UPPER COLUMBIA RIVER

FINAL
Phase 3 Sediment Study – Sediment Facies Mapping
Data Summary Report

Prepared for

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September 2020

Data for this study is available upon request.

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File No.: 01-773180-000

Ms. Bonnie Arthur
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Subject: Upper Columbia River Remedial Investigation and Feasibility Study – Final Technical Memorandum Sediment Composition and Facies Maps for Upper Each Operable Unit (September 2020) – Errata

Ms. Arthur:

On behalf of Teck American Incorporated (TAI), I am submitting for your record this errata providing a summary of corrections we have made to Table 5-2 of the above-referenced final data summary report (DSR) and the corrected table (attached). The following revisions have been made to Table 5-2:

1. A new note 1 for clarity has been added to the table that states, "Dates and times are listed in Universal Coordinated Time (UTC)."

2. Data corrections as follows:

Date	Time	Station ID	Image ID
7/11/2019	No change	013-01	~~4133~~ 4110
10/24/2018	No change	064-03	~~3450~~ 3750

3. Data for two images were added:

Date	Time	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to 64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)
10/22/2018	19:10	039-04	3904	0.00	0.00	0.00	100.00
10/5/2018	17:16	089-02	8902	100.00	0.00	0.00	0.00

We will add this errata to the referenced DSR that is publicly available on the Upper Columbia River remedial investigation and feasibility study website, at (https://www.ucr-rifs.com/home/documents-plans/).

Should you have any questions or require any additional information at this time, please do not hesitate to contact me directly at (509) 623-4551.

Sincerely,
Teck American Incorporated

Rob Orr
Program Manager, Environmental Projects

Attachment (electronic): Table 5-2 with corrections for the Final Technical Memorandum Sediment Composition and Facies Maps for Upper Each Operable Unit (September 2020)

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ACRONYMS AND ABBREVIATIONS

ADCP	acoustic Doppler current profiler
AECOM	AECOM Technical Services, Inc.
AOI	area of interest
ASCII	American Standard Code for Information Interchange
CNI	Columbia Navigation, Inc.
DEA	David Evans and Associates, Inc.
DEM	digital elevation model
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ESRI	Environmental Science Research Institute
FSP	Field Sampling Plan
FSR	field survey report
Gravity	Gravity Consulting, Inc.
GSF	generic sensor format
HIPS	hydrographic information processing system
MBES	multibeam echosounder
MMU	minimum measurement unit
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
OU	operable unit
QAPP	quality assurance project plan
QPS	Quality Positioning Systems
RI/FS	remedial investigation and feasibility study
RM	river mile
RPD	relative percent difference
SAV	submerged aquatic vegetation
SOP	standard operating procedures
TAI	Teck American Incorporated
UCR	Upper Columbia River
USGS	United States Geological Survey

UNITS OF MEASURE

cm	centimeters
dB	decibels
ft	foot/feet
ft/s	foot/feet per second
m	meter(s)
mm	millimeter(s)

1 INTRODUCTION

This report presents the data processing methodology and digital geospatial products for data acquired as part of the Upper Columbia River site (UCR; hereafter, the Site[1]) Phase 3 Sediment Study—Sediment Facies Mapping project (hereinafter, the study). The study was conducted in accordance with the quality assurance project plan (QAPP) for the study (ERM et al. 2018) that was approved by the U.S. Environmental Protection Agency (EPA) on August 17, 2018. The Phase 3 Sediment Study is part of the UCR remedial investigation and feasibility study (RI/FS), which is being conducted under the June 2, 2006 Settlement Agreement (USEPA 2006) between Teck American Incorporated (TAI) and EPA, with EPA oversight. The Phase 3 Sediment Study is focused on the Upper Reach Operable Unit (OU) of the Site that extends from the U.S.-Canada border north of river mile (RM) 745 downstream to RM 7092 and includes three Areas of Interest (AOIs): Deadman's Eddy, China Bend, and Evans (Map 1-1). In addition to the sediment facies mapping work described in this report, the Phase 3 Sediment Study also includes characterization of sediment and porewater conditions in the three AOIs such that an overall understanding of risk to benthic organisms and the nature and extent of contamination in this portion of the Site can be assessed (ERM et al. 2019).

Data acquisition for the study was conducted by AECOM Technical Services Inc. (AECOM) in association with David Evans and Associates, Inc. (DEA), Gravity Consulting LLC (Gravity), and Columbia Navigation, Inc. (CNI) from September 25 to November 10, 2018 and from July 8 to July 19, 2019. The primary objectives were to acquire high-resolution acoustic data and georeferenced underwater photographs of the riverbed and then utilize these data to identify and map sediment grain size fractions and texture of the riverbed in the Upper Reach OU. Further characterization of sediment bed attributes was needed to inform and support development of the study design for the subsequent Phase 3 efforts to characterize sediment and porewater chemistry and reduce uncertainties regarding potential risk to benthic

[1] The Site as defined within the June 2, 2006, Settlement Agreement is the areal extent of hazardous substances contamination within the United States in or adjacent to the Upper Columbia River, including the Franklin D. Roosevelt Lake, from the U.S.–Canada border to the Grand Coulee Dam, and those areas in proximity to the contamination that are suitable and necessary for implementation of response actions.

[2] On January 8, 2018, EPA defined the upper reaches of the riverine portion of the Site as the Upper Reach OU encompassing "the upper reaches of the Columbia River between Marcus at river mile (RM) 708 and the international border just north of RM 744." However, the RM designations used by EPA in the January 8, 2018 letter differ from the RM designations conventionally used by the National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS). As explained in the Final Baseline Ecological Risk Assessment Work Plan (Page 2-3, footnote 7; Exponent et al. 2011), the discrepancy in RM designations used by USGS and those used by EPA dates back to the 2005 EPA Phase I sampling reports. USGS RMs increase from RM 680 to RM 682 over a river segment that is less than one RM in length when transitioning between the Inchelium and Rice USGS quadrants, whereas the EPA RMs increase from RM 680 to RM 681 over the same segment. As a result, above RM 680 the EPA RMs are *one less than* the USGS RMs. In this report, the USGS RM designations are used, by which the Upper Reach OU encompasses the Columbia River between RM 709 and RM 745.

organisms. To meet the study objectives, high-resolution acoustic data and georeferenced underwater photographs of the riverbed were acquired from the downstream end of the Upper Reach OU, starting at the downstream end of the Evans AOI at approximately RM 709, up to the U.S.-Canada border at approximately RM 745. The following data were acquired for the study:

- Bathymetry and acoustic backscatter imagery using a multibeam echosounder (MBES)
- Water column velocity profile measurements using an acoustic Doppler current profiler (ADCP)
- Underwater imagery using a drop-frame camera equipped with scaling lasers.

The field survey methods are detailed in the Field Survey Report (FSR) (Appendix A). The postprocessed digital geospatial data products described in this report were produced by DEA in association with Gravity, using the data processing methodology outlined in the QAPP (ERM et al. 2018). A description of the geospatial products is provided in Appendix B. The sediment facies mapping methodology was detailed in a Technical Memorandum approved by EPA on May 2, 2019 and finalized on May 6, 2019 (TAI 2019).

1.1 STUDY PURPOSE AND DATA QUALITY OBJECTIVES

This study is one of five study elements, originally designated as Data Quality Objectives (DQOs) 1 through 5, of the Phase 3 Sediment Study[3]. The Phase 3 Sediment Study—Sediment Facies Mapping QAPP (ERM et al. 2018) describes the sediment facies mapping data quality objective (i.e., DQO 1) only. The QAPP identified an approach for filling a data gap concerning the characterization of sediment types within the Upper Reach OU at a level of resolution sufficient for baseline ecological risk assessment and RI/FS decision making, in addition to informing and supporting subsequent Phase 3 Sediment Study data collection efforts. The following primary objectives of this study were as follows:

- Acquire high-resolution acoustic data and georeferenced underwater photographs of the riverbed within the Upper Reach OU
- Generate sediment composition and facies maps of the Upper Reach OU to support development of the remaining Phase 3 Sediment Study elements.

