Pit River Bridge

Financial Impact Study of Interstate 5 Closure from a Catastrophic Failure

Shasta County

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The California Department of Transportation (Caltrans), like State Department's of Transportation throughout the nation, is faced with the task of addressing an aging transportation infrastructure. Many of today's highways and bridges were constructed during the Great Depression and shortly after World War II. For more than a half century Caltrans has maintained these facilities ensuring public access to fast and reliable travel and providing California with the means to conduct commerce throughout the State and beyond. As these facilities have aged, costs associated with maintaining them have grown considerably. Many of these facilities require major rehabilitation to bring them up to standards necessary to meet today's travel demands and safety requirements. Bridges of this era are exceeding their design life potentially putting travelers and the State's economy at risk were they to fail. Now, after 50 to 70 years, these facilities have served the traveling public well beyond the number years for which they were designed.

Caltrans is evaluating California's aging transportation infrastructure to determine the feasibility of replacing these facilities or continue maintaining them so long as they are safe and functional. The Pit River Bridge on Interstate 5 (I-5) in Shasta County is one such facility. Built in 1942, the Pit River Bridge is a combination road and rail bridge double deck structure spanning Shasta Lake. The top road deck of the bridge measures 3,588 feet long and 2,754 feet along the rail line below and is supported by a central span on two piers. The Pit River Bridge is owned by the United States Bureau of Reclamation. Caltrans maintains and operates the highway on the upper deck of the bridge and Union Pacific Railroad (UPRR) maintains and operates rail service on the lower deck. Amtrak runs passenger service along the UPRR tracks between San Diego, CA and Seattle, WA. After over 70 years of dual use service, Caltrans is analyzing the potential impacts of an aging bridge on the movements of travelers and freight in the event of a failure to the Pit River Bridge. This paper presents a brief analysis of the traffic impacts resulting from a catastrophic failure of the Pit River Bridge, which would close I-5 for an extended period of time and impose additional costs to travelers redirected around the bridge.

BACKGROUND

The Pit River Bridge is located on I-5 in Shasta County, north of the City of Redding. The Pit River Bridge is a double deck, dual purpose bridge designed to serve vehicle traffic on the upper deck and a railway on the lower deck. Constructed in 1942, the steel double deck, deck truss designed bridge spans 3,588 feet long on the upper deck and 2,754 feet along the lower deck. The bridge was built by the Bureau of Reclamation as part of the Central Valley project as a necessary component of the construction of the Shasta Dam. Today, I-5 is the principal interstate in California serving passenger and freight traffic moving north/south through the State. I-5 stretches from Mexico to Canada, intersecting through California, Oregon and Washington as part of the National Highway System. The Pit River Bridge is also a vital link for freight and passenger rail service along the pacific coast connecting the major shipping ports in California with large urban centers in Oregon, Washington and Canada. Amtrak uses this rail line to operate the Coast Starlight passenger train from Los Angeles to Seattle, Washington.

The segment of I-5 in which the Pit River Bridge is located is known as the "Corridor of the Future" and an "Intermodal Corridor of Economic Significance." Travel on this section of I-5 is predominately longer interregional trips and goods movement. Approximately a quarter of all traffic moving along this segment is 5+axle trucks, making it one of the highest volume truck corridors in the State. The UPRR operates the only rail line, also utilized as a detour when needed by Burlington Northern Santa Fe Railway (BNSF) and used daily by Amtrak, which runs north/south along the Pacific Coast and crosses over the Pit River Bridge over Lake Shasta. The region is also considered a highly desirable recreation destination. The region consists of Lake Shasta offering boating, fishing and camping activities and the vast Shasta-Trinity National Forest.

TRAFFIC IMPACT

A potential failure of the Pit River Bridge is expected to close the highway for months while repairs, or even a replacement, are completed. A sketch-level analysis was performed to estimate the traffic impacts in case of the full closure of I-5 as a result. In the event of closure, northbound I-5 through traffic would be diverted east at Redding along State Route 299 (SR-299) to State Route 89 (SR-89) heading north to the community of Mount Shasta where travelers will rejoin I-5. Southbound traffic would take the same route in the opposite direction. It was assumed that all traffic traveling along this

corridor of I-5 would utilize the detour route around the closure. The following table shows the current traffic volumes on I-5 between Redding and Mount Shasta, and compares vehicle-miles of travel (VMT) on I-5 and the SR89/299 detour for the same level of travel.

