

# FINAL REPORT

## Risk Analysis Study of Hazardous Materials Trucks through Eisenhower/Johnson Memorial Tunnels



**Parsons Brinckerhoff Quade & Douglas**

**for**

**Colorado Department of Transportation**

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## Executive Summary

The Eisenhower/Johnson Memorial Tunnels (EJMT) are located approximately 70 miles west of Denver, Colorado on Interstate I-70. Each tunnel consists of two lanes and carries one-way traffic. The tunnels are approximately 9,000 feet long at an elevation of 11,000 feet above sea level. The tunnels are horseshoe-shaped with asphalt pavement road, concrete-lined sidewalls with wall panels, and concrete slab ceiling with ceiling panels. There are ventilation buildings at both ends of the tunnels with a fully transverse ventilation system. Both fresh air and exhaust ducts are located side-by-side above the ceiling.

At present, hazardous materials (Hazmat) trucks, such as gas tankers, are not allowed passage through EJMT and are routed over Loveland Pass via U.S. 6. U.S. 6 is a mountain pass with tight switchbacks and steep grades. Hazmat vehicles are currently only allowed through EJMT when U.S. 6 is closed and then only allowed once an hour when the tunnels are closed to normal traffic.

The Colorado Department of Transportation (CDOT) asked Parsons Brinckerhoff Quade & Douglas (PB team) to conduct a study to determine the risk involved in allowing Hazmat vehicles through EJMT on a regular basis throughout the year and compare it the risk of the vehicles traveling over Loveland Pass. The team was also asked to review and summarize Hazmat transport policies at tunnels in other locations in the U.S. and worldwide, as well as develop mitigation options for the EJMT to help minimize the consequences of a Hazmat incident in the tunnel.

To carry out the study, the PB team conducted a site visit of the EJMT and Loveland Pass; collected all relevant route information, traffic data, accident data, population exposure, tunnel design information, and Hazmat truck transport data; conducted a comparative risk assessment of the two routes using the industry-standard PIARC/OECD QRAM<sup>1</sup> model; and obtained input from the Colorado State Patrol and Colorado Motor Carriers Association. The results of the risk comparison – comparing the U.S. 6 route with its current rate of Hazmat truck transport to the I-70 route through EJMT with a changed policy to allow unrestricted Hazmat truck transport – are summarized as follows.

**Casualty Risk:** On an annual expected value basis, the number of casualties on the I-70 route is higher than on the U.S. 6 route for all scenarios together. Tunnels are usually designed for 20MW fires as per National Fire Protection Association (NFPA) Guidelines. A significantly higher fire, such as 100MW, is possible with gasoline trucks. The 20MW and 100MW fires dominate the results for both routes. If one of the non-fire scenarios were to occur in the tunnel causing an explosion during a peak travel time, the consequences could be catastrophic in terms of loss of life.

**Environmental Impact:** The U.S. 6 and I-70 routes have a similar significant potential for environmental impact from a Hazmat incident. Sensitive wildlife habitat, forest and

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<sup>1</sup> World Road Association / Organization for Economic Cooperation and Development Quantified Risk Assessment Model

vegetation, and water supply sources could all be adversely affected by a Hazmat spill, explosion, or fire. For the U.S. 6 route, the Snake River and Dillon Reservoirs are at risk, and for the I-70 route, the Clear Creek and Straight Creek are at risk.

Infrastructure Damage: A Hazmat incident on each route (outside of the EJMT on the I-70 route) would result in similar damage to the roadway on both routes, with a replacement cost of approximately \$5.5M/mile. Along the U.S. 6 route, there is also the possibility that adjacent buildings and other infrastructure in Keystone, the A-Basin ski area, and Dillon could be damaged in an explosion or spreading fire caused by a Hazmat incident. The greatest risk to infrastructure is the EJMT on the I-70 route. The QRAM model results show that the worst Hazmat incident would cause damages with a repair cost of 12.5% of the replacement value of the tunnel. It is highly unlikely that the tunnel structure would collapse; however, there would be severe damage to the tunnel ceiling, as well as the electrical and mechanical systems.

Local Economic Impact: The local economy of the region is highly dependent on tourism, not only skiing in the winter months, but also other outdoor recreation in the summer months. For the U.S. 6 route, the local economies of Keystone, Dillon, and the A-Basin ski area are all dependent on the proper function of the U.S. 6 route, and would be severely impacted if a Hazmat incident were to occur on the U.S. 6 route and cause a soil or water contamination problem in these locations. In a similar manner, the local economies of Silverthorne and Dillon depend on the proper function of the I-70 route and would be similarly impacted by a nearby Hazmat incident on the I-70 route. The criticality of the I-70 route extends beyond the local economy in the area. This route serves as a major east-west corridor for the state, as well as for the United States. Closure of the EJMT for a significant period of time, even one tube with the other operating with bi-directional traffic, would significantly disrupt traffic flow between the Denver metropolitan area and the western slope of the Rocky Mountains causing a severe economic impact to areas such as Vail and Aspen.

Based on these results and the information gathered in the study, the PB team recommends the following:

1. The current policy of routing Hazmat trucks on the U.S. 6 route over Loveland Pass should be maintained. The risk of Hazmat truck transport through the EJMT is too great in terms of potential for catastrophic loss of life, extensive infrastructure damage, environmental impact to Clear Creek, and economic impact to the areas on the western slope to warrant a change in the current policy. In addition, if Hazmat truck transport were allowed through the EJMT, the attractiveness of this asset as a target for terrorism utilizing a Hazmat vehicle as the weapon, would significantly increase. Hazmat truck travel on the I-70 route, including through the EJMT, should be allowed only when Loveland Pass is closed and then only under convoy with the tunnel closed to regular traffic, as is the current policy.
2. The current procedures for convoying Hazmat trucks through the EJMT should be revised to limit the speed of the trucks through the tunnel to 30 mph, using CCTV at tunnel exits and Colorado State Patrol personnel to help enforce this speed limit. In addition, the dangerous traffic condition related to the mixing of passenger cars and Hazmat truck traffic (cars at high speed attempting to overtake the trucks on the

- stretch of I-70 following the exit of the tunnel after the Hazmat truck convoy has ended) should be examined.
3. Improvements should be made to the U.S. 6 route at Loveland Pass to accommodate the parking and pedestrian demands associated with the increased recreational use, especially during the nighttime hours when Hazmat truck travel through the area is common.
  4. The U.S. 6 route should undergo evaluation to determine if mitigations to the route geometry and roadway conditions could be done to help reduce the problems faced by Hazmat truck drivers with side-to-side sloshing of liquid cargo in bulk containers while traveling over Loveland Pass.
  5. A truck runaway ramp should be installed in the westbound direction on the U.S. 6 route near Milepost 220, and it should be designed to contain a possible Hazmat spill. In addition, the current truck runaway ramps on the I-70 route outside of the EJMT should be modified to contain a possible Hazmat spill, and the regular use of these ramps should be evaluated to determine if additional ramps are needed for exit from the left side of the road.
  6. The Colorado DOT should evaluate the CMCA “Proposal for Pilot Program for Movement of Hazardous Materials through the Eisenhower Tunnel”.