Development of a Web-based Training Course to Augment "Streamflow Records Computation using ADVMs and Index-velocity Methods" (SW1319) and the "*Computing Discharge using the Index-Velocity Method*" Techniques and Methods Report 3A-23

Short Title: Index-Velocity Streamgages

Long Title: A Web-based Technology Enabled Learning (TEL) Training Course to Augment "Streamflow Record Computation using ADVMs and Index-velocity Methods" (SW1319) and the Techniques and Methods Report, "*Computing Discharge using the Index-Velocity Method*"

Lead Subject Matter Expert: Molly S. Wood (mswood@usgs.gov) (208) 387-1320
Supervisor: Michael E. Lewis (mlewis@usgs.gov) (208) 387-1321

Molly will serve as the Lead Subject Matter Expert and work on the following topics: (1) Acoustic Doppler velocity meter (ADVM) theory, (2) River hydraulics, (3) Selecting the proper type and frequency of ADVM, (4) Configuring the ADVM's measurement volume, and (5) Configuring the ADVM's other settings. Molly will adapt existing course material and create new material for this proposed TEL course.

Vitae for Lead SME:

- Experienced in using ADVMs in variety of environments for measuring streamflow in rivers and also to estimate suspended sediment concentration using acoustic backscatter.
- Member and past Vice Chair of the Hydroacoustic Work Group (HaWG), an advisory committee to the Office of Surface Water for Hydroacoustics
- Instructor for the USGS courses, "Streamflow Record Computation using ADVMs and Index-velocity Methods" (SW1319) and "Streamflow Measurements Using ADCPs" (SW1321)
- Developed short, informative webcasts on hydroacoustics topics. An example is available at: http://hydroacoustics.usgs.gov/training/podcasts/advm.measurement.volume.podcast.shtml.
- Surface-Water Specialist, Idaho Water Science Center (WSC)

Subject Matter Expert: Lars Soderqvist (lsoderq@usgs.gov) (239) 275-8448 x12
Supervisor: Richard L. Kane (rkane@usgs.gov) (813) 498-5057

Lars will work on the following topics (1) Reconnaissance techniques and site selection, (2) Mounting options, (3) Configuring the ADVM's measurement volume, and (4) Configuring the

ADVM's other settings. Lars will adapt existing course material and create new material for this proposed TEL course.

Vitae for SME:

- Experienced in the deployment and operation of acoustic Doppler velocity meters (ADVMs) for measurement of streamflows in coastal and backwater environments.
- Instructor for the USGS course, "Streamflow Record Computation using ADVMs and Index-velocity Methods" (SW1319)
- Hydrologic Technician, Florida WSC

Contributing SME: Jeff W. East (jweast@usgs.gov) (936) 271-5326
Supervisor: Terry L. Schertz (tschertz@usgs.gov) (512) 927-3590

Jeff will assist other SMEs by serving as a technical advisor and reviewer of the developed material.

Vitae for Contributing SME:

- Long-term experience in the operation of ADVMs for measurement of streamflows in coastal environments.
- Current Chair of Hydroacoustic Work Group (HaWG), an advisory committee to the Office of Surface Water for Hydroacoustics
- Instructor for the USGS courses, "Streamflow Record Computation using ADVMs and Index-velocity Methods" (SW1319) and "Streamflow Measurements Using ADCPs" (SW1321)
- Developed short, informative webcasts on hydroacoustics topics. An example is available at: http://hydroacoustics.usgs.gov/training/podcasts/program.satlink.advm.podcast.shtml
- Surface-Water Specialist, Texas WSC

Contributing SME: Kevin Oberg (kaoberg@usgs.gov) (217) 328-9739
Supervisor: Robert R. Mason (rrmason@usgs.gov) (703) 648-5305

Kevin will assist other SMEs in producing, modifying, and reviewing PowerPoint presentations for the course and will assist in transforming course material into Flash using Adobe Presenter. Kevin will provide oversight for the project and facilitate reviews of the scripts and final product.

Vitae for Contributing SME:

- National Coordinator for the Office of Surface Water's (OSW's) Hydroacoustics program
- Instructor for the USGS courses, "Streamflow Record Computation using ADVMs and Index-velocity Methods" (SW1319), "Streamflow Measurements Using ADCPs" (SW1321), and "Intermediate Streamflow Measurements using ADCPs"

- Co-author of Techniques and Methods Report 3A-23, "*Computing Discharge using the Index-Velocity Method*" (Levesque and Oberg, 2012)
- Has attended the course "Designing, Developing and Deploying Effective Technology Enabled Learning" and has access to and uses Breeze Presenter.