[4] The elements of the Phase 3 Sediment Study that were previously expressed as DQOs 1 through 5 included sediment facies mapping (DQO 1), characterization of chemical/physical properties in surface sediment (DQO 2), characterization of in situ sediment porewater chemistry (DQO 3), characterization of toxicity in surface sediments (DQO 4), and characterization of benthic macroinvertebrate communities (DQO 5). Study elements previously described as DQOs 2 through 5 were revised in the Final 2019 Phase 3 Sediment Study QAPP (ERM et al. 2019) to be presented under a sediment quality triad approach, instead of a series of individual DQOs.

1.2 REPORT ORGANIZATION

This report is organized into the following sections:

- **Section 1—Introduction.** This section provides background information, identifies the purpose of the study, and outlines the organization of the report.
- **Section 2—Study Design and Methods.** This section provides an overview of the field sampling methods and details the data processing methodology.
- **Section 3—Quality Assurance Project Plan Modifications and Deviations.** This section discusses deviations from the QAPP.
- **Section 4—Validation Assessment.** This section provides a summary of the data validation assessment of the results.
- **Section 5—Results.** This section presents a summary of the results.
- **Section 6—Summary.** This section presents a summary of the study.
- **Section 7—References.** This section presents bibliographic information for the documents cited in this report.

Figures, maps, and data tables are provided after Section 7. Raw geospatial data have been provided in native formats to EPA via digital hard drives. Postprocessed geospatial data products will also be provided to EPA via digital hard drives.

2 STUDY DESIGN AND METHODS

This section summarizes the study design and methods, including field data acquisition and data processing methods. The field data collection methods are primarily detailed in the FSR (Appendix A). Details concerning the technical specifications and considerations for instruments and software selected for use in this study are described primarily in Standard Operating Procedures (SOPs) 1 through 4 of the Field Sampling Plan (FSP), included as Appendix A in the QAPP (ERM et al. 2018). The sediment facies mapping methodology was detailed in an EPA-approved technical memorandum titled Sediment Facies Maps for Upper Reach Operable Unit Areas of Interest, Upper Columbia River Phase 3 Sediment Study (TAI 2019).

The UCR riverbed is composed of substrates that include mixtures of unconsolidated fine-grained sediments (sediments < 2 mm including sands and muds), gravels (2 mm to 64 mm), cobbles (> 64 mm), and bedrock. Sediment organisms use these substrates differentially and chemical of potential concern concentrations may differ as a function of sediment composition and bed characteristics, with finer-grained deposits potentially containing granulated slag, which may be a source of elevated concentrations of chemicals of potential concern. Sediment (or sedimentary) facies describe physical, chemical, and biological aspects of bed composition. In the Upper Reach OU, larger grain sizes are common and create sediment facies that are discontinuous and highly variable.

This study involved an MBES survey throughout the Upper Reach OU to acquire full-coverage, high-resolution bathymetry and acoustic backscatter imagery. In addition, ADCP current velocity measurements and georeferenced underwater images were acquired at discrete point locations ("stations") positioned along predefined river transects throughout the Upper Reach OU and with increased frequency within the three AOIs (Map 2-1). Outside of the three AOIs, transects had a nominal spacing of 0.5 miles; within the AOIs, transect spacing was 0.25 miles. Transects were typically oriented perpendicular to the flow path to provide representative coverage of the riverbed. ADCP measurements and underwater images were acquired at ten stations along each transect within the AOIs and at five stations along each transect outside of the AOIs. The MBES, ADCP, and underwater imagery data were processed, integrated, and analyzed to determine sediment grain size fractions and textures with a goal of identifying locations where finer-grained sediments are predominant. The final study design was developed collaboratively by TAI and EPA through the DQO process.

The following sections provide a summary of the field data collection and details on the data processing methodology for MBES, ADCP, and underwater imagery. Additional details on the study design and rationale are presented in the QAPP (ERM et al. 2018).

2.1 FIELD DATA COLLECTION METHODS

Sediment facies mapping field data collection in the Upper Reach OU was conducted by AECOM in association with DEA, Gravity, and CNI. Land-based survey work to establish a survey positioning control network was conducted from September 25 to 28, 2018 prior to beginning field data collection. Twenty survey control monuments were either installed (new control monuments) or reoccupied (existing control monuments) for use during field data collection. In 2018, sediment facies mapping field data collection was conducted from October 1 to November 10 and prioritized the three project AOIs (Evans, China Bend, and Deadman's Eddy) with areas between AOIs completed later. Field data collection activities were discontinued on November 10, 2018 due to hazardous winter weather conditions at the Site. At the conclusion of the 2018 field data collection, ADCP and underwater imagery data collection was complete throughout the Upper Reach OU, except at locations where data were obstructed by dense submerged aquatic vegetation (SAV), depths were too shallow, or conditions were deemed unsafe. MBES data collection was complete from the downstream end of Evans AOI at RM 709 to the upstream end of Deadman's Eddy AOI at approximately RM 739. In 2019, field data collection was conducted from July 8 to July 19 and focused on completing MBES bathymetry and coverage from the upstream end of the Deadman's Eddy AOI to the U.S.-Canada border (RM 739 to RM 745). During 2019 field operations the UCR water elevation was approximately 3 ft higher than during the 2018 field operations, which provided an opportunity to acquire additional MBES bathymetry and backscatter coverage at the Deadman's Eddy AOI as well as underwater images at locations that were obstructed or too shallow during 2018 field operations. In accordance with communications between EPA and TAI in April 2019, and upon EPA's approval on May 20, 2019, of the work plan for the 2019 field survey effort (USEPA 2019), no additional ADCP data were acquired during 2019 field operations.

A hydrographic survey vessel simultaneously acquired MBES bathymetry and acoustic backscatter imagery. Approximately 36 RMs of continuous coverage was obtained from the downstream end of the Upper Reach OU at RM 709 to the U.S.-Canada border north of RM 745, including complete coverage in all three AOIs.

A second survey vessel acquired ADCP and underwater imagery data. ADCP data were acquired at 635 of 682 proposed stations; underwater imagery was acquired at 649 of 682 proposed stations. Data were not acquired at the remaining stations due to various obstructions, including the presence of dense SAV, shallow water depths, location of proposed station on land, safety concerns, or hazardous conditions that precluded data collection. ADCP data acquired in 2018 represent river conditions at the time of data collection; however, water levels and flow velocity varied during field operations. The FSR (Appendix A) contains a discussion of time-spatial flow variability in Section 1.2.

All work was conducted in accordance with the QAPP (ERM et al. 2018). At the conclusion of 2018 field data collection, approximately 1.4 terabytes of raw field data were provided to TAI by AECOM for subsequent postprocessing and analysis by DEA and Gravity. At the conclusion of the 2019 field data collection, approximately 275 gigabytes of raw field data were provided to TAI by AECOM for subsequent postprocessing and analysis by DEA and Gravity.

2.2 MBES DATA PROCESSING METHODS

MBES data were processed by DEA following the workflow illustrated in Figure 2-1. Upon receipt of the raw MBES data from TAI, the data were transferred to secure servers at DEA's Vancouver, Washington facility where they were inventoried, stored, and routinely backed up during the data processing workflow. MBES data processing followed specifications in SOP-1 of the FSP, included as Appendix A of the QAPP (ERM et al. 2018).

Following basic data management, the MBES bathymetric data were prepared for import into Caris Hydrographic Information Processing System (HIPS) software, which was used for all MBES bathymetric data processing. A HIPS vessel file, which stores the sensor offset configuration and associated sensor uncertainty estimates for the survey vessel, was constructed using the results of a precision offsets survey performed on the survey vessel on September 28, 2018, prior to beginning field data collection. The MBES bathymetric data were imported into HIPS, merged with the HIPS vessel file, and stored logically by survey day. Once in HIPS format, the patch test data acquired during field data collection were analyzed. Patch tests determine any misalignments or time offsets relative to the vessel motion sensor and/or positioning systems. The resulting alignment corrections were applied to the bathymetric soundings. Sound speed profiles were incorporated to correct slant range measurements and compensate for refraction in the water column. For each survey line, position and vessel motion data were evaluated for quality and conformance to project specifications. After the evaluation was complete, the bathymetric soundings were viewed in 2-D and 3-D space and evaluated for artifacts indicative of erroneous depth soundings (e.g., "flyers"), excessive vessel motion, timing errors, sensor alignment errors, and other systematic biases. Erroneous bathymetric soundings were flagged and rejected using a standard combination of automated and manual filtering techniques available in Caris HIPS software.

