

Environmental Laboratory Researchers Evaluate Bedload Sediment Collector on Niobrara River

Impact Statement: The ERDC Environmental Laboratory (EL), the USACE Omaha District (NWO) H&H engineers, and the NWO Gavin's Point Dam service base staff installed and evaluated a 12-foot bedload sediment collector on the Niobrara River, NE, with partners at the Missouri Sedimentation Action Coalition (MSAC) during 9-13 September 2024. US Geological Survey (USGS) scientists simultaneously developed a sediment budget to help evaluate the sediment collection efficiency and to support interagency research objectives. A substantial base flow moves very fine to medium sand year-round compared to most other sites that only move sediment during storm spates or seasonal floods. This base flow sampling demonstrated a great capacity to collect sediment with a semi-passive, cost-effective system to collect and remove riverine sediment. While designed for bedload, we found a substantial fraction of very fine sediment. We will continue to evaluate the technology for USACE St Louis District (MVS) lead-contaminated sediment capture and Mississippi River navigation channel tests.

The Niobrara River has historically contributed at least 50 percent of the sediment to the Missouri River reach that now makes up Lewis and Clark Lake, created by the construction of the USACE Gavins Point Dam Project. The dam is the lowest in the Missouri River system and is critical for lower Missouri River flood protection and navigation regulation on the Missouri River. The immense sediment load from the Niobrara River is partly responsible for a 30 percent loss of reservoir capacity.

The Niobrara is a spring fed river with a high base flow capable of constantly moving sand. The effect of continuous high base flow through the Sandhills landscape creates a chronic sediment supply downstream, whereas other rivers show more episodic sediment transport with seasonal floods. This chronic sediment supply makes the Niobrara an ideal location to manage sediment with a bedload sediment collector, which was one of four methods recommended to manage sediment in Lewis and Clark Lake Sediment Management Plan Phase II Report published by USACE in late 2023. The USACE Regional Sediment Management (RSM) Program supported an NWO request for Dr. Chuck Theiling (ERDC Environmental Laboratory [EL]), Dr. Paul Boyd (NWO), and Gavin's Point Dam service base staff to install and evaluate a 12-foot bedload sediment collector on the Niobrara River, NE, with partners at the Missouri Sedimentation Action Coalition (MSAC) during 9-13 September 2024. Dr. Boyd (NWO) identified interagency sediment research funding to enable US Geological Survey (USGS) scientists to collect data to develop a sediment budget for the river reach.

The bedload sediment collector used in this evaluation was a 12-ft, in-stream trough plumbed to pumps and placed on the river bottom to remove the sediment slurry from the river (Figure 1). They are placed perpendicular to river flow where sediment is transported to the technology device which can run continuously during high sediment transport, or episodically if sediment transport is seasonal or low volume. Sediment can be removed for storage or beneficial use to increase reservoir sustainability.



Figure 1. (Left): Niobrara River bedload sediment collector deployment. (Right): Site setup with generator, control box, collector in the river, sediment separation tanks, and dewatering tank to capture large volumes of sediment.

This evaluation collected sediment in a 20-cy sediment dewatering bag most of the time, except when we collected quantitative samples at different pump speeds (Figure 2). USGS used both traditional sediment budget methods with integrated water column samples and bedload grabs, and digital bedform mapping and water column backscatter analysis (Figure 3). Preliminary results indicate the backscatter detector could “see” when the bedload collector’s pumps were turned on and off. Observations also suggested the system was catching sand dunes migrating across the collector, though future bedform and bathymetry monitoring around the collector is required to properly assess the impacts on bedforms.

Dr. Boyd (NWO) has a career-long relationship with the Niobrara community (Figure 4). He and the Missouri Sedimentation Action Coalition (MSAC) Board worked hard to promote awareness to this research and created several outreach opportunities. They had one public open house, and agency site visit, 2 school groups, and local news media. MSAC hired a videographer and the NWO Public Affairs Office made a site visit to collect drone video and project awareness. ERDC Corporate Communications will collaborate to create video products and social media outreach.

Near-term bedload collector activity will evaluate lead-contaminated sediment removal in the Big River, MO, with the USACE St. Louis District (MVS) working with the US Environmental Protection Agency (EPA). The ERDC Environmental Laboratory (EL) hopes to get to an Upper Mississippi River (UPR) dredge site or tributary during Spring 2025.

Funding for the bedload sediment collector evaluation was provided by the USACE Regional Sediment Management (RSM) Program; by the USACE Dredging Operations and Environmental Research (DOER) Program; and by the Innovations in Sediment Management (ISM) Strategic Focus Area.

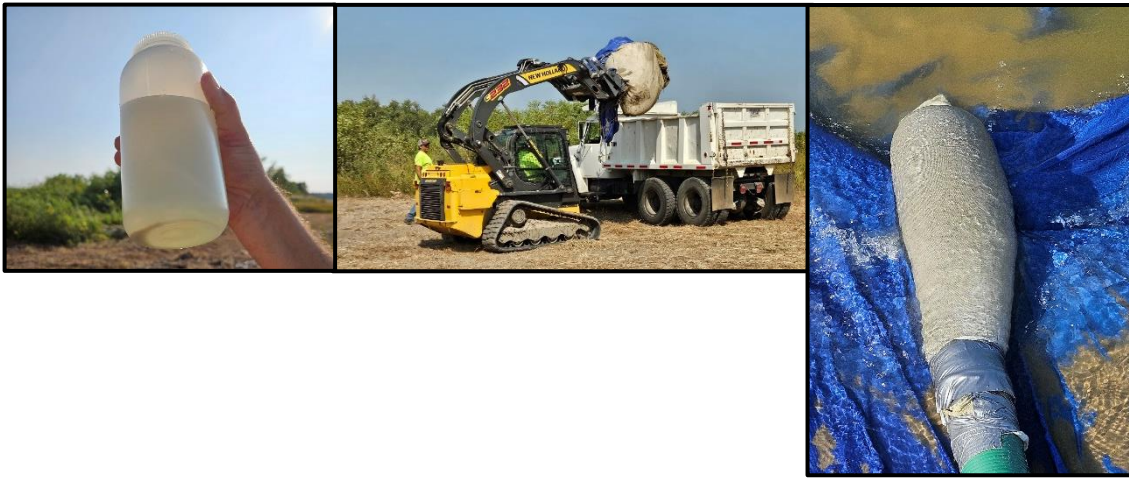


Figure 2. Sediment sampling for all fractions of the sediment regime included large de-watering bag and water samples to see what escapes collection devices. The coarse mesh de-watering allowed most of the fine fraction to escape. Future implementation will adapt sediment capture methods.



Figure 3. USGS used advanced digital methods and traditional methods to develop a sediment budget for the site.



Figure 4. Dr. Boyd (NWO) and the Missouri Sedimentation Action Coalition (MSAC) created many outreach activities with a public meeting, agency site visits, and two school groups studying agriculture, environmental science, economics, and social studies.

PoC: Chuck Theiling, ERDC-EL Charles.h.theiling@usace.army.mil and Paul Boyd, USACE-NWO paul.m.boyd@usace.army.mil