Daily Traffic on I-5, and I-5 VMT vs. SR 89/299 Detour

	AADT	VMT via I-5	VMT via Route's 89/299	Added VMT
All Vehicles	20,150	1,128,000	2,297,000	1,169,000
5+ Axle Trucks	4,433	248,000	505,000	257,000

Truck Traffic

As described above this segment of I-5 carries interregional traffic, including a significant volume of trucks. Due to the remoteness of the area surrounding the Pit River Bridge, SR- 89 and SR-299 are the most direct and accessible routes for moving diverted traffic around the closure. For these reasons the analysis assumes that all trucks traveling north and south along I-5 will divert accordingly. SR- 89 and SR-299 are primarily 2-lane conventional highways (Terminal Access (STAA)) traversing the Cascade Mountain Range east of I-5. These routes offer limited passing opportunities and are main streets to a number of towns along the route. Trucks are also known to travel SR- 89, via SR- 44 and US-395 between Reno, Nevada and I-5 adding to the mix of vehicles diverted by the closure.

As the table below indicates, the number of extra truck-miles of travel required to detour from I-5, via SR's 89 and 299, is approximately 58 miles. Assuming an average speed of 45 MPH, the detour via SR's 89 and 299 would take an estimated 1 hour and 30 minutes of additional driving time per truck to bypass the closure on I-5. It is estimated that the detour will cause approximately 6,700 daily truck hours of delay. Based on Caltrans Benefit-Cost Evaluation Model (Cal-B/C), the truck delay costs are $192,100 per day. The additional 257,000 miles of truck travel adds $247,100 per day to truck operating costs. Total added cost for trucks is estimated to be $439,000 per day or approximately $13.0 million per month

5+ Axle Truck Impact of Total Closure of I-5

	AADT	Via I-5	Via Route's 89/299	Added Travel Impact
5+ Axle Trucks	4,433	248,000	505,000	257,000
Total Distance (Miles)		56	114	58
Hours of Travel				6,694
Additional Time per Truck (Hours/Trip)				1.5

Due to geometric deficiencies along some segments and numerous communities located along the detour routes, it was determined that an average truck speed of 45 MPH would be used in the analysis of travel along the detour. Both state routes consist mostly of 2-lane conventional highway with intermittent areas of 4-lane expressway. Center turn lanes are common features through communities located along the detour route. Traffic detoured from I-5 will co-mingle with existing traffic on these routes. Approximately 30 percent of existing traffic on SR- 89 is 5+ axle trucks though total volume does not approach that of I-5. Additionally, the detour route is curvilinear through many of its segments as it traverses the Cascade Mountain Range.

Passenger Vehicles

The scenario for the rest of the vehicles (excluding 5+ axle trucks) is the same as that applied to trucks. The analysis assumes all non-truck vehicles that would travel through this corridor will divert onto the detour to continue their travels. Beyond the reasons stated above, the analysis also assumes that all drivers traveling along this segment are to be well-informed that there would be a roadblock on I-5. Therefore, drivers would be able to preplan their trips according to the District's Traffic Management Plan (TMP) recommendations, choosing an alternative route that would minimize delays on their journey. The table below shows the passenger vehicle impacts from a closure of I-5

Passenger Vehicle Impacts of I-5 Closure

	AADT	Via I-5	Via Route's 89/299	Added Travel Impact
Passenger Vehicles	15,717	880,000	1,792,000	912,000
Total Distance (Miles)		56	114	58
Hours of Travel				19,018
Additional Time per Passenger vehicle (Hours/Trip)				1.2

As a result of diverting passenger vehicle traffic around the repair or rebuilding of the Pit River Bridge there will be an additional 19,000 daily vehicle hours of delay, which would cost motorists approximately $309,000 per day. The additional 912,000 miles of travel per day would also cost motorists about $247,100 per day in operating costs. The total added user costs would amount to $710,000 per day, or $21.3 million per month.

Daily User Costs of I-5 Closure

	Daily Cost of Time	Vehicle Operating Cost	Total Cost
5+ Axle Trucks	$192,000	$247,000	$439,000
All Other Vehicles	$309,000	$401,000	$710,000
Total			**$1,149,000**

The analysis also considered the effects of the existing traffic traveling along SR's 89 & 299. SR- 89, at the junction of SR-299 to the junction with I-5, averages approximately 2,000 vehicles per day, about 280 of which are 5+ axle trucks. SR-299 heading west from I-5 to the junction of SR-89 averages approximately 4,300 vehicles per day, of which about 516 are 5+ axle trucks. The total daily travelers from both of these routes were combined with the travelers from I-5 and applied to the Cal-B/C model to determine the delay to all travelers. The low volumes from SR's 89 & 299 had no net impact on delay along the alternate route. However, it is possible that isolated travelers may experience delay due to the added volume of traffic on the alternative route, particularly from the additional 5+ axle trucks.

