INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY CONCERNING AN ACCIDENT ON THE LINE OF THE SOUTHERN PACIFIC COMPANY NEAR HARGIS, N. MEX., ON AUGUST 29, 1933.

November 17, 1933.

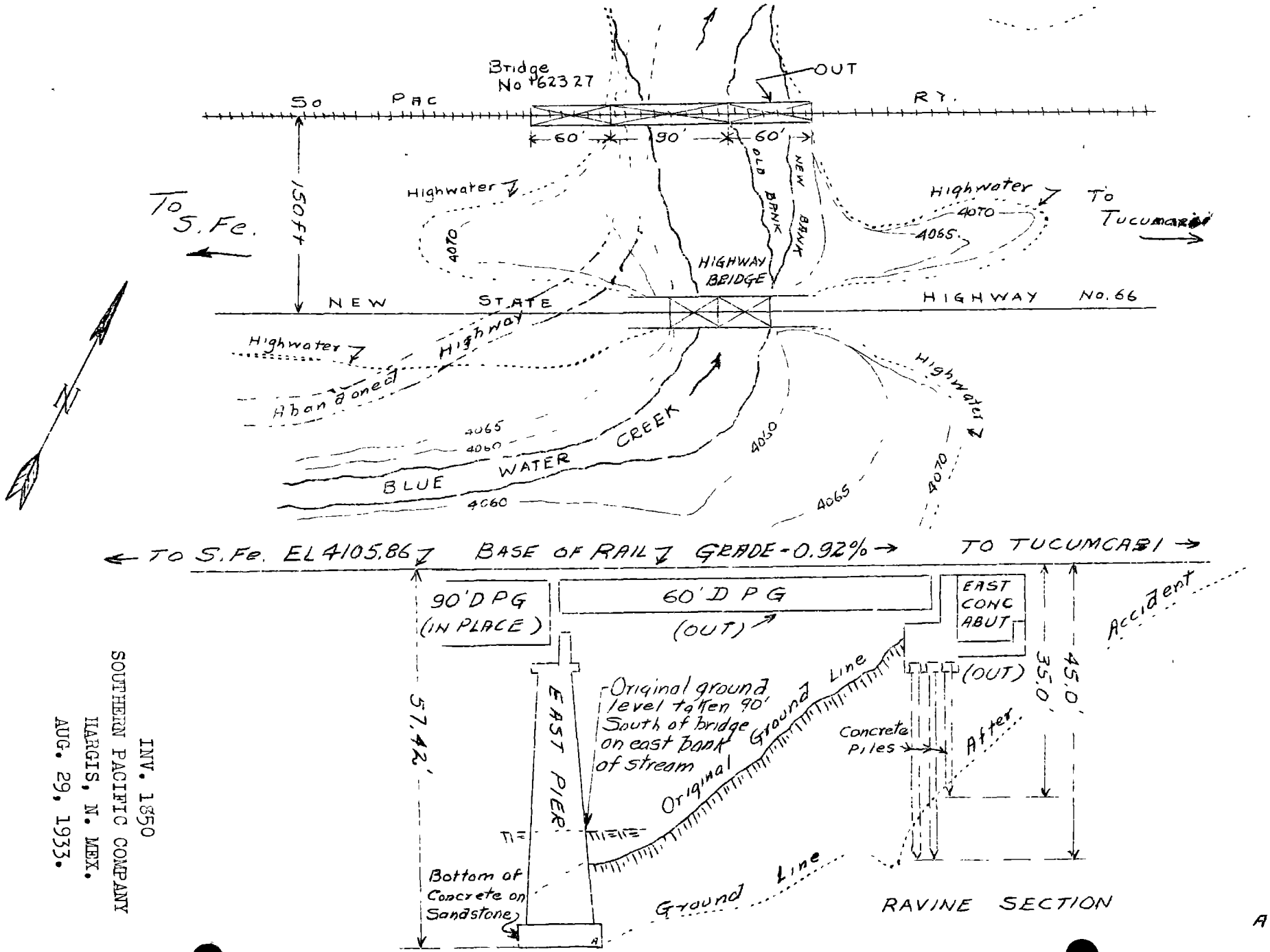
To the Commission:

On August 29, 1933, there was a derailment of a passenger train on the line of the Southern Pacific Company near Hargis, N. Mex., which resulted in the death of 8 passengers and 3 employees, and the injury of 39 passengers, 1 mail clerk, 4 employees and 2 Pullman porters. The investigation of this accident was made in conjunction with representatives of the New Mexico State Corporation Commission.

Location and method of operation

This accident occurred on the Santa Rosa Sub-division of the Rio Grande Division, which extends between Carrizozo and Tucumcari, N. Mex., a distance of 187.5 miles. In the vicinity of the point of accident this is a single-track line over which trains are operated by time table, train orders, and an automatic block-signal system. The accident occurred at the eastern end of bridge 1623.27, which is located approximately 1.37 miles east of Hargis or 4.1 miles west of Tucumcari; approaching this point from the west, there is a 1°31' curve to the left 1,250 feet in length, followed by 573 feet of tangent to the point of accident, this tangent continuing for some distance beyond that point. The grade is 0.92 percent descending. The track is laid with 90-pound rails, 33 feet in length, with 20 ties to the rail length, tieplated, and ballasted with limestone to a depth of about 12 inches.

Bridge 1623.27 spans a normally dry creek bed known as Blue Water Creek and is a single-track, 3-span, deck plate-girder bridge, 210 feet in length, built in 1914, replacing a pile trestle of about the same length. The track on either side of the bridge is on a high fill; the filled approach at the east end of the bridge is 400 feet long, 37 feet high at the east abutment sloping to 50 feet high at a point 150 feet east of the east abutment while the filled approach at the west end of the bridge is 600 feet long, 35 feet high at the west abutment and sloping to 30 feet high at a point 150 feet west of the west abutment. The bridge consisted of a 90-foot channel span with a 60-foot span on each side of it, and was supported by two mass concrete piers resting on bed rock and by U-type concrete abutments with reinforced concrete



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wing walls, the abutments resting on earth embankments and reinforced concrete piling, there being 15 concrete piles under each abutment, while there were creosoted pile bents under the wing walls. The toe of the earth fill at the east end of the bridge sloped downward to the east pier, the ratio of the slope being 1 1/3 to 1. The as-built plan indicated that the stream bed was level with the point at which the toe of the slope contacted the east pier, but earth marks on the end of the pier showed that the stream bed had been lowered several feet since the bridge was built. Blue Water Creek is dry practically all the time except in rainy weather. The following are the measurements in feet below the base of the rail:

Bottom of concrete abutment	16.00
Maximum depth of concrete piles supporting east abutment	45.00
Bottom of east pier	57.42
Toe of slope east side of east pier before accident	44.46
Toe of slope east side of east pier after accident	56.42
High water August, 1933	33.70

The indicated maximum depth of the water passing under this bridge as a result of the flood conditions was 23.72 feet.

A concrete highway formerly passed under the center span of the railroad bridge close to the channel of the creek but in 1931 a new highway and highway bridge were built parallel to and south of the railroad track, being spaced about 150 feet from the track in the vicinity of the bridge. The channel of Blue Water Creek runs along on the south side of the highway, nearly parallel with it, and then makes a sharp turn to the left and passes under the highway bridge and then the railroad bridge. This highway bridge consisted of two 40-foot spans supported by a pier in midstream and by U-type abutments on each bank, all of reinforced concrete and on rock foundation. The clear opening under the highway bridge is 75 feet; the following are the measurements below the surface of the highway:

Earth marks on east abutment (indicative of approximate ground line prior to recent storms)	25.0
Bed of stream after last storm (maximum)	36.0
High water of August 1933	9.84

These figures indicate that at some time during the storm there was a maximum depth of water passing under the highway bridge of 26.16 feet.