Problem Statement—Why is this Course Needed?

The application of index-velocity methods for computing streamflow records has been expanding rapidly within the USGS. This expansion is being driven in part by the demand to more accurately measure streamflows in locations that are very challenging for streamflow measurement, such as tidally- or backwater-affected streams. Accurate streamflow information is needed in these environments for a variety of purposes, including biological assessments, flood hazard warning, geospatial flood mapping, climate change analysis, and water availability and sustainability assessments. Technological changes such as the introduction of low-cost ADVMs have made this method more practical and affordable.

Although the OSW has provided index-velocity training for approximately 10 years, OSW's Surface Water reviews have revealed many shortcomings in index-velocity streamgages, highlighting the need for more effective index-velocity training. Furthermore, many problems with computing index-velocity records can be traced back to deployment location of the ADVM and configuration of the measurement volume. The proposed TEL course would provide a more efficient way to get introductory training delivered to our hydrographers in the field without requiring that they leave their office to attend a course. The course also would serve as a mandatory pre-requisite for the "Streamflow Record Computation using ADVMs and Index-velocity Methods" (SW1319) course, providing an opportunity for more "face-time" with students on records computation and enabling hydrographers to be more prepared for the course. An additional benefit for the proposed TEL course will be that employees who have previously taken the SW1319 course will be able to "refresh" their skills by taking the TEL course. Continuing education is an important factor in effective use of the index-velocity method.

Return on Investment

The current instructor-led course ("Streamflow Record Computation using ADVMs and Index-velocity Methods", SW1319) is one of the most in-demand training courses in the USGS. In fact, an additional course was added this year to accommodate the large number of requests. Even with this added course, we may not be able to meet the current demand this year. More than 50 USGS employees per year are expected to attend the course in 2014 and future years. The SW1319 course currently encompasses both field and records computation aspects of the index-velocity method. This proposed TEL course would focus more on the field aspects related to the establishment of an index-velocity streamgage so that the duration and travel costs associated with SW1319 could be reduced. The development of the proposed TEL course

would result in an estimated $16,000 - $18,000 in cost savings per year for student and instructor travel and per diem when attending the SW1319 course. Cost savings within the first three years of the course's offering would exceed the OED cost for developing the course.

Potential DOI Learn Course Summary

This web-based course will teach hydrographers about how to go about establishing an index-velocity streamgage. The material presented will augment both the information in the USGS Techniques and Methods report "*Computation of Streamflow using the Index-velocity Method"* and the existing index-velocity training course, SW1319. The course will teach the important aspects of establishing an index-velocity streamgage including the following topics:

1. Acoustic measurement theory
2. Evaluating river hydraulics to properly site an ADVM
3. Reconnaissance techniques for identifying the location for an ADVM
4. Mounting an ADVM
5. Selecting the proper type/frequency of ADVM
6. Configuring the ADVM's measurement volume
7. Configuring the ADVM's other settings

It is expected that it will take students about 8 hours to complete the course. We will use a post-course assessment to help reinforce important concepts.

Has Course Been Taught Before?

The parent course SW1319, "Streamflow Record Computation using ADVMs and Index-velocity Methods", is offered one to two times per year. The most recent offering was at the Denver National Training Center in July 2013, taught by four USGS instructors from the Water Mission Area. Currently, the course is 4.5 days and includes 20-25 students per course. Portions of the proposed TEL course are taught in the SW1319 course, but have also been presented as webcasts or short courses at USGS National Meetings.

Existing Course Materials

Most of the material that will be used as a starting point for the TEL course already exists as PowerPoint slides and .mp4 videos, archived on the OSW Hydroacoustics Training SharePoint site (https://xcollaboration.usgs.gov/wg/oswha/training/default.aspx) and last updated in July 2013. However, we propose to revise and improve this material and introduce various forms of media (videos of field work and software demonstrations) to convey concepts and practices important to the course.

Intended Audience

The audience will be Hydrologic Technicians, Biologists, Geologists, and Hydrologists engaged in collecting index-velocity data as a part of the USGS data collection program. We anticipate that USGS cooperators, such as the Bureau of Reclamation and state agencies such as California

Department of Water or South Florida Water Management District will also wish to make use of this course. We expect about 650 – 700 course participants over the three years after implementation, including about 150 USGS and cooperator employees who attend the SW1319 course and 500-550 other USGS employees and cooperators looking for on-demand training from their offices.

