USGS

# WATER RESOURCES RESEARCH GRANT PROPOSAL

**Title**: The Role of Turbulence and Sediment Availability in Sediment Erosion Processes

**Focus Categories**: SED, HYDROL, FL

**Keywords**: Sediment Control, River Beds, Numerical Methods, Dams, Powerhouse Intake.

**Project duration**: 3/1/99 to 2/28/2000

**Fiscal year 1999 federal funds**: $15,000

**Fiscal year 1999 Non-Federal funds**: $32,652 $23,005 $9,647 (Total) (Direct) (Indirect)

**Principal Investigator(s) Name(s) and University**: Thanos N. Papanicolaou
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**Congressional District of University where the Research is to be Conducted**: Washington fifth.

## Statement of Critical Regional or State Water Problems

The work plan proposed is designed to provide alternatives to the current dredging practice for the Monroe Street Intake situated on the Spokane River near Riverfront Park in the City of Spokane. This has been a recurring issue for many years. Washington Water Power (WWP) operates this power intake.

Washington Water Power annually dredges the site to keep it functional. This solution, however, is costly and marginally effective. In the present study, ways to retain the eroded material well upstream of the intake will be proposed. WWP is found to be in complete agreement with these objectives and has commited $15,000 as a matching fund (see the attached letter) to initiate this research. This investigation is strongly related to the Water Quantity priority areas of the Washington Water Research Center and specifically with the basic studies of the hydrologic and hydraulic phenomena (item J under the Water Quantity Problems section, program 104).

## Statement of Results or Benefits

The following benefits will be obtained upon the termination of the present study: a. Determine the source(s) of the eroded sediment (bedload material) b. Determine the sediment characteristics c. Estimate velocities and flows necessary for transport d. Design and evaluate methods for bedload removal and control.

## Nature, Scope, and objectives of research

The Washington Water Power Company maintains and operates two hydropower plants on the Spokane River near Riverfront Park in the city of Spokane, Washington. Figure 1 shows the primary area of interest. As shown in the figure, the upstream facility is controlled by a 16-foot high Upper Falls Diversion Dam labeled "A". This structure diverts flow through the channel south of River Front Park through a powerhouse and back into the river at the point labeled "B". A second diversion structure, called the Monroe Street Dam ("C" in figure 1) diverts flow into an intake labeled "D" then into a penstock which carries flow into the Monroe Street Powerhouse ("E" in figure 1) and discharges back to the Spokane River.

Large cobble and boulder size sediment is being transported down the Spokane River and deposited in the forebay area of Washington Water Power's Monroe Street Intake ("D"). As this bedload accumulates on the upstream screen, it interferes with the normal flow of water through the intake structure thereby reducing power production. Consequently, work crews remove the sediment. Some of the stones less than two inches in diameter pass through the trashrack at the Monroe street powerhouse intake and subsequently cause impact and erosive damage to turbine blades. The intensity of this problem is increased in high flow years since more bedload sediment is delivered. Last year (1997), for example, crews excavated approximately 15,000 yd3 of material. Because of changes in minimum instream flow requirements and the proposed construction of a highway bridge over the excavation area, access to the deposited sediment is a primary concern.

The work plan proposed within this document is designed to find alternatives to the current dredging practice. Since other studies have investigated the possibilities of constructing a sluice through the dam structure, this proposal focuses on upriver alternatives for reducing sediment load. It is based on the hypothesis that the bedload causing the most significant portion of the problem is being delivered from areas upriver from immediate vicinity of Washington Water Power's two downtown power stations.

The overall objectives of the proposed plan of study will be to:

1.Determine source(s) of bedload sediment,

2.Evaluate characteristics of the bedload,

3. Estimate velocities and flows necessary for transport,

4. Design and evaluate optimal strategy for bedload removal and control.