The territory drained by Blue Water Creek above the bridges contains from 21½ to 23 square miles, ranging in altitude from 4,100 to 5,000 feet, all of which is rolling land with an impervious soil, resulting in a quick run-off of rainwater.

The bed of the creek for more than ¼ mile either way from the railroad bridge has a uniform grade of 0.5 percent. High water on the upstream side of the highway bridge was found to have been 6.16 feet higher than it was at a point 500 feet farther down stream. The stream bed and terrain at the highway bridge are such that the greater volume of water passes under the eastern portion of the bridge; the center-line of the highway bridge pier is six feet west of the center line of the east pier of the railroad bridge, the result being that the flow of water under the highway bridge is directly against the east bank of the stream and the fill between the east pier and the east abutment of the railroad bridge.

On the night of this accident there had been an unusually heavy rainfall in this vicinity; at the time of the accident, which occurred about 4:20 a. m., it was dark and a light rain was falling.

Description

East-bound passenger train no. 4 consisted of 1 mail car, 1 baggage car, 1 chair car, 1 Pullman tourist sleeping car, 1 club car, 5 Pullman standard sleeping cars, and 1 observation sleeping car, in the order named, and all of steel construction, hauled by engine 4388, and was in charge of Conductor DePew and Engineman Croft. This train left Santa Rosa, the last open office, 53.6 miles west of Hargis, at 2:37 a. m., 11 minutes late, and was derailed at bridge 1623.27 while traveling at a speed estimated to have been about 20 miles per hour.

The west abutment and both piers of the bridge remained intact but the east abutment, which apparently had been undermined by flood waters in the creek, settled under the weight of the engine, resulting in the collapse of the eastern span of the bridge. The abutment toppled over upon its west face and slid part way down the embankment, the wings extending toward the southwest. The east girder was displaced and lodged between the east embankment and the southeast corner of the east pier approximately midway between the bridge seat and the bed of the stream, at an angle of approximately 40°. The engine overrode the dislodged abutment; the front end of the engine struck the embankment above the abutment and after the accident the rear of the boiler was on top of the abutment. The tender and first five cars were also derailed in the gap in the track caused by the collapse of this span of the bridge and were piled in various positions upon the engine, the bridge girder and the embankment. The sixth car fell over the north side of the bridge into the stream bed practically opposite the middle span of the bridge. The front truck of the seventh car was derailed but the rest of the train remained on the rails and sustained no damage. The derailed equipment was badly damaged and some of the cars were destroyed either by the derailment or in clearing up the wreckage. The

employees killed were the engineman, fireman, and a bridge inspector.

Summary of evidence

Conductor DePew said that at Vaughn, 96.5 miles west of Hargis, a slow order was received effective at certain points west of Hargis, together with an order which read as follows:

> "Within storm limits between Pastura and Tucumcari run carefully engineers keeping sharp lookout for high water and soft track reducing speed if necessary to insure absolute safety."

Pastura is 74.7 miles west of Hargis. At Santa Rosa train order no. 759 was received, reading as follows:

> "Very high water from mile post 1610 to Tucumcari bridge just east of mile post 1613 and near mile post 1614 running full track washing in cut west switch Palomas spillway and pond just east of Palomas is dangerous stop and examine before passing over it to make sure track safe."

