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Methods for Developing a Surficial Sediment Facies Map for Lower Granite Reservoir, Idaho and Washington

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Background

Lower Granite Reservoir, the farthest upstream of four impoundments on the lower Snake River, entraps sediment contributed by its tributaries joining the main Snake River: the Salmon, Grande Ronde, Imnaha, and Clearwater Rivers. The U.S. Army Corps of Engineers (USACE) has determined that sedimentation in Lower Granite Reservoir is reducing the safety of commercial navigation and the reservoir storage capacity in the Clarkston, WA and Lewiston, ID ports (fig. 1).

Dredging, the traditional method of removing sediment, has been questioned due to potential environmental effects to threatened species within the river. Alternative sediment management options are being evaluated within the watershed to reduce the total sediment being delivered to the downstream reservoirs.

During the fall of 2009 and the winter of 2010, scientists from the U.S. Geological Survey (USGS) Idaho Water Science Center conducted bathymetric and underwater video surveys to determine surficial sediment facies and bedform morphology on the Snake and Clearwater River reaches of Lower Granite Reservoir near Lewiston, Idaho. The surficial sediment facies map provided the USACE with a view of the current sediment distribution within Lower Granite reservoir.

Methods

USGS scientists used underwater video to visually identify the surface substrate type and its embeddedness by determining particle size characteristics and the percent to which coarse substrate is surrounded or covered by sand or silt (fines).

The following rock diameters and sediment categories define the facies map areas: bedrock, boulder, cobble, gravel, sand, silt, and riprap material. For the purposes of this study, coarse substrates (boulder, cobble, and gravel) were combined into one category because the occurrence of coarse substrate can change over a small area.

The different patterns on the facies map distinguish sediment categories; hatching indicates the presence of fines. The average percent of embeddedness is depicted by a color ramp (fig. 1).

Capturing video along transects

More than 900 video clips were recorded at discrete, equal-width increments (video points) along 61 cross sections and 5 longitudinal dredge material deposits areas established by USACE (fig 4). The video clips were recorded using a high-resolution, color video camera outfitted with two high-power laser pointers. The laser pointers had a constant 4-inch separation as a scale of reference to determine sediment grain size. The camera was lowered through the water column until it was near the bed and the substrate could be identified (fig 2). Each video was then reviewed to determine sediment size and embeddedness.

Layering multibeam bathymetry

A companion study using multibeam echo sounding resulted in a nearly seamless digital elevation map of the channel bed. This bathymetry was layered behind the sediment facies map (fig 3a) to identify sediment category boundaries, and to delineate the sediment facies, such as sand dunes (fig 3b) and bedrock.