After bathymetric data processing and review was completed, bathymetric soundings were gridded to a digital elevation model (DEM) with gridded resolution of 50 cm. The finalized bathymetric DEM was exported to 32-bit floating point Geotiff format.

The processed MBES bathymetric data were exported from Caris HIPS software in Generic Sensor Format (GSF) and imported into Quality Positioning Systems (QPS) FMGT software,

which was used for all MBES acoustic backscatter imagery processing. The FMGT backscatter data processing workflow involved pairing each GSF file, which contained processed bathymetric data with corrected beam footprints and associated metadata, with its corresponding native MBES data file, which contained the raw, time-series backscatter data. The pairing workflow was necessary to preserve edits made during bathymetric data processing and provided access to the normalized, time-series backscatter data format within the raw MBES data files. After file pairing was complete, the raw backscatter data were extracted from each file. Radiometric and topographic corrections were automatically applied to each file using processed bathymetric data from the paired GSF file, which provided accurate riverbed geometry for correct representation of acoustic backscatter imagery on steep slopes and other rough riverbed terrain. The backscatter data were then filtered, which included angle-varying gain adjustments as well as anti-aliasing. After corrections and filtering were completed, preliminary backscatter imagery was extracted for each paired file and combined into a composite imagery "mosaic." The preliminary acoustic backscatter imagery mosaic was quantitatively and qualitatively evaluated for artifacts indicative of excessive vessel motion and other systematic biases. After all processing and evaluation stages were completed, a final acoustic backscatter imagery mosaic was produced with a pixel resolution of 50 cm and acoustic backscatter intensity in units of decibels (dB). The finalized acoustic backscatter imagery mosaic was exported to 32-bit floating point Geotiff format.

To accommodate a condensed project timeline and to support and inform the study design developed in the QAPP for the remaining Phase 3 Sediment Study tasks, MBES data processing initially focused on the three AOIs. Bathymetric DEMs and acoustic backscatter mosaics for the AOIs, presented in TAI (2019), were approved by EPA on May 2, 2019. The complete bathymetric DEM and acoustic backscatter imagery mosaic are included with this report.

2.3 ADCP DATA PROCESSING METHODS

ADCP data were processed by Gravity following the workflow illustrated in Figure 2-2. Upon receipt of the raw ADCP data from TAI, the data were transferred to secure servers at DEA's Vancouver, Washington facility where they were inventoried and then transmitted to Gravity for processing and analysis. ADCP data processing followed specifications in SOP-3 of the FSP, included as Appendix A in the QAPP (ERM et al. 2018).

Following basic data management, ADCP data were processed using Matlab software. Each ADCP data file consisted of approximately 300 raw velocity profiles ("ensembles") acquired at each station location. Initial data processing steps included removing individual ensembles greater than 3 m from the target station location. The physical limitations of an ADCP instrument preclude velocity measurements near the riverbed, generally the bottom 6 percent

of the velocity profile. Therefore, for this study the velocity data were vertically binned into 1 ft (0.3048 m) bins with the lowermost bin located at least 6 percent of the flow depth above the river bottom. Each ensemble was then corrected for temperature by inverting sound velocity measurements acquired by the hydrographic survey vessel during MBES field data collection in the proximity of the ensemble. The processed ensembles were then averaged to produce a mean velocity profile for each target station location.

Estimates of near-bed shear stress (coefficient of friction) and apparent roughness height were calculated for each target station. The coefficient of friction is calculated as the ratio of shear velocity to average velocity, while apparent roughness height is a dimensionless mathematical construct. As described in the QAPP (ERM et al. 2018), quantification of the coefficient of friction and apparent roughness height was performed by fitting each mean velocity profile to the logarithmic law of the wall, or log law, using a least squares regression. This general procedure is commonly used with ADCP data (e.g., Rennie et al. 2002; Sime et al. 2007; Stone and Hotchkiss 2007; Rennie and Church 2010).

The processed ADCP data were exported to several formats to conform to specifications listed in the QAPP (ERM et al. 2018). The position, mean velocity, coefficient of friction, and apparent roughness height for each station location was exported in an Environmental Science Research Institute (ESRI) point shapefile. Text data files containing raw data were exported in American Standard Code for Information Interchange (ASCII) format and Microsoft Excel spreadsheet format.

2.4 UNDERWATER IMAGERY PROCESSING METHODS

Underwater images were processed and analyzed by Gravity following the workflow illustrated in Figure 2-3. Upon receipt of the raw underwater imagery data set from TAI, the data were transferred to secure servers at DEA's Vancouver, Washington facility where they were inventoried and then transmitted to Gravity for processing and analysis. Underwater imagery data processing and analysis followed specifications in SOP-2 of the FSP, included as Appendix A in the QAPP (ERM et al. 2018).

Following basic data management, imagery preprocessing was conducted using Adobe Lightroom software. Each image was qualitatively evaluated for quality and clarity, then cropped to a 4 x 3 ratio (5,333 x 4,000 pixels) to remove any dark corners caused by the underwater camera housing. Each image was then manually edited to improve quality and clarity by adjusting exposure, white balance, contrast, clarity, and saturation settings.

The preprocessed images were imported into ImageJ software for quantitative, semi-automated sediment grain size analysis using a scaling and gridding technique. After import, the scale of each image was determined by calculating the field of view based on the height of

the camera in the frame and validated by the visible red dots from the scaling lasers used by the underwater camera during field data collection[4]. This scaling process converted image pixel length to a calibrated distance in mm. After scaling each image, a numbered 8 x 6 grid was superimposed onto each image. In each grid cell, the longest length of each sediment particle was measured using tools within ImageJ software. A grain size classification was then assigned to each sediment particle based on its measured length. Finally, statistics from each image were calculated to produce a percent composition for each sediment grain size classification. The following sediment grain size classifications were used:

- Fine-grained sediment (< 2 mm) including sand, mud, silt, and clay
- Gravel (2 mm to 64 mm)
- Cobbles and boulders (> 64 mm)
- Bedrock.

A significant amount of manual interpretation was required due to the wide variability of grain sizes, the presence of SAV in some images, and the presence of cobble/boulder material covered lightly with fine-grained sediment. These images were flagged for review during subsequent sediment facies mapping and analysis.

After processing and analysis were completed, the sediment composition data were exported in an ESRI point shapefile containing the position, image identification number, and percent composition of each sediment grain size classification for each photo location.

To accommodate a condensed project timeline and to support and inform the study design for the 2019 elements of the Phase 3 Sediment Study, underwater imagery processing and analysis initially focused on the three AOIs. Processed underwater imagery and interpreted grain-size composition data for the AOIs, presented in TAI (2019), were approved by EPA on May 2, 2019. The complete underwater imagery data set is included with this report.

2.5 HORIZONTAL AND VERTICAL DATUMS

All geospatial data deliverables conform to the National Geodetic Survey National Spatial Reference System, National Adjustment of 2011.

[4] Due to an equipment malfunction, the underwater images acquired in 2019 did not include red dots from the scaling lasers. The underwater camera was mounted at a fixed height within the frame, therefore the field of view was always the same. Underwater images were not acquired if the underwater camera frame was not resting flat on the riverbed. The lasers provide a valuable visual reference, but their absence did not affect the scaling of the underwater images.

Horizontal datum, projection, and units for all geospatial data deliverables are as follows:

- Datum—North American Datum of 1983, 2011 realization (NAD83 [2011]) epoch 2010.00
- Ellipsoid—Geodetic Reference System of 1980
- Projection—Washington State Plane Coordinate System
- Zone—WA-4601 Washington North
- Coordinate Units—U.S. survey feet.

Vertical datum and units for all geospatial data deliverables are as follows:

- Datum—North American Vertical Datum of 1988 (NAVD88)
- Geoid—Geoid12b
- Elevation Units—U.S. survey feet.

