SOIL STORAGE OF SNOW WATER: LINKING SEDIMENT SOURCE CONTROL TO WATER SUPPLY

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ABSTRACT

Water supply in the arid west is becoming an increasingly problematic issue. Water quantity and quality are topics of great concern. This is nowhere more important than in mountain resort areas where an increased pressure on surrounding real estate can have significant impacts on the water supply, often through building and other construction activities. Further, global climate change is expected to have significant effects on both the amount and type of precipitation received in mountainous areas as well as the storage period of frozen water. These elements of western water supply, when considered as a whole, suggest distressing trends in timing, quality and amounts of downstream delivery of water resources. They also suggest a strong need for a number of ameliorative solutions. Ski resorts offer the potential for both a focused study of changing watershed dynamics as well as the opportunity to develop a host of mitigation measures. Some of these measures offer the potential to both store additional water and to attenuate the runoff hydrograph. This paper describes two related processes and outcomes. The first is a soils restoration process that has been implemented and shown to increase water infiltration into the soil, in some cases by over an order of magnitude. The second is a proposed experimental project that uses wood chips as a snow surface cover to reduce snowmelt rate, thus extending and attenuating the runoff hydrograph. Further, when snow finally melts, the wood chips provide a highly effective soil surface mulch, thus reducing erosion potential. An additional potential benefit to both of these processes is the ability to sink carbon into the soil, thus potentially reducing global warming inputs. These processes suggest a strong positive potential to offset some anthropogenic impacts to water supply fro mountain development in the arid west.

PRESENTATION EXTRACTS

Slide 2: Global Warming: Manifestations: More severe weather, more unpredictability, higher snow levels, less water storage in snow.
Impacts: Water Supply, ecosystem perturbation, social impacts.

Slide 3: Study Area: Squaw Creek, Sierra Nevada Range, California

Slide 7: Anthropogenic disturbances affect watershed hydrology:
- Ski runs and road cuts and fills cause higher runoff
- Soil compaction reduces infiltration and water storage in soil
- Soil nutrients and soil mass is transferred down slope.

Slide 9: Evolution of goals: Erosion control, restoration, functional restoration, water storage in soil, carbon storage, and snowmelt rate reduction

Slide 13: Functional treatment options: Compost and/or wood chips, organic fertilizer, soil mixing (e.g. tilling or ripping, native grass seed, or native pine needle mulch.

Slide 23: Model conclusions – local:
- Bare soils lack depths and adequate K_{sat} values to infiltrate high snowmelt or rain on slopes (i.e. >90% off melt remains on surface)
- Mulched soils improve water holding and delay surface runoff of snowmelt while improving infiltration and seepage.
- Treated soils with high K values and water holding capacity direct snowmelt to subsurface flows and deeper seepage.

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Slide 24: Model conclusions – stream:

- Bare soils result in snowmelt volumes translating directly into larger streamflows.
- Mulched soils delay snowmelt translation to streamflow, decreasing flow peaks while improving groundwater recharge.
- Treated" soils direct snowmelt volumes to subsurface flows and groundwater storage resulting in slowly increasing streamflows for long time periods without suspended sediment.

Slide 26: Increasing snowpack residence time through surface addition of wood chips