RESEARCH PROBLEM STATEMENT #DC-515

I – Problem Title
Vegetative root-soil strength assessment of cut and fill slopes (LAP-08)

II – Research Problem Statement
Newly constructed cut and fill slopes are commonly compacted to 90 – 95 percent. The interaction of compaction (as a slope stabilizing technique) and revegetation (as an erosion control method) is unknown, but, in general, these are mutually opposing objectives. The role of root strength in stabilizing slopes is not quantified as a slope stabilizing technique. This research shall quantify the shear and tensile strength values of plant roots in the top 50 cm soil depth. Design for roadside cut and fill slopes can bridge the gap between engineering solutions and plant growth to meet water quality objectives.

III – Objective
To assess a range of revegetation treatments for soil strength and water quality (erosion) improvement through a range of assessment tools including tension shear vane testing, root measurement and modeling, and simulated rainfall assessment.

Output: shear and tensile strength values used to design, assess and defend vegetative use on roadside cut and fill slopes, protecting water quality and providing long-term soil strength on highway slopes.

IV – Background
Soil strength is critical element for stable cut and fill slopes. Compaction is generally an accepted method of slope stabilization. Compaction reduces plant growth and infiltration, resulting in erosion and reduction growth in water quality. Recent research and other data clearly suggest that soil strength can be achieved by root reinforcement. The ability to develop defensible data to support engineered design of roadside cut and fill using de-compacted surface reinforced with vegetation will allow the Department to achieve both stability and water quality goals. The shear and tensile strength of roots of various colonizing plant species is unknown. Values need to be developed for plant, especially grass species.

V – Statement of Urgency and Benefits
This research is critical where water quality is an issue, such at the Lake Tahoe Basin, the lower Truckee River and other areas where Total Maximum Daily Loads are being developed. Without the ability to attain water quality and engineering goals concurrently, the Department will face insurmountable obstacles to achieving water quality objectives. The magnitude of return in investment is high since alternatives to controlling erosion at its source, on road cut and fill, are very costly and prone to ongoing maintenance costs or temporary road closures. Further, those technologies have not proven to be completely effective in removing fine sediment. Recent UC Davis and Caltrans work in the Tahoe Basin has shown source control to be effective in eliminating sediment runoff in the 100-year 15-min design storm.

VI – Related Research

Caltrans D&D, Grismer and Hogan (2 pubs), Gray and Sotir (1996); Nilaweera, (1994), others. Research and field plots in the Tahoe Basin have clearly indicated the ability of proper soil-vegetative treatments to both stabilize the soil (up to 0.75:1 h:v) and provide sufficient soil strength to protect against any soil movement. Others have quantified tree and shrub species.

VII - Deployment Potential

The project will be integrated into other ongoing projects with both Caltrans (D&D and Vic Claassen's Project) and other related projects (USFS CURTEM and Ski Area Guideline project).

The deployable project is a set of engineering values for specific plant cover amounts and types that will be used to design and engineer highway slopes.