

## NOTICE OF INTENT TO AWARD

This Funding Announcement is not a request for applications. This announcement is to provide public notice of the Bureau of Reclamation's intention to fund the following project activities without full and open competition.

ABSTRACT	
<b>Funding Announcement</b>	R12AC80083
<b>Project Title</b>	Passive Acoustic (Hydrophone) Measurement of Coarse Bed Load
<b>Recipient</b>	University of Mississippi National Center for Physical Acoustics (NCPA)
<b>Principal Investigator / Program Manager</b>	Mr. Scottie Casey
<b>Anticipated Federal Amount</b>	\$150,000.00
<b>Cost Share</b>	\$0
<b>Total Anticipated Award Amount</b>	\$150,000.00
<b>New Award or Continuation?</b>	New Award
<b>Anticipated Period of Performance</b>	January 1, 2011 –September 30, 2014
<b>Award Instrument</b>	Cooperative Agreement
<b>Statutory Authority</b>	Omnibus Public Lands Management Act of 2009, Section 9504, Public Law 111-11, (b) RESEARCH AGREEMENTS.
<b>CFDA # and Title</b>	15.507 Sustaining and Manage America's Resources for Tomorrow
<b>Single Source Justification Criteria Cited</b>	4 – Unique Qualifications
<b>Reclamation Point of Contact</b>	Michelle Maher, Grants Officer Email: <a href="mailto:mmaher@usbr.gov">mmaher@usbr.gov</a> Phone: 303.445.2025

## **OVERVIEW**

Prior research has indicated that passive hydro-acoustic technology shows great promise to replace conventional bed load sediment transport monitoring that is logistically difficult, costly, and potentially unsafe. The research question is: How can a surrogate method of bed load measurement using passive hydro-acoustic technology (hydrophone) be implemented to provide quantitative, accurate, and reliable measurements? In order to answer this primary question, the following inquiry must be answered, which is the goal of this research. What instrumentation developments, interdisciplinary collaborations, and testing are necessary to extend existing passive hydro-acoustic technology into a viable new tool that can consistently provide reliable bed load measurements at a lower cost for better management of gravel bed rivers? This research proposal is being submitted on the heels of a funded scoping proposal to investigate the current state of using hydrophones to measure bed load, determine potential collaborators, and form partnerships that will advance the science of hydro-acoustic bed load measurement. This effort revealed that the Agricultural Research Service (ARS) is interested in pursuing a means to measure bed load with hydrophones. The ARS has planned to collaborate with the University of Mississippi's National Center for Physical Acoustics (NCPA) to advance this research. A collaboration with team members knowledgeable in the fields of sediment transport and acoustics and signal processing is well positioned to advance the application of passive hydro-acoustics in the measurement of bed load.

**Research Strategy** The work proposed here encompasses the development of a passive (listening) acoustic system for monitoring coarse bed load movement, including calibration, data processing, and, if warranted, the fabrication of a dedicated instrument. The magnitude and frequency of the acoustic signal generated by gravel transport along the bed may be influenced by the size and mineralogy of the sediment and the local channel morphology; therefore, these characteristics will be investigated as part of the work. Barton et al. (2010) have shown that collisions between moving sediment grains and a stationary bed generate acoustic energy that can be related to a rate of bedload transport. According to studies by Thorne (1986), the frequency ranges generated by gravel interactions vary from 50 kHz for fine particles (2mm) to 2 kHz for coarse particles (64 mm). The main goal of this project is to expand on previous work with new laboratory and field measurements in order to pursue development of dedicated hardware for the long-term recording of acoustic emissions generated by bed load movement.

## **RECIPIENT INVOLVEMENT**

Laboratory tests are scheduled to take place at the National Sediment Lab belonging to the Agricultural Research Service (ARS) in Oxford, MS. These tests will be carried out by experts in sediment transport and acoustics, as the NCPA is also located in Oxford, MS. Field testing of the hydrophone system will be scheduled to take place concomitant with physical bed load measurements using pressure difference samplers. Currently this sampling is scheduled to take place on the Trinity River (CA) and the Elwha River (WA) during the proposed research period. Both lab and field components are necessary portions of this research, taking advantage of the controlled environment in a lab setting and utilizing physical measurements in a field environment for testing and calibration.