3 QUALITY ASSURANCE PROJECT PLAN MODIFICATIONS AND DEVIATIONS

All data processing and analysis were performed in accordance with the QAPP (ERM et al. 2018). There were no deviations from the QAPP during the study that affected data quality.

Six Field Modifications during the 2018 and 2019 field data collection were documented via Protocol Modification Forms, which are included in the Field Summary Report (Appendix A).

- **Field Modification No. 1 (2018).** Dense SAV in some shallow areas prevented acquisition of usable underwater photographs. At these locations, an underwater photograph was acquired to document the dense SAV, then the vessel was relocated to a position half the distance to the next station and an underwater photograph was acquired at that position.
- **Field Modification No. 2 (2018).** In the QAPP FSP SOP-1 for MBES data collection, the first sentence of the latency patch testing section was revised to correctly state that the frequency for latency patch tests was the start of the project, end of the project, and in the event that the sonar configuration was changed.
- **Field Modification No. 3 (2018).** To be consistent with QAPP FSP SOP-2, the text in QAPP FSP Section 2.7.2 was revised to state that underwater video would be recorded continuously from the deployment of the underwater camera to the point at which the camera was retrieved.
- **Field Modification No. 4 (2018).** To mitigate the risk of damaging underwater camera equipment, underwater images were captured immediately upon the drop camera frame settling on the riverbed if the average water velocity exceeded 5 feet per second.
- **Field Modification No. 5 (2018).** The QAPP FSP SOP-2 and SOP-3 stated that ADCP data would be acquired concurrently and co-located with underwater image acquisition; however, during field data acquisition there were three scenarios that resulted in ADCP and underwater image not being acquired concurrently.
- **Field Modification No. 6 (2019).** The laser scaling device was functional during camera calibrations but malfunctioned during the acquisition of underwater photographs. This malfunction did not affect the scaling and size calculations of the underwater photographs.

4 VALIDATION ASSESSMENT

Data validation was performed by DEA in accordance with the QAPP (ERM et al. 2018). The objective of the data validation was to determine the quality and utility of each data set for use in identifying and mapping sediment grain size fractions, textures, and facies. The principal criteria for data validation related to answering the following questions:

- Do the data have known horizontal/vertical accuracy and resolution to support a minimum mapping unit (MMU) of 1 square meter?
- Does the quality of data allow combinations of particle types > 2 mm to be distinguished from those that are < 2 mm and differentiation between primarily sand areas and areas that are mixtures of sand and gravel/cobbles/boulders?

The accuracy and precision of each data set were evaluated against the measurement quality objectives and performance criteria listed in Table B4-1 of the QAPP (ERM et al. 2018). Draft geospatial data deliverables were reviewed to assess whether the data were of adequate quality to support the intended uses of the data. Validation included a review of data processing and analysis methods.

4.1 OVERALL DATA QUALITY

All MBES, ADCP, and underwater imagery data sets met or exceeded the quality requirements specified in the QAPP (ERM et al. 2018). No data products were rejected, although some products have been flagged for further review by analysts and users when generating sediment composition and facies maps. The following sections discuss the data quality review methodology and results.

4.2 MBES DATA QUALITY

All MBES data exceeded quality requirements as specified in SOP-1 of the FSP, included as Appendix A in the QAPP (ERM et al. 2018).

MBES bathymetric and backscatter data were acquired with 100 percent quality coverage from approximately UCR RM 709 at the downstream end of the Evans AOI to approximately UCR RM 745 at the U.S.-Canada border. One hundred percent quality coverage is defined as MBES data coverage in which neighboring MBES swaths overlap and there are no data gaps between swaths. MBES data coverage is complete to minimum water depth of 2 m and in some shoreline areas to a minimum water depth of 1 m. In areas where water depth was shallower than 1 m at the time of the survey, MBES data acquisition was not attempted due to the hazards to vessel safety and MBES equipment. Dense SAV in shallow, protected shoreline regions

prevented access by the hydrographic survey vessel due to the potential for vessel and/or equipment damage; this resulted in isolated gaps in coverage. No interpolation was applied to fill these areas. The density of quality coverage exceeded the minimum density of one sounding per 50 cm and supported the gridding of the final bathymetric DEM to a horizontal resolution of 50 cm. No interpolation was applied between contiguous swaths.

During MBES data quality review, areas with anomalously rough bottom texture were observed in the MBES bathymetric data. These areas were typically located in sheltered shoreline regions with water depths shallower than approximately 5 to 6 m and were spatially coincident with anomalously low acoustic backscatter intensity. Underwater images from these regions were reviewed to determine if the rough bottom textures and low acoustic backscatter intensity were due to erroneous soundings and/or acquisition artifacts or actual riverbed features. After review of the underwater imagery, these regions were confirmed to be areas with dense accumulations of SAV. Because of the density of SAV in these areas, accurate bottom detections and valid acoustic properties of the riverbed could not be determined. As a result, these areas were flagged as "dense SAV" for further analysis during sediment facies mapping.

A crossline analysis was conducted to evaluate overall MBES system performance and assess survey precision and accuracy against project requirements. During field data collection, crosslines were acquired at least once per day in a relatively flat area avoiding steep slopes. During MBES bathymetric data evaluation and quality review, crossline data were gridded at a 50-cm resolution to match the final bathymetric DEM. To evaluate survey precision, the mean difference between surfaces was calculated. Results indicate a mean surface difference of 0.027 ft or 0.008 m, exceeding project requirements (Table 4-1). A statistical analysis of the crosslines was also conducted by individual beam number. Results of this analysis indicate 100 percent of the data are within the vertical accuracy requirement of 10 cm (Table 4-2).

4.3 ADCP DATA QUALITY

All ADCP data met quality requirements as specified in SOP-3 of the FSP, included as Appendix A in the QAPP (ERM et al. 2018).

ADCP data were acquired at 635 of 682 proposed stations in the Upper Reach OU. Data were not acquired at the remaining 47 stations due to a variety of obstructions including the presence of dense SAV, shallow water depths, location of proposed station on land, or safety concerns or hazardous conditions that precluded data collection.

Sequential duplicate 300-ensemble samples were acquired at 5 percent of the ADCP measurement locations. To assess the precision and variability of riverbed roughness

parameters derived from ADCP measurements, the relative percent difference (RPD) was calculated from primary and duplicate ADCP measurements of sediment bed roughness parameters (coefficient of friction and apparent roughness height) (Table 4-3). Elevated RPD values are likely due to variation of the mean velocity profile through water surface interactions (i.e., winds, waves, excessive vessel motion), local variations in current, and/or water bottom interactions (i.e., mobile sediments, rough terrain).

Of the 635 ADCP measurement locations, 136 (21 percent) featured nonlogarithmic mean velocity profiles, resulting in problematic and likely inaccurate coefficient of friction and apparent roughness height values. The standard log-fitting procedure used to calculate coefficient of friction and apparent roughness height values assumes a two-dimensional flow over flat boundaries, thus it is reasonable to assume that the nonlogarithmic mean velocity profiles are likely due to contamination by three-dimensional flow structures caused by bedrock outcrops and other rough riverbed geometry (e.g., Petrie et al. 2013). Stations that displayed a nonlogarithmic mean velocity profile typically displayed either mean velocity increasing towards the riverbed or a uniform mean velocity profile (Figure 2-4). A mean velocity profile that increases towards the riverbed may be an indication of mobile sedimentary bedforms or nearby bedrock outcrops shedding turbulent eddies. A uniform mean velocity profile may be indicative of bedrock outcrops, increased shear due to local riverbed geometry, or insufficient measurements inside the boundary layer. At stations that showed a nonlogarithmic mean velocity profile, the results should be examined in a broader context using high-resolution bathymetry and backscatter. All apparent roughness height and coefficient of friction values are presented in Chapter 5; however, the nonlogarithmic stations have been flagged for further evaluation during generation of sediment composition and facies maps.

4.4 UNDERWATER IMAGERY QUALITY

All underwater imagery met quality requirements as specified in SOP-2 of the FSP, included as Appendix A in the QAPP (ERM et al. 2018).