Palomas is 6.4 miles west of Hargis. After leaving Santa Rosa the train was stopped east of Palomas and Conductor DePew inspected the bridge at that point in company with the engineman, while another stop was made before reaching Hargis in order to examine boulders which had fallen close to the track. After the train passed the station at Hargis, Conductor DePew, riding in the observation car felt a service application of the brakes, this application being released gradually; shortly afterwards the brakes were applied in emergency and then came a crash, at which time the speed of the train was about 20 miles per hour. After arranging with Conductor Vaughn, who was deadheading on train no. 4, to apply hand brakes on the cars remaining on the track, Conductor DePew started for Tucumcari and in passing over the highway bridge he saw 4 or 5 feet of water running in the stream, but driftwood lying around indicated that the water had been much higher. Conductor DePew considered bridge 1623.27 to have been one of the best on the railroad and had felt no uneasiness concerning it. His statements were practically corroborated by those of Conductor Vaughn.

Head Brakeman Harvey, who was riding in the third car in the train, practically verified the statements of Conductor DePew except that he said the speed was 30 miles per hour when passing Hargis, that a service application reduced the speed to 20 miles per hour, and that there was no application of the brakes immediately prior to the accident.

Rear Brakeman McMechen said that between Palomas and the point of accident the train was handled very carefully, the

maximum speed varying from 20 to 25 or 30 miles per hour, with slow-downs at intervals. It was his opinion that a service application of the brakes was made three or four train lengths west of bridge 1623.27, the brakes being released before the train reached the bridge. He was riding in the observation car at the time and the stop was sudden and rough. Rear Brakeman McMechen further stated that no heavy rain had been encountered between Santa Rosa and the point of accident.

Engineman Jacobs, of west-bound train no. 3, said that it began to rain at about 11:45 on the night of the accident; he left Tucumcari at 12:32 a. m., and encountered very heavy rain between Tucumcari and Palomas. He passed over bridge 1623.27 at a speed of about 40 miles per hour and at that time he judged there might have been from 18 inches to 2 feet of water running under it, which he said was not unusual in stormy weather. Engineman Jacobs did not notice any unusual track conditions at the eastern approach to the bridge and so far as he knew it was in safe condition. West of that point he was flagged because of high water which endangered the track, and his observation of conditions resulting from the storm in that territory caused him upon his arrival at Santa Rosa to send a message to the chief dispatcher concerning high water between mile post 1610 and Tucumcari, with the suggestion that train no. 4 be notified.

Fireman King, who was deadheading on train no. 4 said he had passed over the bridge on the morning prior to the accident and had not noticed any rough track at the eastern approach. Engineman Alexander said he passed over the bridge on August 26 and again about 10:20 a.m. August 28, without noticing anything unusual on either occasion. Engineman Wack, who passed over the bridge on August 27, said there were 2 feet of water under the bridge at that time; according to his statements he had upon several occasions noticed an unusual amount of water in the stream but never had felt any apprehension for the safety of the bridge.

Deputy Sheriff White, who had lived along Blue Water Creek for 27 years, said the rainfall on the night of August 28 was the heaviest he had ever seen in that locality and that the water was several feet higher than at any previous time within his knowledge. There had been high water earlier in the month and when passing over the highway bridge on the evening

of August 28 he had noticed that 10 or 12 feet of the bank of the creek between the two bridges had been cut away by the water, creating a condition which he thought would be dangerous should there be another storm. He also noticed that water had been running between the east pier and the east abutment; in fact, the conditions were such that when the rain came on the night of August 28 he felt that both bridges might be washed away and discussed with his family the question of whether he should proceed to the scene and flag trains.

Louis Metzger, a rancher who had lived in the vicinity for 22 years, said that in 1924 prior to the erection of the highway bridge there was a flood in which the water rose as high as in the present case, although at present the channel is deeper and therefore could handle more water without rising higher. At the time of the 1924 flood he saw the water passing freely under the railroad bridge, the only damage being the washing away of 5 or 6 feet of the east bank just above the railroad bridge. The storm involved in this accident was the third which occurred during the month and Mr. Metzger said that after the first storm, which came early in the month, he noticed that earth had been washed away from around the east pier to such an extent that there was water on both sides of the pier and he also noticed that an additional 6 or 8 feet of the east bank of the creek between the two bridges had been washed away. He did not consider that the situation was immediately dangerous but felt that there would be danger if the creek kept rising and washing out more of the earth, unless something was done about it. Mr. Metzger did not, however, bring it to the attention of the railroad or the highway authorities because he said he supposed they would attend to their own business. The last time Mr. Metzger was in the vicinity of the bridge was on August 27 and at that time he did not think the conditions were any more dangerous than they had been earlier in the month.