Considerations not included in the analysis were the potential impact from less travel for recreational purposes and accidents. The area within the vicinity of the Pit River Bridge consists of vast State and federal forests including the largest recreational lake in the State. However, resources were not available to complete a full impact study. Likewise, lack of resources precludes the ability of considering delays from additional accidents, although it is highly possible that the increased volume of traffic along the alternate route could result in additional accidents thus creating additional delay.

It should be noted that these user costs are based on the current average level of traffic. Daily traffic volume on I-5 is projected to grow from 20,150 to 26,850 in 2020 and to 31,500 in 2030 (or 56% increase). Given this projected increase, the daily user costs due the closure of I-5 by the year 2030 could exceed $1.79 million.

RAIL TRAFFIC IMPACT

The UPRR owns and operates the rail line that spans the lower deck of the Pit River Bridge. The UPRR also leases usage rights to the BNSF and Amtrak as this route provides the most direct passage along the Pacific Coast. Subsequently, freight and passenger rail service along this rail line is vital to North/South commerce. Any disruption of rail service because of repairs or replacement of the Pit River Bridge will result in excessive delays in the delivery of goods between the major urban and commercial centers from Mexico to Canada. Re-routing freight trains that utilize this rail line will also result in additional shipping costs by way of labor and operating costs to the UPRR and the BNSF. Long-term disruptions could result in permanent changes in logistics of freight movement along the Western portion of the United States.

Freight Rail Impact

The UPRR and BNSF utilize the UPRR rail line to move mixed cargo along and between the Pacific Coast states of California, Oregon and Washington. Detailed data for completing this analysis was difficult to obtain since railroad companies are privately owned entities. However, the Surface Transportation Board (STB) requires every Class 1 railroad operating in the United States to submit an Annual Report (R-1). The information provided in the R-1 report is intended to allow the STB to monitor and assess railroad industry growth, financial stability, traffic, and operations and to identify industry changes that may affect national transportation policy. The analysis of the impacts to freight rail completed in this

report is based primarily on financial data obtained from the R-1 reports of the UPRR and the BNSF, 2011. Combined labor and operations costs per train mile are estimated at $42. Based on reported 2010 schedules the UPRR and the BNSF each made six round trips per day across the Pit River Bridge of mixed cargo trains. The origin and destination points in California were Oakland and Los Angeles. For the analysis it was assumed that four of the six round trips created by UPRR originated and ended in the Los Angeles vicinity and the remaining two out of Oakland. In the case of the BNSF it was assumed that all six round trips originated and ended in the Los Angeles vicinity. The table below shows the estimated rail miles traveled along the UPRR railroad and the alternative route that would be traveled in the event of a disruption of travel over the Pit River Bridge. The alternative route would require rail travel out and into Oakland and Los Angeles through Salt Lake City, Utah into Portland, Oregon and north to Seattle, Washington.

The BNSF "Inside Gateway" route from Keddie to Klamath Falls via Marysville and Oroville could be utilized as a detour for trains which have no excess height cars if such an option is desired. Tunnels between Keddie and Westwood prohibit the passage of excess height cars such as double-stacked containers so this priority traffic would be seriously delayed by detouring thru Salt Lake City, but there is no shorter alternative route. Trains of standard height cars would have to be specially assembled at major terminals such as Roseville, CA and Portland OR to take advantage of the Inside Gateway. There will be longer travel time via the Gateway due to the longer distance, lower speed in the Feather River Canyon, and lower maximum speed from Keddie to Klamath which is 49 miles per hour on that un-signaled segment.

Rail Miles via Railroad Routes

Rail Miles	LA - Portland	Oak - Portland	LA – SLC	Oak –SLC	SLC - Portland
UPRR Rte	1,190	726			
Alternate Rte			782	803	895

Freight trains originating in Los Angeles and traveling the alternate route north will travel an additional 490 miles to reach Portland, Oregon than by the UPRR route over the Pit River Bridge. In the case of trains originating in Oakland, freight trains will travel an additional 974 miles to reach Portland, Oregon. Based on estimated train mile costs of $42, the additional costs to UPRR and BNSF could range from $258,000 to $316,000 per day from having to detour through Salt Lake City, Utah to reach Portland,

Oregon. This does not include negotiations between railroad companies for access to competitor rail lines and scheduling logistics. On a monthly basis, the railroads stand to incur an additional cost of $7.8 to $9.5 million.

