U.S. Department of the Interior
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Hydrokinetic Impacts to Canal Systems

Research Bulletin
S&T Project 1707

Mission Issue

Impacts to existing infrastructure.

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Problem

Hydrokinetic (HK) power technologies have been applied to inland waterways in recent years such as rivers and canal systems. While they advantageously utilize the existing infrastructure and flow conditions of canal systems, impacts to daily operations and canal safety must be considered. These impacts may include increased water levels and debris clogging which can negatively affect routine operations and safety considerations such as freeboard restrictions.

Solution

A pilot study was conducted under a Cooperative Research and Development Agreement (CRADA) with Denver Water. The study included the installation of 10 HK in Denver Water's South Boulder Canal. Flow and water level measurements were made in the canal for several flow conditions and compared to baseline levels without HK operation.

This study with physical measurements and observations on a full-scale system in the field has provided important information on key considerations to be addressed for decisions regarding application of HK technology to existing canal systems. Results from this study help provide guidance for critical hydraulic design parameters, operating limitations, and safety.

"Results from the collaborative study with Denver Water helps provide valuable guidance for future HK considerations in canal systems."

Josh Mortensen,
Hydraulic Engineer
Reclamation

More Information

https://www.usbr.gov/research/projects/detail.cfm?id=1707

Application and Results

Field testing over several months helped to reveal that safety planning and emergency procedures are imperative to monitor and prevent canal overtopping due to debris clogging in the HK unit or other emergencies.

The potential for freeboard encroachment during normal operations should be evaluated on a site-specific basis. Due to the low energy nature of water delivery canals in the western U.S. many are not conducive to arrays of closely spaced HK units which depend on excess energy from the system. Field measurements showed that head differential across the HK units caused upstream water levels to rise and "stack up" when multiple units were installed too close together. Critical system parameters for determining unit spacing and hydraulic impacts include canal slope and velocity, freeboard, and design discharge.

HK power generation may be advantageous if units are installed in strategic locations such as turnouts, laterals, wasteways, or flumes that offer greater flow velocities, operational flexibility, and where disrupted hydraulic conditions or increased water levels do not compromise normal operations or safety. These locations should be considered on a case by case basis and always be evaluated for impacts to safety and hydraulic performance when considering HK installation.

Future Plans

The final CRADA report is intended to be used as a guide document for design engineers, private developers, and canal system operators in Reclamation and industry. The report demonstrates findings and experience from the case study of an array of multiple HK units installed in the South Boulder Canal. Future testing and research of HK impacts to inland waterways is not currently planned.