**Objectives:**

1. Perform detailed literature review to avoid duplicative work
2. Perform laboratory measurements to determine the acoustic amplitude and frequency range generated by the impact of particles with a range of sizes and impact velocities. Using individual and multiple gravel to gravel contacts to obtain \_typical\_ collision signatures will guide the development of fielded hardware and signal processing algorithms that may include Fast Fourier Transforms or wavelet analysis.
3. Collect calibration datasets that include concurrent sampling of acoustic emissions and physical samples of moving gravel bedload in laboratory flumes.
4. Collect calibration datasets that include concurrent sampling of acoustic emissions and physical samples of moving gravel bedload in field trails.
5. Develop a stand-alone unit that is capable of storing data during a long-term deployment. Some pre-processing of the data such as FFT or wavelet analysis may be used to reduce the acoustic data to a manageable size that can be stored and uploaded efficiently.
6. Calibrate and deploy the dedicated stand-alone passive acoustic system in the field.

**RECLAMATION INVOLVEMENT**

Substantial involvement on the part Reclamation is anticipated for the successful completion of the objectives to be funded by this award. In particular, Reclamation will be responsible for the following:

- Guide contracted research through assistance with planning of flume and field experiments and coordination and assistance with field testing.
- Evaluate and report progress for year 1-3.
- Travel to the National Sediment Lab for collaboration, planning, and progress monitoring.
- Travel to the Trinity River for assistance with field experiments.
- Assist with documentation of research.

**SINGLE-SOURCE JUSTIFICATION**

<b>DEPARTMENT OF THE INTERIOR SINGLE SOURCE POLICY REQUIREMENTS</b>
Department of the Interior Policy (505 DM 2) requires a written justification which explains why competition is not practicable for each single-source award. The justification must address one or more of the following criteria as well as discussion of the program legislative history, unique capabilities of the proposed recipient, and cost-sharing contribution offered by the proposed recipient, as applicable.
In order for an assistance award to be made without competition, the award must satisfy one or more of the following criteria:  (1) Unsolicited Proposal – The proposed award is the result of an unsolicited assistance application which represents a unique or innovative idea, method, or approach which is not the subject of a current or planned contract or assistance award, but which is

deemed advantageous to the program objectives;

- (2) Continuation – The activity to be funded is necessary to the satisfactory completion of, or is a continuation of an activity presently being funded, and for which competition would have a significant adverse effect on the continuity or completion of the activity;
- (3) Legislative intent – The language in the applicable authorizing legislation or legislative history clearly indicates Congress' intent to restrict the award to a particular recipient of purpose;
- (4) Unique Qualifications – The applicant is uniquely qualified to perform the activity based upon a variety of demonstrable factors such as location, property ownership, voluntary support capacity, cost-sharing ability if applicable, technical expertise, or other such unique qualifications;
- (5) Emergencies – Program/award where there is insufficient time available (due to a compelling and unusual urgency, or substantial danger to health or safety) for adequate competitive procedures to be followed.

Reclamation did not solicit full and open competition for this award based the following criteria:

#### **(4) UNIQUE QUALIFICATIONS**

##### **Single Source Justification Description:**

Most of the funding for this research will be contracted to the National Center for Physical Acoustics (NCPA). This research team has the necessary experience in acoustics and signal processing that is needed to carry forward the state of the science. Relevant publications are listed at the end of this section. To date, most of the research in the field of acoustic measurement of bed load has been performed by sediment transport specialists who often lack the knowledge and expertise in fields such as acoustic energy, sound propagation, and signal processing, noted by Belleudy (2010). The NCPA has access to flumes at the Agricultural Research Service's National Sediment Laboratory and the cooperation of sediment transport experts Drs. Roger Kuhnle and Daniel Wren. The NCPA is willing to perform experiments in field locations with the assistance of the PI and Andreas Krause, where concurrent bed load measurements will be made using pressure difference samplers. Combining laboratory and field experiments, along with acoustic and sediment transport expertise, will provide the greatest opportunity for successful development of a passive hydro-acoustic surrogate for measuring bed load.