Anticipated Results and Benefits

The primary benefit for this TEL course will be to provide a cost-effective way to deliver index-velocity training to a larger audience. We believe that if done correctly, the training will enable USGS to collect more accurate data. The proposed TEL course will reduce travel costs, both for attending the SW1319 course, but also the short-courses provided at national data conferences and other USGS venues. Lastly, we anticipate that this course will allow users who attend the SW1319 course to be more prepared AND will provide additional time for focusing on streamflow records computation rather than field activities.

Relevance to USGS Mission Areas and Science Strategy

The use of the index-velocity method has benefitted the USGS streamgaging program by providing a means to obtain more accurate streamflow data in challenging measurement environments. Additionally, the need for water quantity data in conjunction with water quality data in coastal environments or in backwater-affected rivers is growing. The only way to provide these data accurately is to use the index-velocity method. More than 50 percent of the US population lives within 50 miles of the coast. As demands for water increase and pressures on coastal ecosystems increase, the ability to accurately measure streamflow is very important.

The proposed training supports the missions of six out of seven USGS Mission Areas: Climate and Land Use Change, Core Science Systems, Ecosystems, Environmental Health, Natural Hazards, and Water. Additionally, the training helps meets needs identified in the USGS' Strategic Directions for USGS Water Science, 2012-2022 (Evenson and others, 2012) - Goal 4: Anticipate and respond to water-related emergencies and conflicts and Goal 5: Deliver timely hydrologic data, analyses, and decision-support tools seamlessly across the Nation to support water-resource decisions. These goals would be targeted through training to increase the accuracy and availability of streamflow data in challenging environments.

Course Modules and Timetable

Proposed modules (7) are as follows.

1. Acoustic measurement theory (est. 2 weeks development time (DT))
    a. How an ADVM works
    b. Warnings and limitations
2. River hydraulics (est. 2 weeks DT)
    a. Steady versus unsteady streamflow

    b. Turbulent versus stratified streamflows
        i. Turbulent streamflow considerations
        ii. Wake turbulence
    c. Velocity characteristics of channels
    d. Effect of river hydraulics on ADVM measurements
3. Reconnaissance techniques and site selection (est. 3 weeks DT)
    a. Using maps/aerial photography and ancillary data to evaluate streamgage sites
    b. Evaluating streamflow distribution within a reach
    c. Case studies illustrating effect of river hydraulics on ADVM performance
4. Mounting options (est. 2 weeks DT)
    a. Desirable features of mounts
    b. Practical considerations
    c. Special cases
5. Selecting the proper type/frequency of ADVM (est. 2 weeks DT)
    a. Frequency and range
    b. Relation of (a) to existing site conditions such as mean velocities, etc.
    c. Review of instrumentation currently available
    d. Considerations for interfacing ADVMs to DCPs
6. Configuring the ADVM's measurement volume (est. 3 weeks DT)
    a. Range Averaged Cell
    b. Multi-Cell data
    c. Blanking Distance
    d. Cell Size
    e. Number of Cells
    f. Beam checks for configuration of ADVM
7. Configuring the ADVM's other settings (est. 2 weeks DT)
    a. Sampling Interval
    b. Averaging Interval
    c. Salinity
    d. Coordinate Systems
    e. Datalogger Programming

We anticipate it will take about 8 months to produce a test version of the proposed TEL course due to other SME commitments. A version will be ready for review in about 6.5 months from project initiation.

Estimated Timetable (month no. is from receipt of funding):

	Month No.							
Task	1	2	3	4	5	6	7	8
Review/revise proposed outline								
Evaluate existing Powerpoints for use in TEL								
Draft scripts for TEL								
Video tape field techniques								
Review of scripts by SMEs and others								
Modify Powerpoints and(or) create new ones								
Record animations/video for software demos								
Incorporate audio/video into Powerpoints								
Draft evaluation questions								
Draft of TEL for review by other SMEs								
Modify TEL and prepare for submission								

Estimated Frequency for Course Updates

We don't expect the methods described in the course to change, but the instrumentation may change over time. The course will be updated to reflect any new technology that becomes readily available and used within the USGS and as we identify errors.

Estimated Budget and Timeline (assuming USGS Appropriated Funding)

OSW or WSCs will cover 50 percent of the total expected salary costs for Wood, Soderqvist, and East. Oberg's salary is fully covered by OSW. The estimated budget shown below is only for funding requested from OED.

