

## Using Unmanned Aerial Systems to Monitor Sediment Flow

*Collaborating with the U.S. Geological Survey to test unmanned aerial systems for mapping sediment flow at a dam removal site*

### Bottom Line

Researchers tested the feasibility of using unmanned aerial systems (UAS) to map sediment flow on the Elwha River post dam removal in Washington. Although the data gathered did not have the quality needed to track sediment flow, modern platforms and sensors show great promise for high quality mapping.

### Better, Faster, Cheaper

Using updated UAS platforms and sensors will allow for multiple passes over small areas, such as reservoirs that will produce high resolution imagery capable of being used for excellent quality mapping that can be used to monitor changing topography and sediment flow.

### Principal Investigator

Douglas Clark  
Physical Scientist  
Emergency Management and  
Geographic Information Systems  
Group  
Technical Service Center  
303-445-2271  
drclark@usbr.gov

### Research Office Contact

Miguel Rocha  
Science and Technology  
Program Manager  
303-445-2841  
mrocha@usbr.gov

### Problem

Dam removal began on the Elwha River, Washington, in mid-September 2011. Currently, Elwha Dam and over 50 percent of Glines Canyon Dam have been removed, Lake Mills and Lake Aldwell Reservoirs have drained, and the Elwha River flows freely from its headwaters in the Olympic Mountains to the Strait of Juan de Fuca for the first time in nearly 100 years. This restoration project is unique as it encompasses an entire watershed (i.e., 320 square miles from the Olympic Mountains to the Strait of Juan de Fuca) of predominantly pristine wilderness, historically home to all runs of Pacific Northwest salmon.

These two reservoirs were filled with sediment, and removing these dams represents the largest controlled release of sediment in the history of North America—an “end member case” for dam removal. Because this is the first dam removal on such a large scale, there are uncertainties about how rapidly, and in what patterns, sediment will erode from the reservoirs and move downstream. Monitoring the changing topography as the approximately 24 million cubic yards of sediment are being eroded and redistributed downstream is a critical component of the science of dam removal.

Many of those uncertainties can be answered by using aerial over flights, including those from unmanned aerial systems (UAS), to monitor changes in the reservoirs and river channels. But conventional aerial photography is expensive and not justified unless it is for large surveys over wide areas. This Reclamation Science and Technology Program research project sought to test whether UAS could be used to monitor sediment transport on the Elwha River as two dams were being removed.



*UAS imagery captured Lake Aldwell Reservoir on the Elwha River, Washington, with a GoPro Hero2 Camera mounted on a Raven A in September 2012.*

## Solution

The researchers tested UAS to determine if this could be used for repeated and frequent monitoring in such a dynamic environment. The research showed that UAS could indeed be used for this purpose, however, newer platforms and sensors would be required to obtain high quality mapping. This research project used old military surplus technologies that were not designed for high resolution mapping.

## Application and Results

This research project was conducted on the Elwha River on Lake Mills and Lake Aldwell Reservoirs. A 10-year-old military surplus Raven RQ-11A platform with a 0.5-megapixel electric-optical sensor system was used. Results were suboptimal. Subsequently, the native sensor system was replaced by a GoPro Hero2 Camera with 11 megapixels, which produced substantially better results. However, the quality was still insufficient for the high quality mapping necessary to track sediment flow.

## Future Plans

Researchers will continue to test UAS to determine how they can best be used to serve Reclamation's mission requirements. Reclamation personnel have expressed interest in testing the feasibility of using UAS for wildlife surveys, water quality studies, water management, vegetation mapping, telemetry surveys, reservoir surveys, operations and maintenance planning, restoration monitoring, ineligible lands monitoring, surveys of inaccessible areas, monitoring encroachments/trespasses, monitoring boundaries, habitat surveys, flow surveys, crop surveys, archeological surveys, and endangered species protection.



*Raven RQ-11A launch at the Aldwell Reservoir on the Elwha River, Washington.*

***“Unmanned aerial systems hold promise for making it possible to conduct frequent missions to gather high resolution imagery over small areas.”***

**Douglas Clark**  
Physical Scientist, Reclamation's  
Technical Service Center

## Collaborators

- U.S. Geological Survey's National Unmanned Aircraft Systems Project Office
- National Park Service

## More information

[www.usbr.gov/research/projects/detail.cfm?id=3734](http://www.usbr.gov/research/projects/detail.cfm?id=3734)

U.S. Geological Survey  
information:

[http://rmgsc.cr.usgs.gov/UAS/WA\\_BORRiverSedimentMonitoring.shtml](http://rmgsc.cr.usgs.gov/UAS/WA_BORRiverSedimentMonitoring.shtml).

[www.youtube.com/watch?v=5KKtjGVZFkw](http://www.youtube.com/watch?v=5KKtjGVZFkw)