracing is provided by intermediate cross frames spaced up to 10'-6" on center, with additional bracing provided diagonally between cross-frames. Cross-frames and lateral braces are built-up from lateral and diagonal angle irons and attached with gusset plates. The top chord member of the cross-frame is a 4" x 4" angle iron. The remaining members of the cross-frame are 3" x 3" angles. A single 4" x 4" angle iron runs diagonally between each cross frame at the level of the girder top flange. The five 54' spans and the single 40' span are of identical construction but with cross-frames spaced at appropriate lengths.

SPANS. In the final assembly of the bridge, the six spans are joined by gusset plates into a continuous 310' long structure, with the five bents located at the splice-points of the six spans. The end spans are set on masonry abutments. Under each main girder, the north end is carried on sliding bridge plates and the south end bears on plates with fixed connections.

BENTS. Each trestle bent frame has two legs, which are braced together with intermediate horizontal struts and rod cross-bracing for lateral support. The bent legs have a defined batter (spread) to provide lateral stability, and horizontal and diagonal lateral-bracing to maintain rigidity. The batter ratio denoted on the original plans is 15 units horizontal to 100 units vertical (15:100). The leg and strut elements are slender built-up box sections made up of two channels laced together, with lattice-bracing and complex riveted assembly. Each leg sits on a fabricated base plate, which is on a masonry (or concrete) pier. A fabricated cap tops each leg, and the cap is riveted to the main girders at the splice points.

LONGITUDINAL BRACING. A distinctive and highly unusual characteristic of the Wolf Creek Trestle is the absence of longitudinal bracing from bent to bent. The trestle bents are

[10] HDR Engineering, Inc., "Lobato Trestle, Bridge 339.78, Inspection and Rehabilitation Recommendations Report" (August 19, 2010), 11.
[11] Mansfield Merriman, ed., Civil Engineers' Handbook (New York: John Wiley & Sons, Inc., 1920), 399.

braced laterally, with rod cross-bracing for horizontal loads perpendicular to the tracks; however, the bents have no longitudinal bracing. The bent towers have a true 4-$^{1}/_{2}$" pinned connection in the longitudinal direction at the top and bottom of each leg. The longitudinal support for the entire bridge and bents is provided solely by the superstructure girder splice plates between each span and the anchor bolt connection to the fixed abutment (southern end).

BRIDGE DECK TIMBERS. Railroad company bridge records contained the following engineering orders:[12]

> During 1903 surfaced and lined.
>
> During 1908 firedecked.[13]
>
> During 1911 painted floor beams, drained around abutments.
>
> During 1913 renew tie 7th and 9th and 13th west end and lined bridge and tightened spikes on ties.
>
> During 1914 put on more ties, painted steel work, renewed guard rails.
>
> During 1923 worked on spacing ties.
>
> During 1934 replaced the west stone abutment with concrete and shimmed up all other plates to make safe.
>
> During 1935 renewed ties and guard rails.
>
> During 1936 removed top cap stone from pedestals, replaced same with concrete, using rails for reinforcing bent 6. Bents and footing - ties and guard rail all good.

Current deck timber (bridge tie) dimensions are 8" x 15" x 12' set at a close spacing of a few inches.[14]

C. Site Information:

The bridge is located on the railroad right-of-way at Milepost 339.78, as surveyed by the Denver & Rio Grande Railroad ca. 1915. The survey was made in the course of the Interstate Commerce Commission program of railroad valuation.[15]

The Wolf Creek Trestle is located in an open mountain valley on sloping ground, requiring a built-up roadbed. Wolf Creek is at the bottom of a steep-walled, natural ravine.

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[12] D&RG engineering orders provided by Jimmy Blouch, Colorado Railroad Museum, July 28, 2010.

[13] "Firedeck" is a railroad term for protecting the bridge deck structure against fires from locomotive coals, clinkers or cinders. Typically, the protection consists of a surface of gravel material on the top surfaces of beams and ties or a covering of galvanized sheet iron on the top surfaces of the bridge deck. William C. Willard, Maintenance of Way and Structures (New York: McGraw-Hill Book Company, Inc., 1915), 294.

