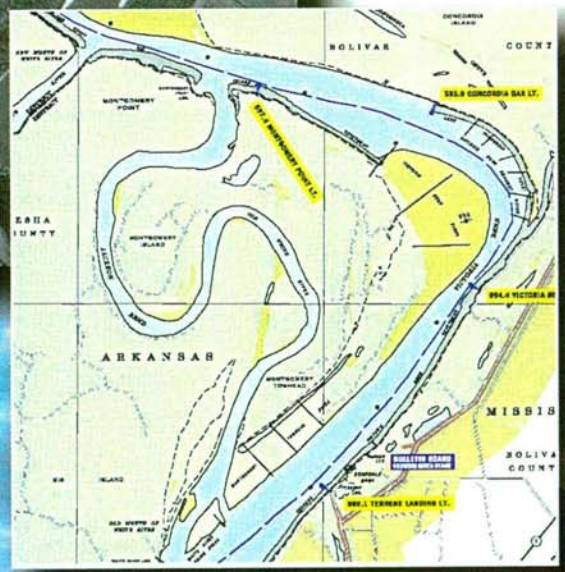
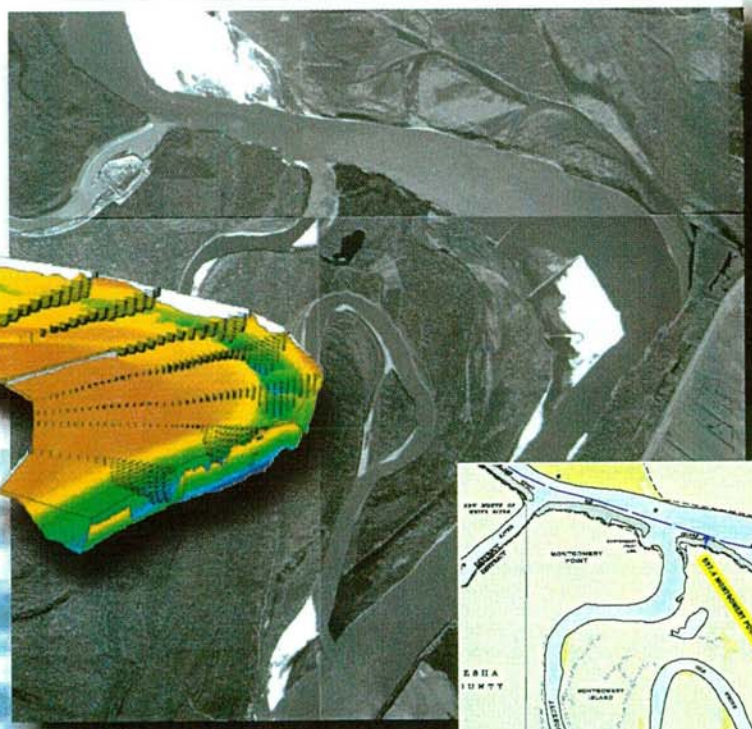


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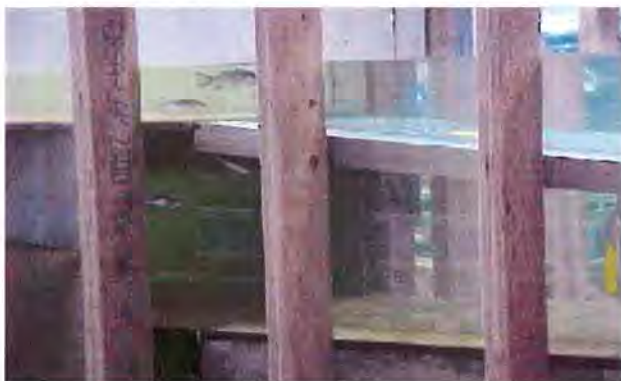


## "Practical Solutions to Water Management Challenges in the Western United States"

**Clifford A. Pugh<sup>1</sup>**

There are numerous practical problems associated with water management that will serve to motivate applied hydraulic research in the future. Wise use of water resources in the future will continue to require hydraulic structures to effectively manage scarce resources. Crucial topics that have emerged in the Western United States for future research include:

**ENVIRONMENTAL HYDRAULICS** - The environmental hydraulics program in the WRRL is focused on applied research to improve environmental compatibility of man's use of water. Reclamation is a provider of irrigation water, municipal and industrial water and power generation. Protecting the resource and managing increasing demands has prompted a strong environmental program within the WRRL that includes work in the areas of fish protection, fish passage, reservoir release water quality programs, river restoration, and wetlands design. These programs are undertaken by cooperative, interdisciplinary teams of engineers, biologists and resource managers.