Figure 1. Snake and Clearwater Rivers facies map

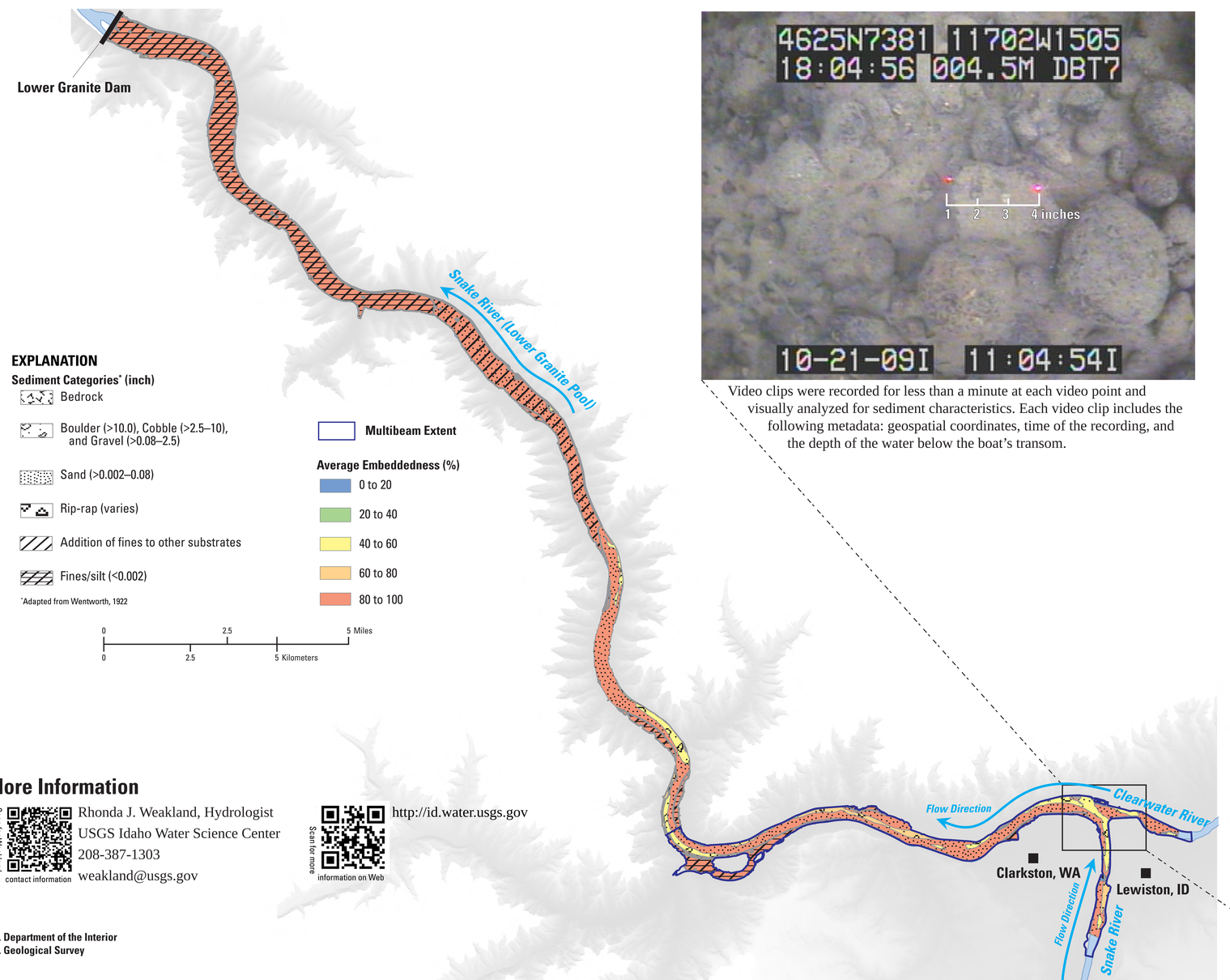


Figure 2. Determining sediment grain size with laser projection

Video clips were recorded for less than a minute at each video point and visually analyzed for sediment characteristics. Each video clip includes the following metadata: geospatial coordinates, time of the recording, and the depth of the water below the boat's transom.

Figure 3a. Layering facies map with bathymetry to identify sediment category boundaries

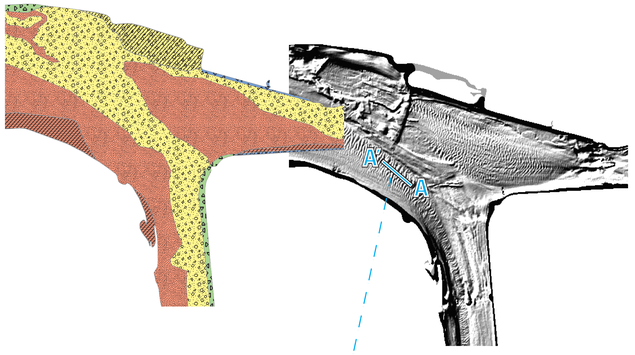


Figure 3b. Sand dune cross-section

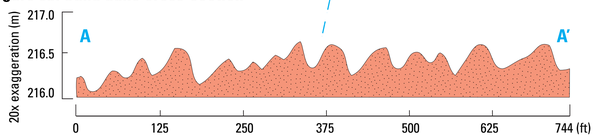
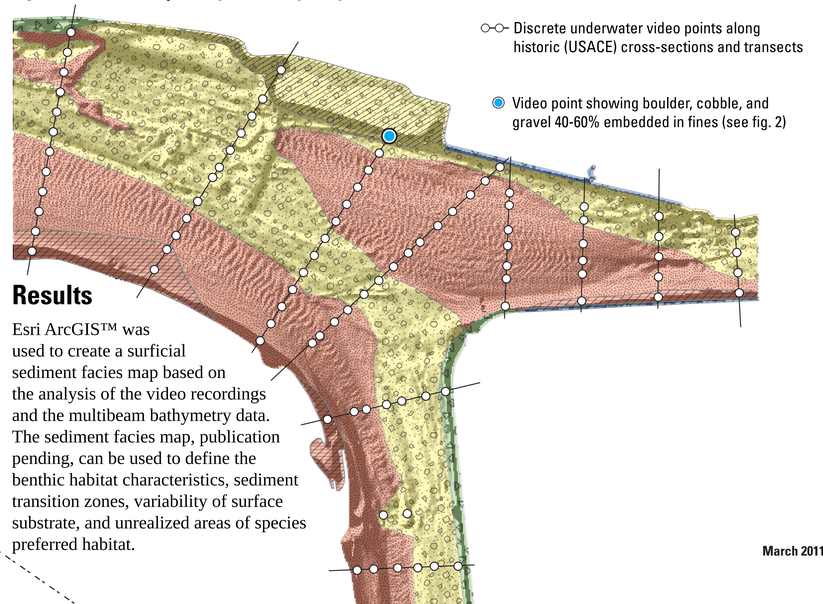


Figure 4. Facies transparency over bathymetry



Results

Esri ArcGIS™ was used to create a surficial sediment facies map based on the analysis of the video recordings and the multibeam bathymetry data. The sediment facies map, publication pending, can be used to define the benthic habitat characteristics, sediment transition zones, variability of surface substrate, and unrealized areas of species preferred habitat.

More Information

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