The statements of these last two witnesses concerning the erosion and washing taking place for some time prior to the day of the accident were verified by several other residents, while a photograph of people standing on the highway bridge, taken on the morning of August 27, confirmed the fact that the east bank of the creek, which was visible in the background of the photograph, had been cut away by previous high water.

Section Foreman Roberts, located at Palomas, said his territory extended from mile post 1613 to mile post 1635, within which territory bridge 1623.27 is located. At 11:30 p.m., August 28, he secured a lineup and started eastward on the motor car with his men in order to examine the flood conditions on his section, taking this action on his own responsibility because of the heavy rainfall. Various bridges were inspected en route, and a flagman was left at a culvert where the track was in danger of washing out. They met train no. 3 at Hargis, passed bridge 1623.27 about 12:40 a.m., without stopping, and continued to a point about 2 miles east of the bridge. It was about 1:20 a.m. when they reached bridge 1623.27 on the return trip and Foreman Roberts said that he and two of his men inspected the condition of the stream from a point on the bridge near the east pier; Section Foreman Roberts inspected one side by lying down on the deck of the bridge and using a flashlight while two of his men inspected the other side by means of a car inspector's lantern, after which the section foreman changed over to the side inspected by the men and gave it an examination while they in turn inspected the side which he had first inspected. It was raining at the time, with about 5 feet of water passing under the bridge; water was flowing on both sides of the east pier, the water extending 6 or 8 feet east of that pier, but the slope extending upward from the pier to the abutment appeared to be in good condition. Marks on the bank indicated that at one time the water had been 18 inches or 2 feet higher than it was at that time, but so far as he could determine there had not been any washing of the ground around the pier and it was his opinion that the storm had not made any change at the time of his inspection. After inspecting both ends of the bridge, Section Foreman Roberts decided that it was safe for normal speed and therefore proceeded on his way westward. Train no. 4 passed him at Palomas and Section Foreman Roberts then continued to the west end of his section, after which he started back toward Palomas, and he first heard of the accident at 6:30 a.m. when he communicated with the dispatcher in connection with bridge 1616, under which considerable water had been flowing during the night. Section Foreman Roberts had been on this section only a few weeks prior to the accident and had made no detailed inspection of bridge 1633.27 or of the bank of the stream between the railroad and highway bridges, nor had he heard of any very high water in that vicinity. His last trip over the bridge prior to the night of the accident had been made two or three days previously.

Roadmaster Wells, who had been assigned to this particular territory since 1928, said he made a trip westward from Tucumcari on the morning of August 28, primarily to inspect switches, but on account of the rains which had fallen on the night of August 26, he stopped and looked at a few of the small pile bridges where he thought damage might have been done. No stop was made at bridge 1623.27 because no trouble at that point had ever been experienced and from his position on the north side of the motor car he could not see the greater part of the area between the two bridges. His last previous trip past this bridge in daylight hours had been on August 23, when he went eastward on the highway in an automobile; at that time he did not notice any erosion of the banks between the two bridges and he said that the possibility that the water would erode the bank and cut into the abutment supporting the railroad bridge had never occurred to him. On July 17 Roadmaster Wells stopped at bridge 1623.27 in connection with looking over rail anchors in the vicinity and at that time he walked out on the side of the fill and looked at the piers and the channel as well as the banks of the creek between the two bridges, and he said that no washing or erosion could be seen; this constituted his last inspection of the bridge. Since that time there had been several heavy rains but they had not caused him to feel any concern as to the safety of the bridge.