Underwater images were acquired at 649 of 682 proposed stations in the Upper Reach OU. Underwater images were not acquired at the remaining 33 stations due to a variety of obstructions including the presence of dense SAV, shallow water depths, location of proposed station on land, or safety concerns or hazardous conditions that precluded data collection.

Duplicate underwater images were acquired at 5 percent of the underwater imagery locations. To assess the precision and variability of sediment grain-size composition as estimated by the semiautomated imagery analysis, the duplicate images were analyzed independently of the primary images and the total percent of sediment < 2 mm was calculated from the primary

and duplicate image analyses. Results are reported as the percent of sediment < 2 mm for each underwater image and associated RPD between measurements (Table 4-4).

Because of a malfunction of the laser scaling device, underwater images acquired during the 2019 field data collection did not include the laser scaling dots. This did not affect the processing or analysis of underwater images (see Section 2.4).

Of the 649 underwater images collected, 32 (5 percent) were partially to almost completely obscured by dense SAV. For the images that were totally obscured, sediment grain size interpretation was not possible; however, these images were helpful in confirming the areas of underwater vegetation visible in MBES bathymetric data. For images that were partially obscured, sediment grain size interpretation was conducted manually. Underwater images containing SAV were flagged for further evaluation during generation of sediment composition and facies maps.

5 RESULTS

High-resolution acoustic data and georeferenced underwater photographs of the riverbed were acquired within the Upper Reach OU from September 25 to November 10, 2018 and July 8 to July 19, 2019. Data postprocessing and analysis began on November 19, 2018 and initially focused on the three AOIs to support development of the 2019 Phase 3 Sediment Study QAPP. Bathymetry DEMs, acoustic backscatter mosaics, and underwater image analysis for the AOIs, presented by TAI (2019), were approved by EPA on May 2, 2019. Postprocessed geospatial data products for the entire Upper Reach OU are provided with this report.

MBES bathymetry and acoustic backscatter were acquired with 100 percent quality coverage from the downstream end of the Evans AOI at approximately RM 709 to the U.S.-Canada border at approximately RM 745, including complete coverage within all three AOIs, and to a minimum depth of 2 m. Data postprocessing produced a bathymetric DEM with a gridded resolution of 50 cm and an acoustic backscatter imagery mosaic with a pixel resolution of 50 cm. All MBES data exceeded quality requirements specified in SOP-1 of the FSP, included as Appendix A of the QAPP (ERM et al. 2018), although dense SAV obscured some shallow shoreline regions of the Upper Reach OU. The bathymetry DEM is shown in Maps 5-1a through 5-1i; the acoustic backscatter imagery mosaic is shown in Maps 5-2a through 5-2i.

ADCP data were acquired at 635 of 682 proposed stations in the Upper Reach OU. Data were not acquired at the remaining 47 stations due to a variety of obstructions including the presence of dense SAV, shallow water depths, location of proposed station on land, or safety concerns or hazardous conditions that precluded data collection. Data postprocessing produced mean velocity profiles for each station as well as calculated estimates of riverbed roughness parameters (coefficient of friction and apparent roughness height). All ADCP data met quality requirements as specified in SOP-3 of the FSP, included as Appendix A of the QAPP (ERM et al. 2018), although approximately 21 percent of the ADCP stations displayed nonlogarithmic mean velocity profiles and anomalous coefficient of friction and apparent roughness height values likely due to boundary layer contamination by effects from riverbed features such as mobile sedimentary bedforms, bedrock outcrops, and rough geometry. ADCP mean current velocities are shown in Maps 5-3a through 5-3i. ADCP results including coefficient of friction and apparent roughness height calculations are listed in Table 5-1.

Underwater images were acquired at 649 of 682 proposed stations in the Upper Reach OU. Underwater images were not acquired at the remaining 33 stations due to a variety of obstructions including the presence of dense SAV, shallow water depths, location of proposed station on land, or safety concerns or hazardous conditions that precluded data collection. Data postprocessing produced sediment grain-size composition estimates for each underwater

image. All underwater images met quality requirements as specified in SOP-2 of the FSP, included as Appendix A of the QAPP (ERM et al. 2018), although approximately 5 percent of the underwater images were partially to completely obscured by dense SAV. The locations and interpreted sediment compositions of the underwater photographs are shown in Maps 5-4a through 5-4i. Underwater image analysis results for the Upper Reach OU are listed in Table 5-2.

6 SUMMARY

Consistent with the QAPP (ERM et al. 2018), high-resolution acoustic data and georeferenced underwater photographs were acquired within the Upper Reach OU in 2018 and 2019. Data postprocessing produced a bathymetric DEM and acoustic backscatter imagery mosaic from the MBES data, mean velocity profiles and estimates of riverbed roughness from ADCP data, and interpreted sediment grain-size composition information from underwater photographs. No data were rejected as part of the data validation assessment and all data are considered usable for sediment composition and facies mapping.