Salary	**OED Cost**
Wood	$ 14,000
Soderqvist	$ 10,000
East	$ 4,300
Oberg*	$ 0
Travel (for TEL Certification Training and OED meeting)	**OED Cost**
Airfare - Wood	$ 1,100
Airfare - Soderqvist	$ 1,100
Per Diem (Lodging, M&IE)	$ 2,800
Other Travel Costs	$ 700
Other Costs	**OED Cost**
Software	$ 2,500
TOTAL OED COST	**$ 36,500**

*Oberg's salary is fully covered by OSW.

References Cited

Evenson, E.J., Orndorff, R.C., Blome, C.D., Bohlke, J.K., Herschberger, P.K., Langenheim, V.E., McCabe, G.J., Morlock, S.E., Reeves, H.W., Verdin, J.P., Weyers, H.S., and Wood, T.M., 2012, Strategic directions for U.S. Geological Survey water science, 2012-2022 – Observing, understanding, predicting, and delivering water science to the Nation: U.S. Geological Survey Open-File Report 2012-1066, 42 p. (Also available at http://pubs.usgs.gov/of/2012/1066/).

Levesque, V.A., and Oberg, K.A., 2012, Computing discharge using the index-velocity method: U.S. Geological Survey Techniques and Methods 3-A23, 148 p. (Also available at http://pubs.usgs.gov/tm/3a23/).

Approvals from SME Supervisors

Wood, Molly <mswood@usgs.gov>

Call for Proposals: Developing Online U.S. Geological Survey Science and Technical Courses

1 message

Lewis, Michael <mlewis@usgs.gov> Tue, May 13, 2014 at 4:30 PM
To: Molly Wood <mswood@usgs.gov>

With regards to the submitted proposal for the development of a web-based technology enabled learning (TEL) course to augment "Streamflow Records Computation using ADVMs and Index-Velocity Methods" SW1319 and the "Computing Discharge using the Index-Velocity Method" Techniques and Methods Report 3A-23, I approve and am supportive of the proposal and Molly Woods as Lead Subject Matter Expert for the effort.
thx
ML

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Michael E. Lewis | *US Geological Survey*
Director
Idaho Water Science Center
230 Collins Rd | Boise, ID 83702
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Wood, Molly <mswood@usgs.gov>

Fwd: Call for Proposals: Developing Online U.S. Geological Survey Science and Technical Courses

1 message

Kane, Richard <rkane@usgs.gov> Tue, May 20, 2014 at 8:13 AM
To: Molly Wood <mswood@usgs.gov>
Cc: Kevin Oberg <kaoberg@usgs.gov>, Richard L Kane <rkane@usgs.gov>, Raphael Rodriguez <rrodrigu@usgs.gov>

Hi, Molly, I discussed this proposal with Lars, and the FLWSC Director, Rafael Rodriguez. We both support Lars' participation in this project. We understand that you are are requesting up to four weeks of his time in FY 15. When you have the project fully scoped out please send me a schedule of the time frame and deliverables you will need from Lars. Good luck, this sounds like a much need prerequisites for the Index Velocity training class.

Respectfully,

Richard Kane, Associate Director for Data, FLWSC

Wood, Molly <mswood@usgs.gov>

Assistance for TEL class material

1 message

Schertz, Terry <tschertz@usgs.gov> Tue, May 20, 2014 at 7:09 AM
To: Molly Wood <mswood@usgs.gov>
Cc: Jeffery East <jweast@usgs.gov>

Molly -

The Texas WSC is fully supportive of Jeff East serving as a technical reviewer on the new TEL class material you will be developing. He would like to be involved and it fits well with his new role as the SW specialist for Texas.

Terry Schertz

Wood, Molly <mswood@usgs.gov>

Fwd: Draft email of support

1 message

Mason, Robert <rrmason@usgs.gov> Wed, May 21, 2014 at 7:19 PM
To: Molly Wood <mswood@usgs.gov>
Cc: Kevin Oberg <kaoberg@usgs.gov>

HydroAcoustic techniques are the cornerstone for cost-effective collection of accurate streamflow measurements. The Office of Surface Water is committed to delivering the field training needed by USGS science centers to employ these techniques in an efficient and effective manner. Technology Enabled Learning (TEL) is an important component of our strategy and we will provide the time and attention of key OSW HydroAcoustic experts, particularly Kevin Oberg, to participate in TEL course development as described in your TEL proposal. -Robert

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