The National Sediment Lab possesses the equipment necessary to carry out the flume experiments, including gravel sized sediment, sieves, four scientific grade hydrophones, data collection system, multiple flumes including a sediment recirculation tank and a flume capable of transporting, re-circulating, and measuring transport rates of gravel. Additional equipment that is on-hand and necessary for collecting experimental data includes function generators, oscilloscopes, digitizers, transducers, and preamplifiers. The NCPA and ARS have an

instrumented test raft on Goodwin Creek in Batesville, MS that can be used for initial field testing and calibration prior to field deployments on the Trinity River.

This and similar research on surrogate sediment measurement technology has the full and complete advocacy of the Federal Interagency Sedimentation Project (FISP). The FISP provides the structure, coordination, and expertise to identify, evaluate, and provide tools and techniques for accurate, standardized, calibrated, cost-efficient, and safe measurement and analysis of sediment properties and transport.

Selected documentation of the NCPA and ARS:

#### PATENT AND LICENSING ACTIVITY

Daniel Wren, Dan Kleinert, James P. Chambers \_DSP Acoustic Backscatter System to Monitor Suspended Sediments\_ USDA Invention Report Number 0010.06

#### SELECTED ARCHIVAL PUBLICATIONS

Carpenter, W. O. Jr., Chambers, J. P., Wren, D. G., Kuhnle, R. A., and Diers, J. A., \_Acoustic Measurements of Suspended Fine Particle Concentrations by Attenuation\_, USDA ARS Research

Report No. 67 12/2009

Carpenter, W., Chambers, J.P, Wren, D., Kuhnle, R., and Diers, J. \_Acoustic Measurements of Clay-Size Particles\_, J. Acoust. Soc. Am. Express Letters submitted Aug. 2009

Kuhnle, R.A., D.G. Wren, and J.P Chambers (2007). Prediction of Grain Size of Suspended Sediment: Implications for Calculating Suspended Sediment Concentrations using Single Frequency Acoustic Backscatter, International Journal of Sediment Research, v. 22, no. 1. p 1-15

#### SELECTED CONFERENCE PUBLICATIONS

Chambers, J. P., Carpenter, W. O. Jr., Wren, D. G., Kuhnle, R. A., and Diers, J. A., \_Acoustic monitoring of sediment transport\_ Workshop on Dam Stability, Safety and Failure (2011)

Carpenter, W., Wren, D., Kuhnle, R., and Chambers, J.P. \_Acoustic Measurements of Clays and Silts\_ Acoustical Society of America (11/10), Cancun, MX

Carpenter, W., Wren, D., Kuhnle, R., and Chambers, J.P. \_Acoustic Measurement of Suspended Fine Particle Concentrations by Attenuation\_ Joint Federal Interagency Conference (06/10), Las Vegas, NV

Carpenter, W., Wren, D., Kuhnle, R., and Chambers, J.P. \_Acoustic Measurement of Fines\_ Acoustical Society of America (5/09), Portland, OR

### STATUTORY AUTHORITY

Omnibus Public Lands Management Act of 2009, Section 9504, Public Law 111-11, (b)  
RESEARCH AGREEMENTS.

(1) **AUTHORITY OF SECRETARY.**—The Secretary may enter into 1 or more agreements with any university, nonprofit research institution, or organization with water or power delivery authority to fund any research activity that is designed—

(A) to conserve water resources;

(B) to increase the efficiency of the use of water resources; or

(C) to enhance the management of water resources, including increasing the use of renewable energy in the management and delivery of water.

(2) TERMS AND CONDITIONS OF SECRETARY.—

(A) IN GENERAL.—An agreement entered into between the Secretary and any university, institution, or organization described in paragraph (1) shall be subject to such terms and conditions as the Secretary determines to be appropriate.

(B) AVAILABILITY.—The agreements under this subsection shall be available to all Reclamation projects and programs that may benefit from project-specific or programmatic cooperative research and development.