[14] Current refers to the time of the field documentation in December of 2010 after the deck fire of June 2010.

[15] "Right of Way and Track Map, Denver & Rio Grande Railroad, Fourth Division," Station 4539+17 to Station 4750+27, Scale 1"=400 feet, June 30, 1919; Corrected to December 31, 1927.

Part III. Sources of Information

A. Primary Sources:

Denver & Rio Grande Western Railroad Company. Timetables, various divisions and dates as noted. Library, Friends of the Cumbres & Toltec Scenic Railroad, Albuquerque.

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Colorado Historical Society. D&RG(W) Archives. Denver, Colorado.

Denver Public Library, Western History Department. Denver, Colorado.

APPENDIX A: RICHARD L. DORMAN COLLECTION PHOTOGRAPHS

All images provided herein are from the Richard L. Dorman Collection of Historic Narrow Guage Railroad Photographs located at the Friends of the Cumbres & Toltec Scenic Railroad Library in Albuquerque, NM.

Frame 1. K-37 Class locomotive #490 acts as helper on a freight train climbing Cumbres Pass in winter. Photographer unknown. Date unknown.

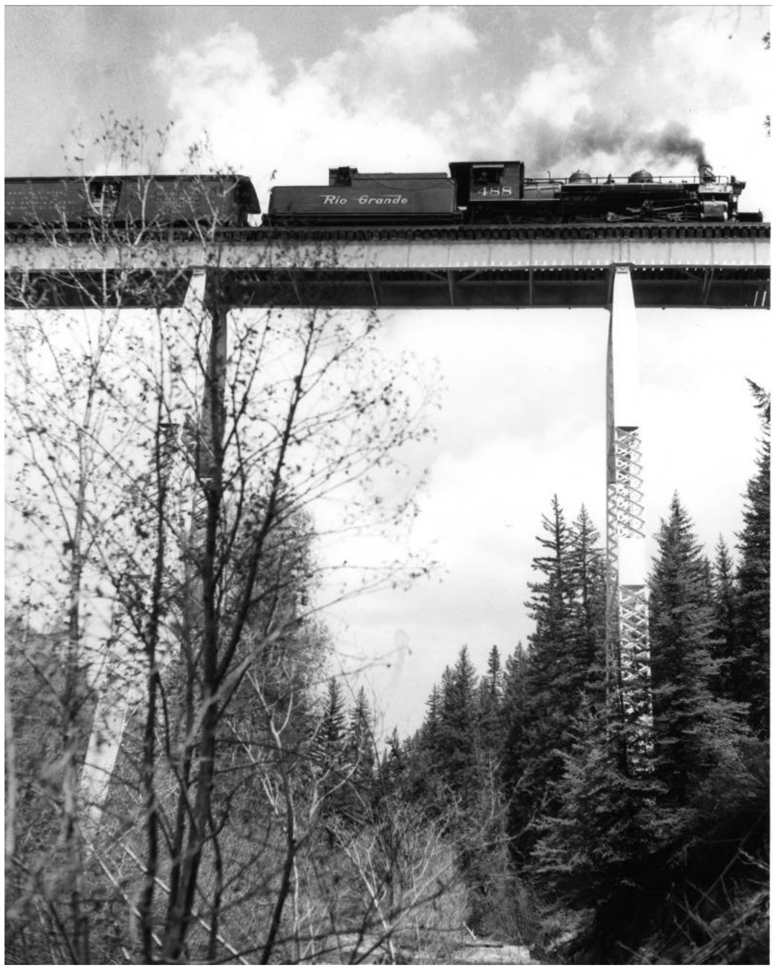
Frame 2. Eastbound freight train crossing Wolf Creek trestle. Lead locomotive is K-37 Class #493. Helper locomotive #494 is cut into the train to separate the two locomotives as they cross the old iron trestle. Photographer unknown. Date unknown. Ref. Page 197, Richard L. Dorman, <u>The Chili Line and The City Different</u>, 2000, R. D. Publications, Santa Fe.

Frame 3. Eastbound San Juan passenger train crossing the Wolf Creek bridge, locomotive K-36 Class #488. Photographer unknown. Date ca. 1938.