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FIGURES

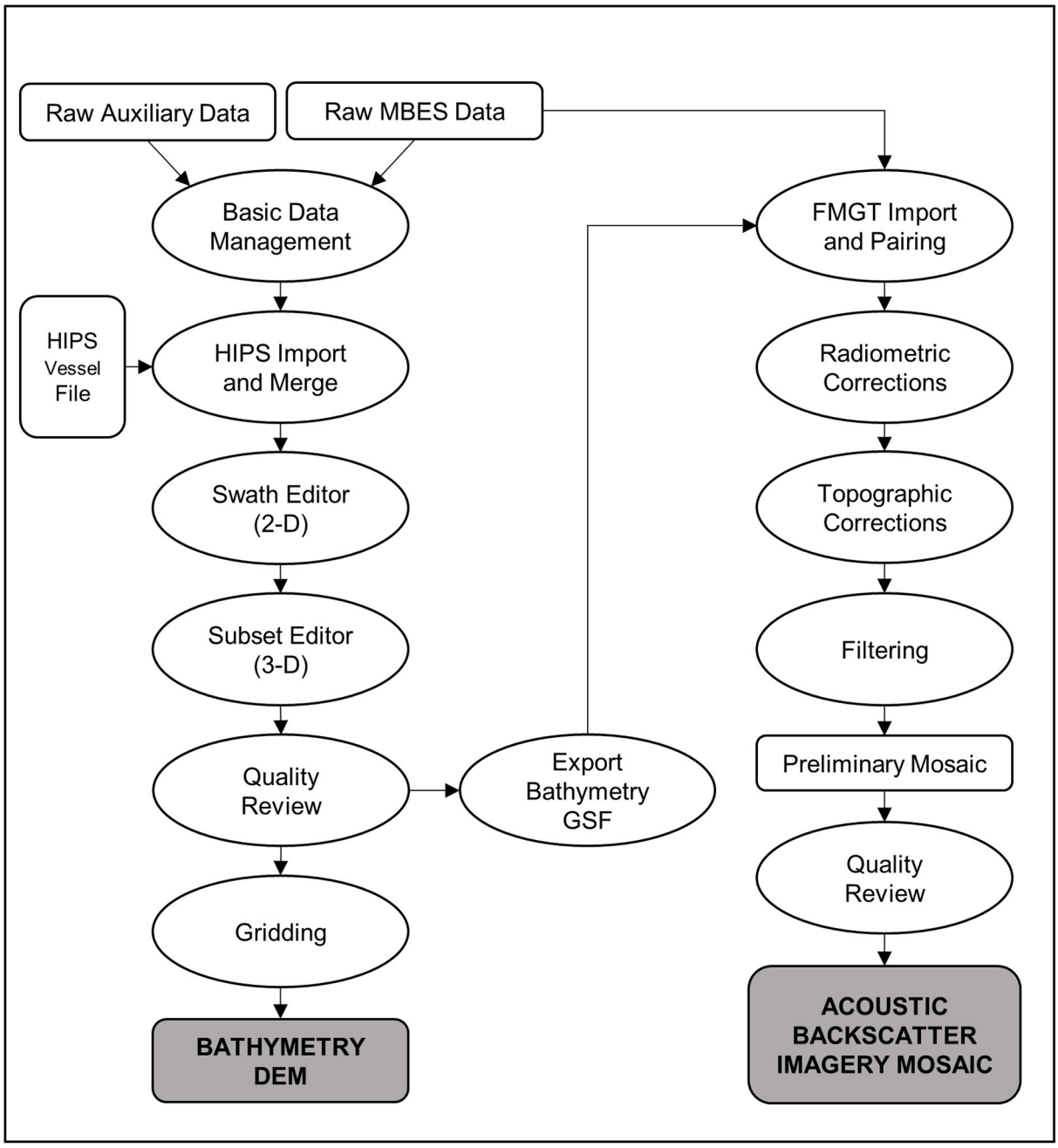


Figure 2-1 Generalized MBES Data Processing Workflow

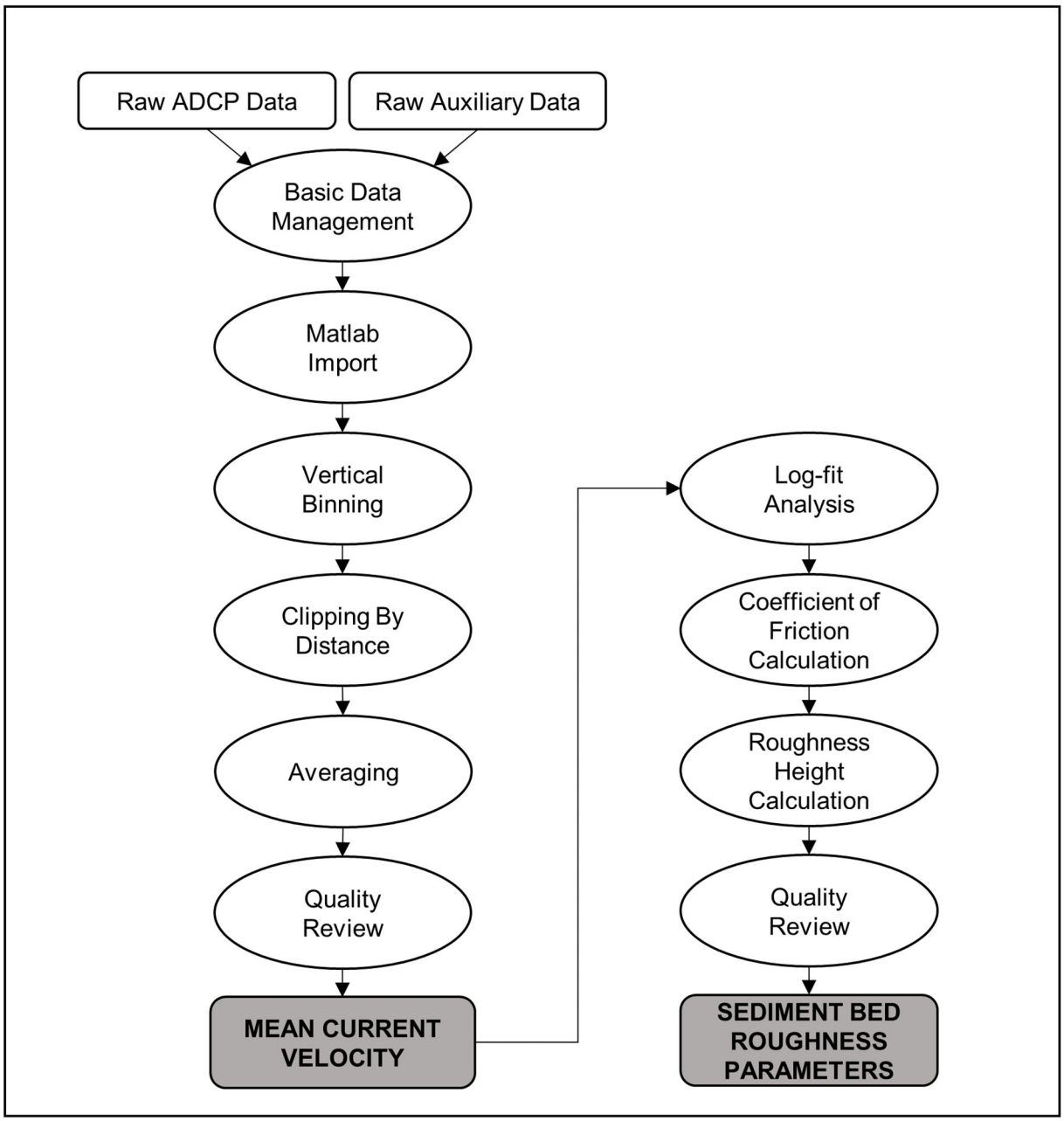


Figure 2-2. Generalized ADCP Data Processing Workflow

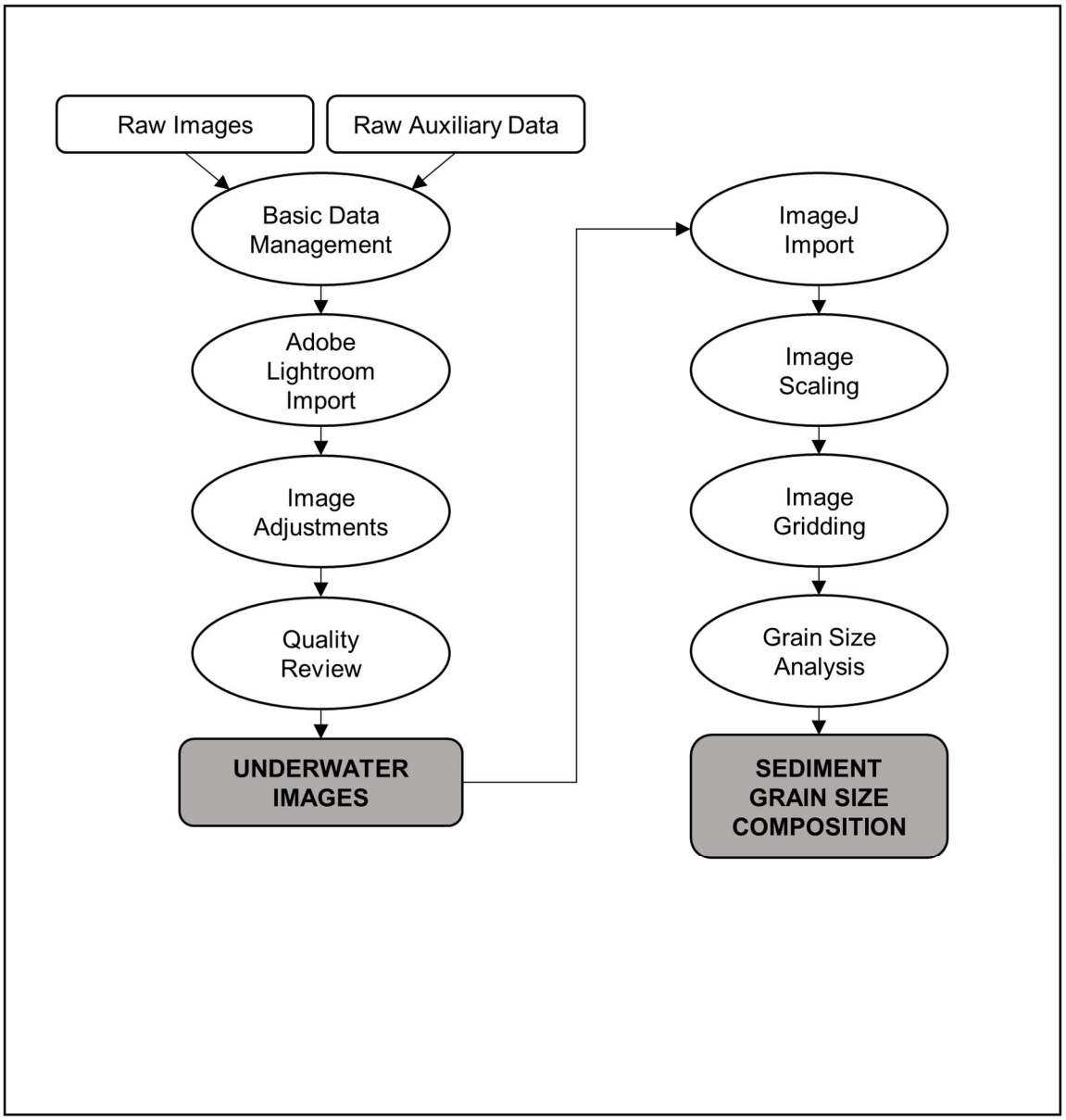