Assistant Signal Supervisor Garrison, who was handling the motor car on which Roadmaster Wells passed over the bridge westbound on the morning of August 28, said the speed passing the bridge was reduced to 8 or 10 miles per hour and he did not observe any washing or caving of the bank between the two bridges, although he felt sure that he would have noticed such a condition had it existed, because of the fact that one of the things they had been doing was to observe the condition of bridges; at the same time, however, he said that if he had noticed a vertical section of bank between the two bridges he doubted if it would have made any impression on him.

The duties of Bridge and Building Supervisor DeBord include the construction, repair and maintenance of bridges, as well as their inspection, which in turn includes the surrounding territory as well as the bridge itself.

Supervisor DeBord said he participated in the last annual bridge inspection, which was made on July 14, 1933, and was accompanied by the general bridge inspector and the division bridge inspector. This inspection was detailed in character and included the bridge, the surrounding country and anything which might affect the safety of the bridge, a permanent record being kept of such inspection. At that time the toe of the fill supporting the east abutment extended to the east pier and at the point of contact was about 4 or 5 feet above the creek bed, which was between the two piers. The east bank between the two bridges was then flush with the face of the east abutment of the highway bridge and followed the natural contour downstream from the highway bridge to the east pier of the railroad bridge,

this bank consisting of a gradual slope with no sign of erosion. It was also a part of the duties of Supervisor DeBord to recommend the use of rip rap where he deemed it necessary but he said its use at bridge 1623.27 had never been thought necessary or even discussed in any way, nor was there any discussion at the time of the annual inspection as to the possible effect on the bridge of the nearby highway bridge. It also appeared from the statements of Supervisor DeBord that any sign of erosion of the bank of the stream between the two bridges or of the fill itself would have been considered as a warning of danger and that the conditions described by various witnesses as having existed prior to the accident were sufficient to have justified immediate action had he known of their existence.

Assistant Division Engineer Dawson thought the location and type of construction of the highway bridge had some effect on the erosion of the east bank of the creek between the two bridges and he also thought that it would tend to result in a greater velocity of the flood waters when passing under the railroad bridge and in directing those waters somewhat to the east of the main channel, toward the toe of the fill. He said that the slope of the fill between the east abutment and the east pier was approximately 1 to 1, which was steeper than desirable in view of the character of the earth used in this fill, and that any tendency to wash at the base of the fill which would result in making the slope steeper would be less favorable; had he known that from 5 to 8 feet of the embankment east of the east pier had been washed away prior to this accident he said he would have made an investigation immediately, in the meantime taking such steps as were necessary for protection. Protection against erosion could have been provided by rip rap, wing walls or other similar measures, but so far as he knew the need for such protection at this point had never been discussed.

Division Engineer Stansbury had been located at Tucumcari since 1913 and he thought this was the greatest flood which had occurred in that time. In his opinion the accident was due principally to the extent of the flood; the highway bridge was a considerable factor in causing the railroad embankment to wash out although he was not sure whether its effect was due to its location relative to the railroad bridge or to the fact that a head of water was built up behind it, resulting in the water being discharged under that bridge with such force as to do more damage than would otherwise have been done. It was Mr. Stansbury's opinion that there was no material settlement, if any, of the east abutment before the engine came upon it. He further stated that the washing away of part of the bank of the creek between the two bridges and part of the fill between the east pier and the east abutment, as a result of prior storms, would have constituted an adequate warning that protective measures were required at this point had the fact been known to the officials of the company, and that such a condition should

have been discovered by his organization. He had no information that the conditions disclosed by this investigation existed at this point prior to the occurrence of this accident.

