THESIS

TRANSPORT AND AQUATIC IMPACTS OF HIGHWAY TRACTION SAND AND SALT NEAR VAIL PASS, COLORADO

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ABSTRACT OF THESIS

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Thousands of tons of sand and salt are applied annually to Colorado highways during winter storms, leading to concern over possible impacts on stream channels and aquatic ecosystems. The storage, transport, and instream effects of this material were studied from June to October 1996 along a 13.3 km stretch of Interstate 70 west of Vail Pass and parallel to Black Gore Creek.

Approximately 12,000 metric tons of traction sand are applied annually to I-70 between the top of Vail Pass and the confluence of Black Gore and Gore Creeks. Total inputs over the life of the highway were estimated as 880 kg/m^2 of pavement. Deposits of traction sand were found more than 30 m from the highway, and the volumes of sand deposited along the highway ranged from negligible up to more than 9 m^3 per meter of road length. Vegetation within 5 to 10 m of the highway is buried annually. Sediment traps four meters from the road bed collected one to two orders of magnitude more sediment than identical traps 30 m from the road.

Sediment detention structures used during road construction are generally filled, breached, or bypassed. Rills created by road surface runoff can be more than 0.5 m deep on fillslopes. Gullies along the road shoulder exceed 1 m^2 in cross-section despite periodic grading. Several slope failures and gullies with cross-sections in excess of 7 m^2 have developed below culvert outfalls.

Traction sanding of Interstate 70 was estimated to result in the delivery of 3600 metric tons of sediment annually to Black Gore Creek. This is 150 times the estimated background sediment yield of 24

metric tons. The relative quantities of road-derived sediment discharged from individual locations were assessed using a mass balance based on estimated inputs and cross sections of sand stored along highway cut and fillslopes. This analysis indicated that two discharge locations are responsible for almost 20 percent of the total traction sand delivered to Black Gore Creek, and more than 50 percent of the total stream inputs result from 20 percent of the sources.

Stream channel characteristics and water quality in Black Gore Creek were compared to two nearby streams unaffected by roads. Black Gore Creek had only one-third the number of pools found along the two control streams; the riffle D_{50} was 3.5 mm, as compared to approximately 38 mm in both control streams. Suspended sediment concentrations were relatively low in all three creeks, but bedload transport was one to two orders of magnitude higher in Black Gore Creek. Chloride concentrations ranged up to 4300 mg/l in culvert outflows and 95 mg/l in Black Gore Creek, whereas chloride concentrations in the control streams never exceeded 1.5 mg/l.

The results of this study may assist efforts to improve aquatic habitats in Black Gore Creek by providing an impetus for changes in the management of I-70. These results also provide a means to prioritize sites to reduce sediment inputs to this stream. In addition, the procedure developed in this study to evaluate individual sediment sources may be applicable to other highways in snow-dominated environments.

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