Figure 2-3. Generalized Underwater Image Analysis Workflow

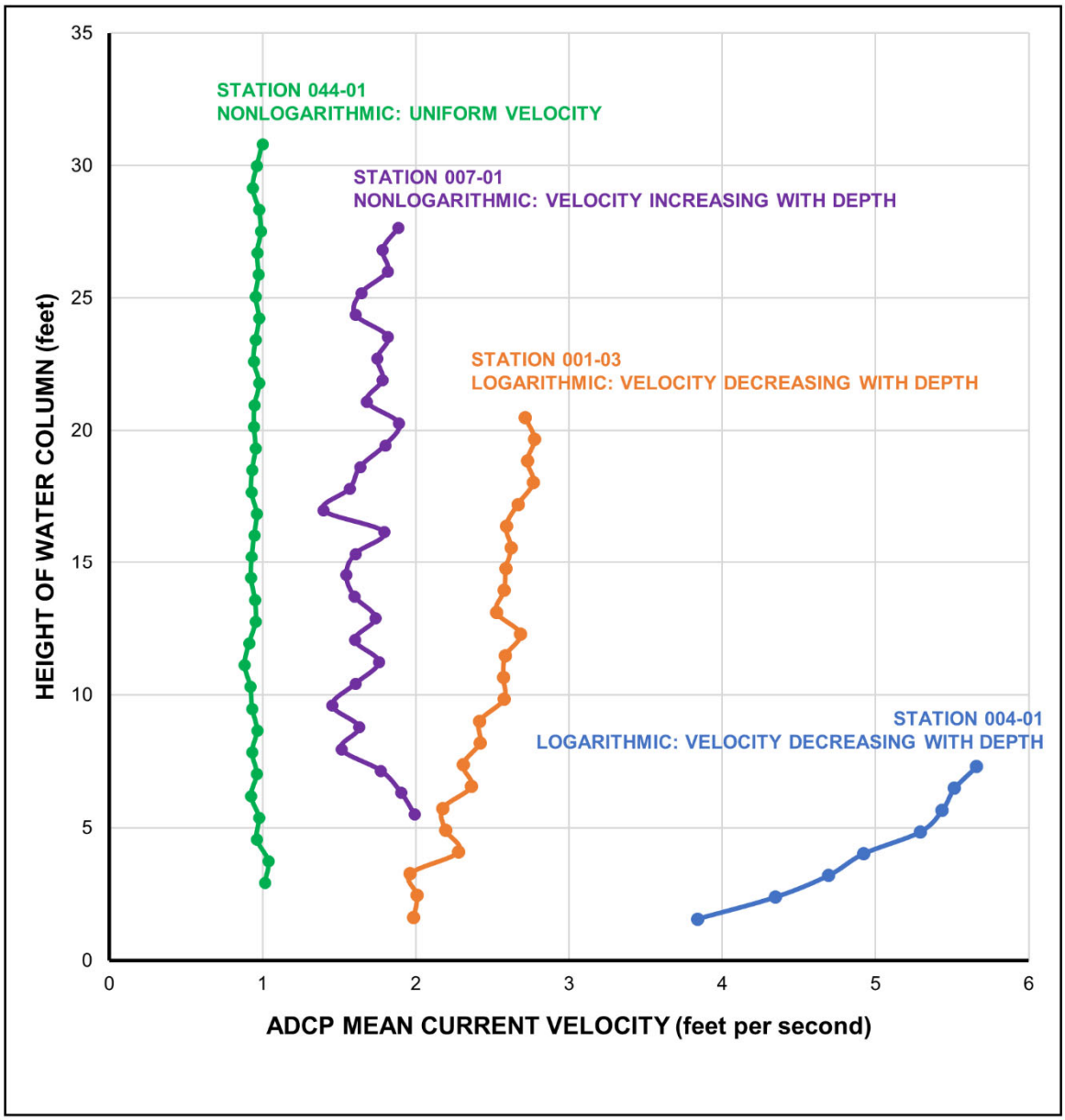
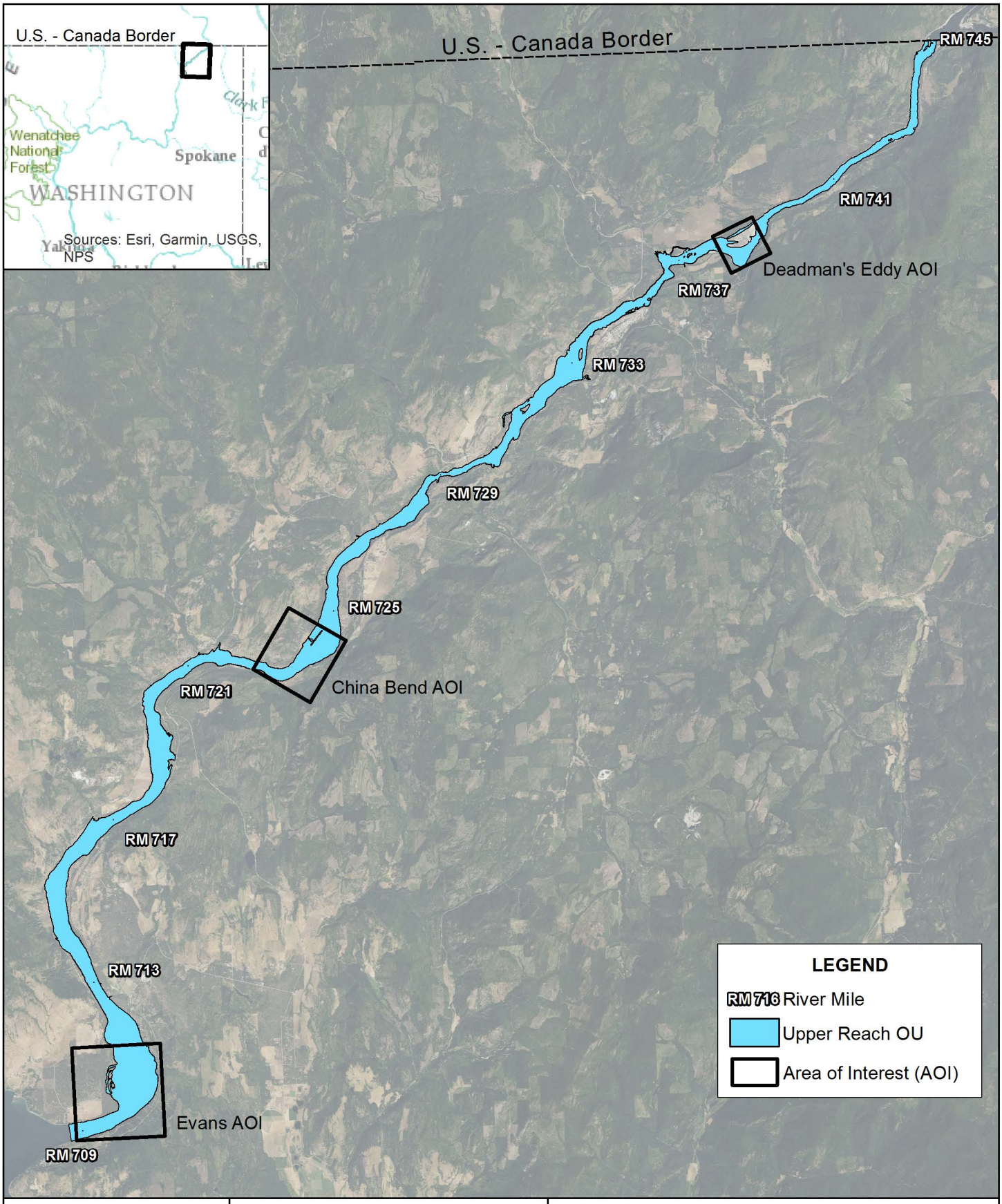


Figure 2-4. Comparison of Logarithmic and Nonlogarithmic ADCP Mean Velocity Profiles

MAPS



DAVID EVANS AND ASSOCIATES INC.