Bridge Engineer Van de Greyn, of the New Mexico State Highway Department, said that in many cases where highway bridges are being built adjacent to railroad bridges conferences are held with railroad officers and consideration is given to the possible effect of the location and construction of the highway bridge upon the railroad structures, but he did not recall any such conference in this case. In building this bridge it was located in position to span the deeper part of the stream bed and no attempt was made to line up the opening under the highway bridge with the opening under the railroad bridge. The foundations were carried down into solid sandstone; the east abutment was located partly in the stream bed and its west face projected would be approximately midway between the east pier and the east abutment of the railroad bridge. From information which he then had it appeared that the high water mark in the recent flood was about 10 feet below the highway bridge floor, and that the cross sectional area of water was more than 1,000 square feet; the height of the water in this case was about 6 feet greater than indicated by records of previous floods which were considered in connection with the design and construction of this bridge. In response to a question as to whether the highway bridge had any influence upon the washing out of the embankment under the eastern abutment of the railroad bridge, Mr. Van de Greyn said that the highway bridge may have afforded some protection to the railroad bridge and that if the highway bridge had not been there the damage might have been worse; on the other hand, any impounding effect resulting from the decreased opening under the bridge would increase the current, and trees, logs or other drift might have lodged against the bridge in such position as to deflect the current. He said he would expect the bank on a curve of this nature to cut in high water and this appeared to have been an extraordinary flood in which damage was to be expected.

General Bridge Inspector Bober, of the Chicago, Rock Island & Pacific Railway, arrived at the scene of the accident at about 6 p.m., August 31, and made an examination of the damaged bridge and derailed equipment. As a result of that examination it was his opinion that the bridge failed after the engine was on the east span; if the bridge had failed earlier he thought the front end of the engine would not have gotten up near the top of the bank. In his opinion the location and construction of the highway bridge was an important contributing factor, as the highway bridge greatly narrowed the opening for the flow of water, thus increasing the velocity of the current, and it probably also imparted an oblique action to the current forcing it against the railroad embankment under the east abutment.

Conclusions

This accident was caused by high water from heavy rainfall undermining the earth fill supporting the east abutment of bridge 1633.27, resulting in the collapse of the eastern span of this bridge under the engine of train no. 4.

There were three principal conditions which contributed to the failure of this bridge, namely, very heavy rains resulting in an extraordinary amount of flood water in Blue Water Creek; the position of the highway bridge which increased the velocity of the current and probably directed it against the railroad embankment, and the fact that the railroad embankment had not been protected against erosion.

This bridge, built in 1914, was of substantial construction. It had withstood without damage the effects of high water several times since it was built. In 1931 the highway bridge was constructed about 150 feet upstream from the railroad bridge, and the railroad bridge failed under the first high-water conditions which occurred after the highway bridge was built. On the night of August 28, there had been a rain storm of unusual intensity, with the result that the water in Blue Water Creek had reached a flood stage which was perhaps unprecedented. Examination of conditions after the accident indicated that when the flood waters were at their height they were damned up behind this highway bridge sufficiently to cause the water at this point to be about 2½ feet higher than it was at the railroad bridge and more than 6 feet higher than it was at a point 500 feet downstream from the highway bridge; it was apparent that the force of the current was directed against the embankment under the eastern span of the railroad bridge, cutting away the bank of the stream and undermining the abutment.

The evidence of engineers who testified in this investigation is convincing that the failure of this bridge could have been guarded against by rip rap, wing walls or other similar protective devices. The need for such measures at this point had existed since the construction of the highway bridge in 1931, and had a comprehensive survey been made by competent railroad engineers the changed hydraulic conditions at this point, as a result of the construction of the highway bridge, should have been recognized. Furthermore, it was brought out in this investigation that as a result of rains earlier in the month of August the east bank of the stream between the bridges, as well as the toe of the fill near the east pier, had been washed away to an extent clearly indicating the need for protection of the railroad embankment. A number of local residents and users of the highway were aware of this condition and recognized the possibility of danger to the railroad; however, the railroad company had not made sufficiently frequent or thorough inspections to discover this condition, and because of this failure to discover and heed the warning given by the partial washing away of the embankment