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Pilot Filtration Studies for Turbidity and Nutrient Removal at Lake Tahoe

ABSTRACT

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PILOT FILTRATION STUDIES FOR TURBIDITY AND NUTRIENT REMOVAL AT LAKE TAHOE

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Abstract

At Lake Tahoe storm water runoff discharged to surface waters will be subject to strict numeric effluent limits for turbidity (20 NTU), total phosphorus (0.1 mg/L), and total nitrogen (0.5 mg/L) starting in 2008. As part of its program to meet these requirements, the California Department of Transportation (Caltrans), which is responsible for more than 500 storm water discharge points in the Tahoe Basin, has constructed a small-scale test facility for developing and testing new storm water treatment technologies. Of particular interest are combinations of settling and gravity filtration units because of their relatively low maintenance requirements and potential for deployment within the Caltrans right-of-way.

Special attention is being given to media with potential to remove dissolved phosphorus. At Tahoe, the dissolved phosphorus fraction is sometimes large enough to violate the effluent limit by itself. Based on a literature review, four promising media for this application appear to be activated alumina, expanded shale, limestone and wollastonite (calcium silicate) tailings. Laboratory batch and column studies using phosphate solutions or wastewater reported in the literature showed that all four media have relatively high phosphate adsorption capacities. To test these and other media with storm water, pilot testing is being conducted at the small-scale facility using 30-inch diameter sedimentation basins and filters dosed with storm water collected from local detention devices. For filter media, three grades of sand, zeolite, activated alumina, and aluminum oxide were tested during the 2001/02 wet season. Fine sand, activated alumina, expanded shale, limestone and wollastonite were tested during the 2002/03 wet season.

During the 2001/02 season, when filters were operated without prior sedimentation and with high hydraulic loading rates, none were able to able to meet the effluent limits for turbidity, phosphorus, or nitrogen. During the 2002/2003 season, improved filter performance was obtained with prior sedimentation, reduced hydraulic application rates, and submerged (versus free-draining) media. In this case, activated alumina and expanded shale media filters (following sedimentation) almost always met the surface water discharge limits for turbidity and phosphorus (nitrogen limits were also met, but influent nitrogen was low). However, both media increased pH and contributed dissolved aluminum to the effluent.