The cooperative work being conducted with Reclamation's fisheries biologists and fisheries agencies in the United States are providing valuable solutions for complex environmental issues.

For example, the passive separator shown in the picture was developed in the WRRL to separate endangered (small) fish from the larger predator fish so they can be transported to the chosen release sites separately.



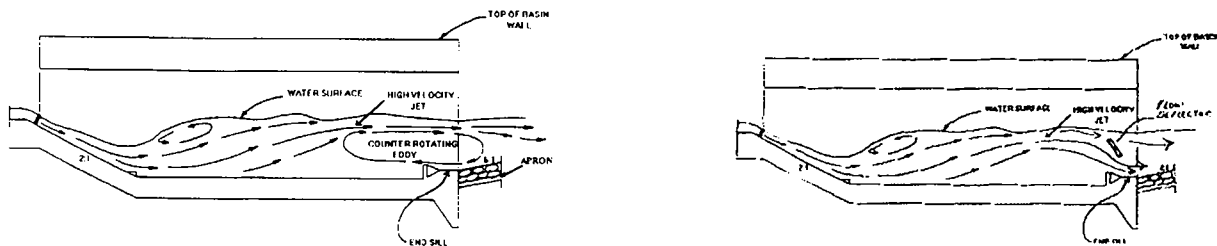
**WATER DELIVERY IMPROVEMENTS**- Accurate flow measurement is a critical component for improving the effectiveness of irrigation delivery and drainage systems. Accurate measurement facilitates timely deliveries at correct flow rates, fair billing and accounting, and effective analysis of system performance for improved water and crop management.

The construction and installation of new, dedicated water measurement structures and equipment are not always feasible in existing irrigation systems, due to cost, lack of available head, limited

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construction opportunities, and other factors. Existing canal gates (at check structures, turnouts, bifurcations, etc.) offer an economical opportunity to measure flow at exactly the point in a system where flow measurements can be most beneficial, the point of flow control. Development of the patented Automated Farm Turnout (AFT) [shown in the figure above] to automatically measure flow rates and deliver desired rates of flow to farm-scale turnouts has added a useful and affordable management tool.

**DAM SAFETY RELATED ACTIVITIES** – Some of the topics being investigated include: stepped spillway energy dissipation, reduction of stilling basin abrasion damage, dam foundation erosion research, embankment dam breach research, overtopping protection, tunnel spillway cavitation investigations and aerator designs, alternative spillway applications for enlarging spillway capacity, modeling of embankment dam failures for the purposes of risk analysis and development of emergency action plans.



A patented device has been developed and tested in Reclamation's laboratories to alleviate a long standing problem of rocks being trapped in stilling basins. The rocks are continuously rolled around the basin until the concrete is worn down to the rebar and must be repaired. The device has been installed and tested in two prototype situations and promises to essentially eliminate the problem.

**DAM DECOMMISSIONING** - The objective of this research is to study sediment transport through the reservoir under multiple dam deconstruction scenarios.

The model in the laboratory uses a sediment modeling technique developed in the WRRL to distort the sediment weight and size using a technique based on the Shields Diagram and Taylor's dimensionless unit sediment discharge concepts.

**CONCLUSION**- This paper will describe practical solutions being developed in these areas to meet the challenges of the future. As values change, the solutions must be adapted to meet the demands. The solutions must be adapted to the local culture and needs. However, one thing is sure- solutions must be developed now if we hope to manage the scarce water supplies in the future. Many of the solutions developed for the Western United States will also be adaptable to other regions of the World with scarce water supplies.