

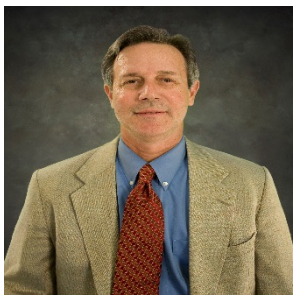


# UNDERGROUND LUNCH & LEARN

## PRESSURE TUNNEL LINING DESIGN CONSIDERATIONS

Mr. Raines will give a general overview of lining and ground support design for water conveyance tunnels with particular emphasis on those that are internally pressurized. He will discuss how in situ stress provides confinement and how that can be used to resist the internal pressure allowing the tunnel to be unsupported, supported with rock bolts and shotcrete, or unreinforced cast-in-place concrete. Where the in situ stress is insufficient, use of reinforced cast in place concrete and steel liners will be discussed. Finally more recent use of composite liners will be presented. These principles primarily evolved from the hydro power industry, but also apply to a range of water conveyance tunnels.

**FEBRUARY 7, 12-1 P.M.**  
**BROWN HALL W250**



Greg Raines is the Waterpower & Dams Tunnel Practice Leader for Stantec Engineering. He has over 30 years' experience in tunnels and underground structure design and construction. He began his career in Colorado as a miner at the Henderson Mine back in the late 1970's. That mining experience motivated Greg

to study civil engineering and geology at Colorado State University where he completed his B.S. degrees. He later attended U.C. Berkeley for his M.Eng. degree in geotechnical engineering. He served on the Underground Construction Association Executive Board of SME for 6 years as one of the founding members bringing underground construction in to the fold of SME. He has worked on hundreds of underground projects including tunnels, shafts, and caverns for water, power, mining, and military applications. He is currently serving as the Lead Tunnel Engineer for the new Chimney Hollow Dam Inlet/Outlet Tunnel adjacent to Carter Lake just outside Loveland.