Passenger Rail Impact

Amtrak runs one trip per day in each direction between Seattle, Washington and Los Angeles. In the event the Pit River Bridge is impassible due to repairs or replacement, it is assumed that passengers would be bused around the bridge. Due to their proximity to the Pit River Bridge the Redding and Klamath Falls Amtrak Stations appears to be the most suited locations for transferring passengers from rail to bus in order to bypass the bridge. Based on the Amtrak Timetable for rail service between these two stations, travel by bus would actually be faster. Even when taking into account passenger transfer time between train and bus, Amtrak passengers would not be delayed to their final destination of Seattle or Los Angeles, or any point in between. Therefore, it is assumed that closure of the Pit River Bridge would not have an appreciable impact on ridership. Another alternative would be to detour Amtrak trains via the BNSF Inside Gateway from Marysville to Klamath Falls. This line is a combination of the UPRRs Feather River Route from Marysville to Keddie and the BNSF's line from Keddie to Klamath Falls. The delay to passengers would be considerable due to the slower speeds on this detour route so busing between Klamath and Redding would be a much faster and more efficient alternative.

TOTAL IMPACT

The estimated total cost from the closure of I-5 due to extended repairs or replacement ranges from $1.4 to $1.5 million dollars per day for vehicle and rail travel. Assuming gasoline and diesel fuel prices do not fluctuate substantially during re-construction daily costs to travelers can be stated in monthly terms or longer by multiplying daily costs by a given number of days. The table below provides the estimated costs per day, on month and over a six month period.

Total User Costs of I-5 Closure

	Total Costs Daily (Millions)	**Total Costs 30 Days** (Millions)	**Total Cost 180 Days** (Millions)
Truck and Passenger Vehicle	$1.1	$34.5	$206.8
Rail	$0.258 – 0.316	$7.7 – 9.5	$46.4 – 56.9
Total (millions)	$1.4 – 1.5	$42.2 – 44.0	$253.2 – 263.7

The analysis of the passenger and truck vehicle traffic and rail service assumes that volumes will remain constant throughout the evaluation period. It is possible, even likely, were repairs or reconstruction efforts to extend beyond 30 or 60 days travelers would forego non-essential trips over this route and haulers of freight would begin to shift movement of freight to less expensive means or methods. The impact would be less travel along I-5 and the detour route as construction continued, possibly leading to permanent changes in shipping and freight movement patterns. Evaluating such impacts is difficult since transport costs vary across industries and decisions are driven from a long-term cost outlook.

In addition to the above stated costs, re-routing of traffic around the Pit River Bridge would also lead to the consumption of more fuel and the release of more exhaust emissions. It is estimated that an additional 88,000 gallons of gasoline and diesel fuel would be consumed each day travelers are required to divert around the Pit River Bridge. Consumption of fuel would be evenly split between gasoline and diesel. Re-routing of travelers would also release approximately 500 tons of CO_2e (Greenhouse Gas) emissions into the atmosphere each day. Both of these estimates can vary extensively depending on traffic volume, speeds and driving conditions. Adverse weather conditions would also have a negative impact on driving conditions and travel time affecting most or all of the travel cost estimates.

ECONOMIC IMPACTS

This analysis did not consider the economic impacts to the local communities either along I-5 or the alternate route from a closure of the Pit River Bridge due to repairs or replacement. This is a

consideration that should be explored in the future in order to provide decision makers and the community a sense of the potential impacts from such activities.

OTHER IMPACTS

The detour of traffic off I-5 and onto lesser State Routes will have a significant impact on the quality of those routes. Extended use of SR's 89 and 299 could result in major damage to these roadways from the additional axle load as more trucks travel this route. Deterioration of the roadway will also increase vehicle operating costs to users in the form of maintenance and fuel costs, particularly regular users. Essential and emergency service travel will also be impacted during repair or reconstruction activities. The impacts described above were not evaluated under this study. The potential for significant impact to roadway quality and essential and emergency services exists and should be considered accordingly.

Of particular interest will be the Lake Britton Bridge on highway 89. This bridge was constructed in 1955 and has been considered for replacement and is will likely not handle large cargo loads for the length of time required to replace the Pit River Bridge in the event of a catastrophic failure.