Frame 4. Westbound Train No. 115, the San Juan passenger, on Wolf Creek trestle, K-28 Class locomotive #477. Photographer R. H. Kindig. Date July 2, 1941.

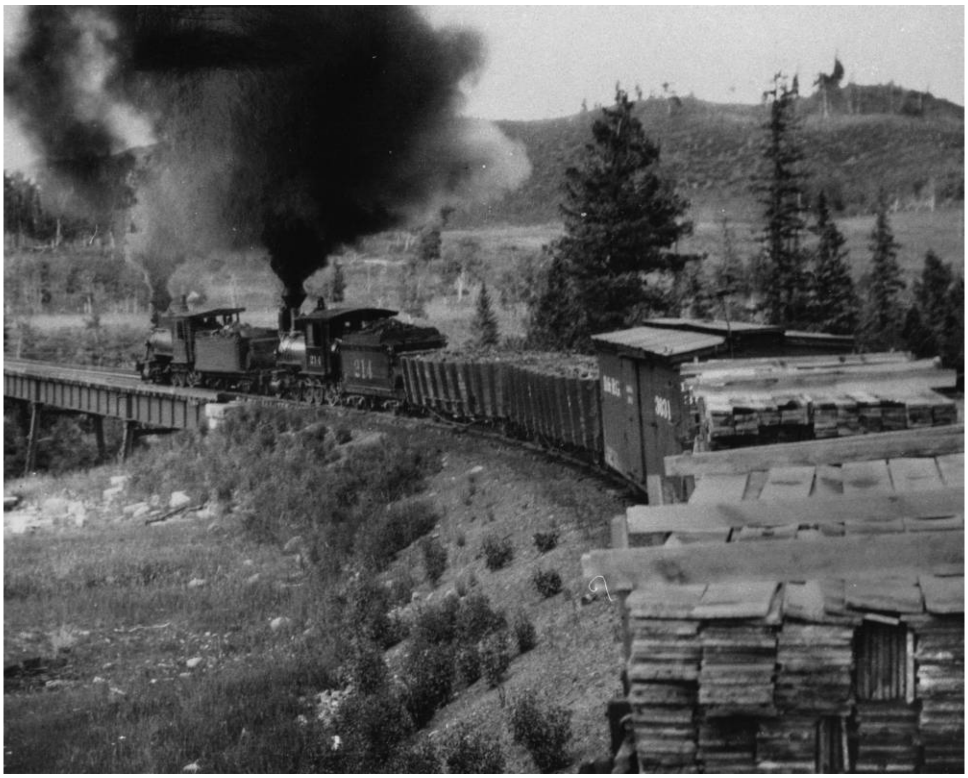
Frame 5. K-37 Class 493 brings an eastbound freight across Wolf Creek. Among the loads on the train are cars of crude oil from the Gramps oil field north of Chama. The oil was destined for the small refinery at Alamosa. Photographer Robert W. Richardson. Date July 18, 1952.

Frame 6. K-36 Class engine #487 crosses Wolf Creek trestle ahead of engine #483 with passenger train eastbound. This view illustrates the practice of separating double-headed locomotives prior to crossing the trestle. Photographer C. W. Jernstrom. Date June 1958.



Frame 7. K-36 Class engine #488 crossing Wolf Creek trestle with passenger train. View from below. Photographer unknown. Date unknown.

Frame 8. Cumbres & Toltec Scenic Railroad. K-27 engine 463 crosses Wolf Creek trestle in advance of second locomotive and train on eastbound run from Chama to Antonito. Photographer unknown. Date unknown.



Frame 9. Two Class 60 locomotives cross Wolf Creek trestle with a heavily loaded freight train. Photographer Fred Jukes, from Andy Payne collection. (Jukes was a professional photographer who worked as a railroad telegrapher at Chama.) Date ca. 1908.

Frame 10. Class 70 engines 419 and 406 head a freight train on the Wolf Creek trestle. Photographer unknown. Date ca. 1908. (This photo has been published in many places and issued as a post card.)

APPENDIX B: PHOTOGRAPHS BY ROBERT L. HAYDEN

All images provided herein are from 35mm photographs taken in 1982 and 1984 by Bob Hayden.

Frame 11. Cumbres abutment and bents A, B, C, and D (looking north).

Frame 12. Base of bents A, B, C, and D (looking north).

Frame 13. East end abutment and bents A, B, and C (looking north).

Frame 14. East end abutment and bents A, B, C, and D (looking north).

Frame 15. View from west end of bridge of upstream side of Wolf Creek (looking north).

Frame 16. Cumbres abutment and bents A, B, C, and D (looking north).

Frame 17. View from west end of bridge (looking north towards Cumbres).

Frame 18. View from east end of bridge (looking south toward Chama).

Frame 19. View from west end and upstream side of Wolf Creek (looking north).

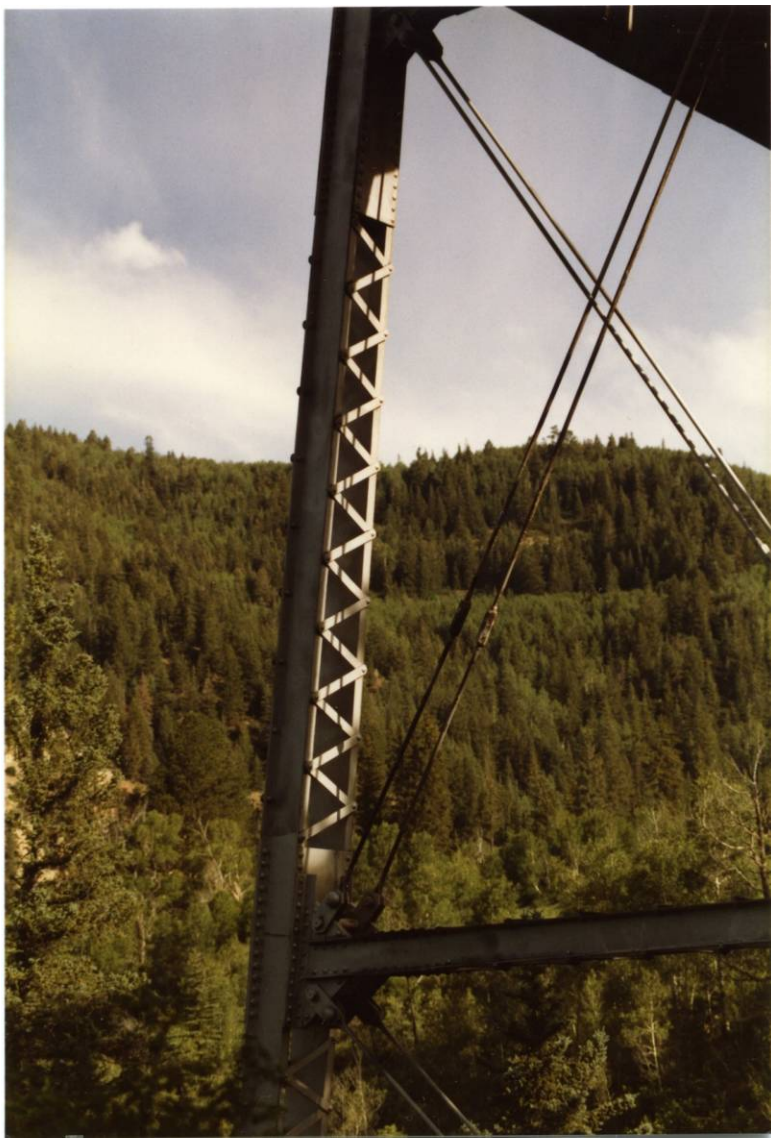
Frame 20. View from west end and downstream side of Wolf Creek (looking north).

Frame 21. View of west end of bridge (looking northwest).


Frame 22. View of bent E upper tier from upstream side of Wolf Creek.


Frame 23. View of bents A, B, C, and D upper tier from upstream side of Wolf Creek.

Frame 24. View of bent D upper tier from upstream side of Wolf Creek.



Frame 25. View of bent D upper tier from upstream side of Wolf Creek.

Frame 26. View of bent A lower tier from downstream side of Wolf Creek.

Frame 27. View of upper pin of bent E upper tier from upstream side of Wolf Creek.

Frame 28. View of bent lower pin base detail.