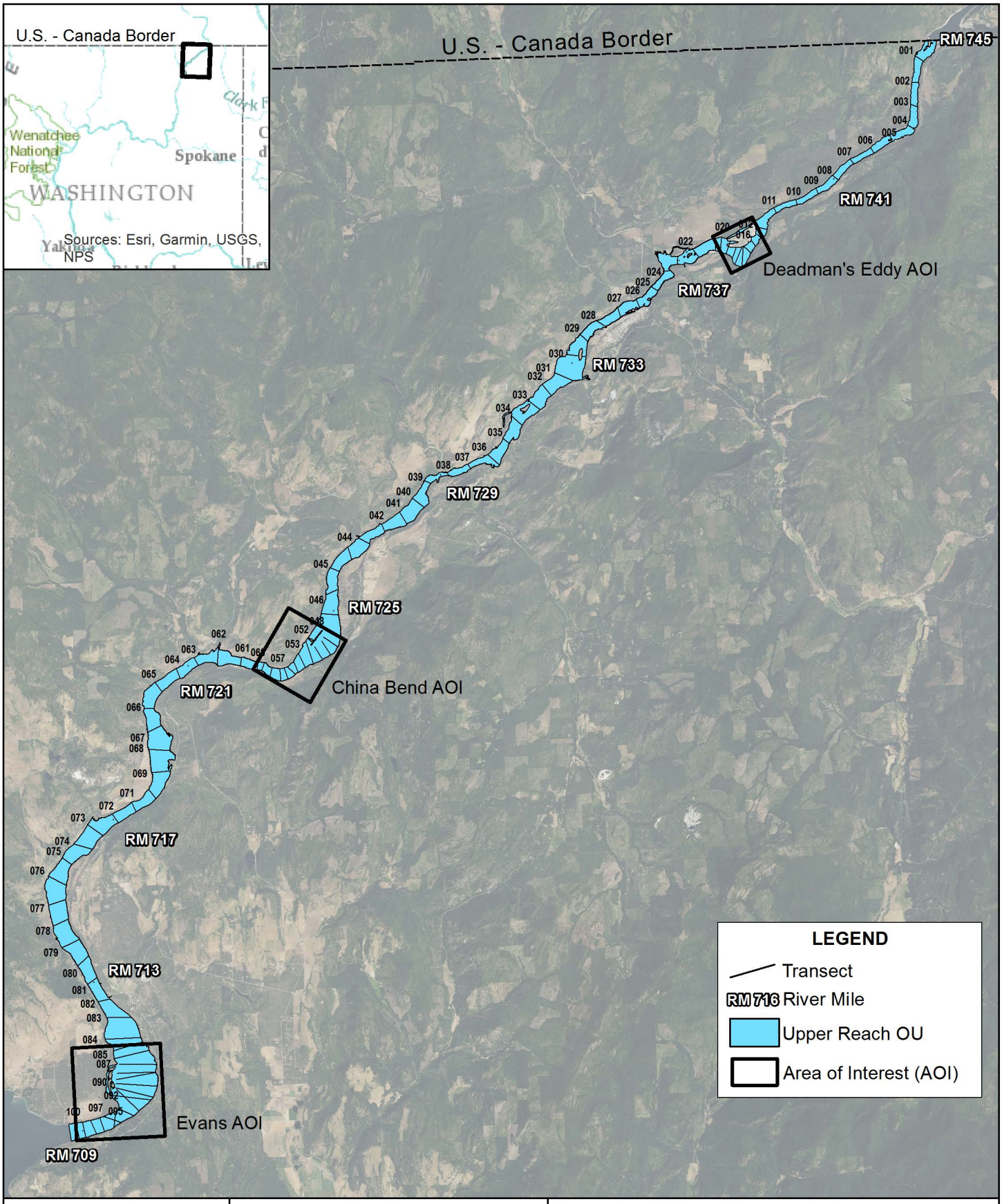
0 1.5 3 Miles

0 1.5 3 Kilometers

N

Map 1-1. **Upper Reach OU and Areas of Interest**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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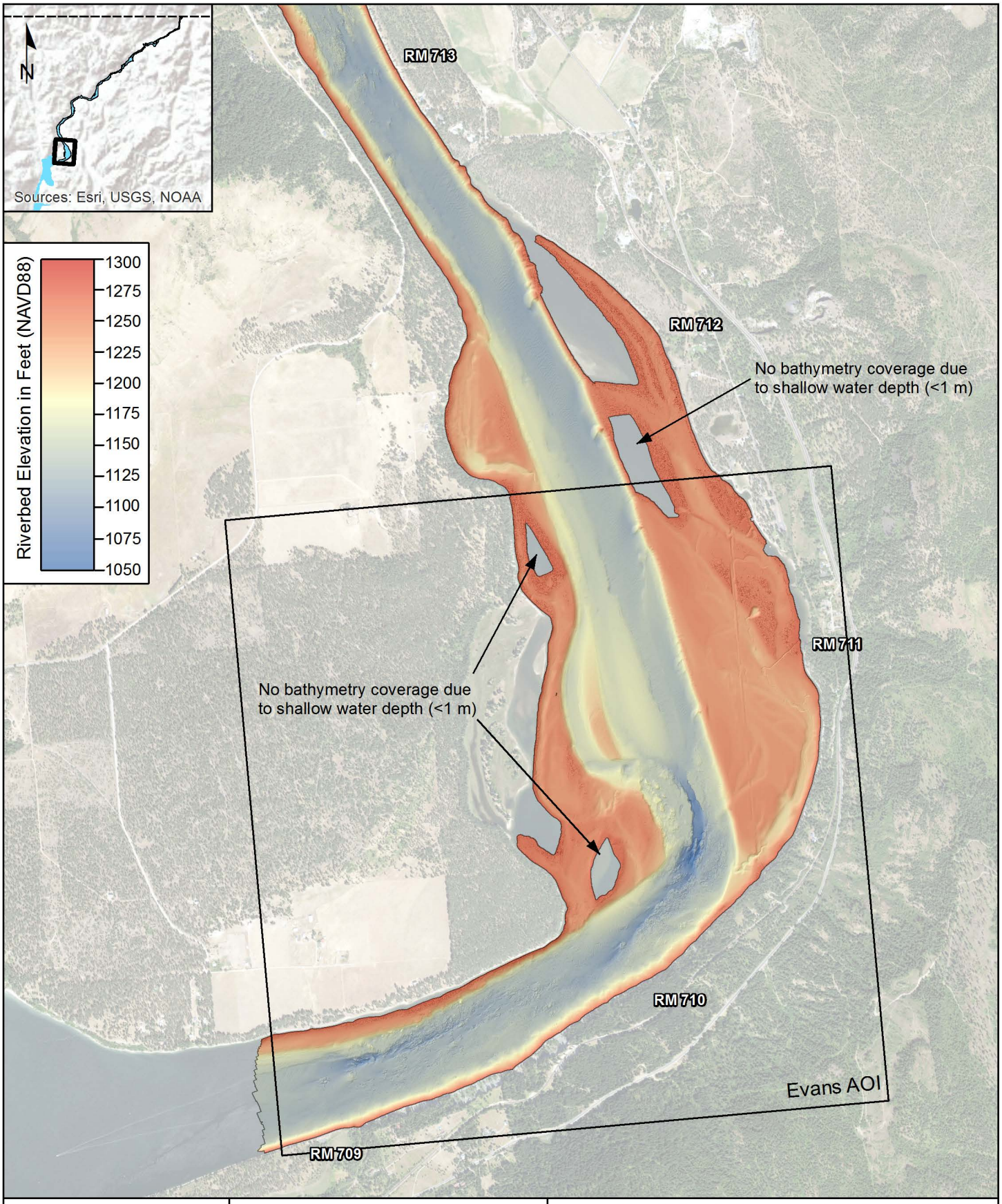
Map 2-1. **ADCP and Underwater Imagery Transects**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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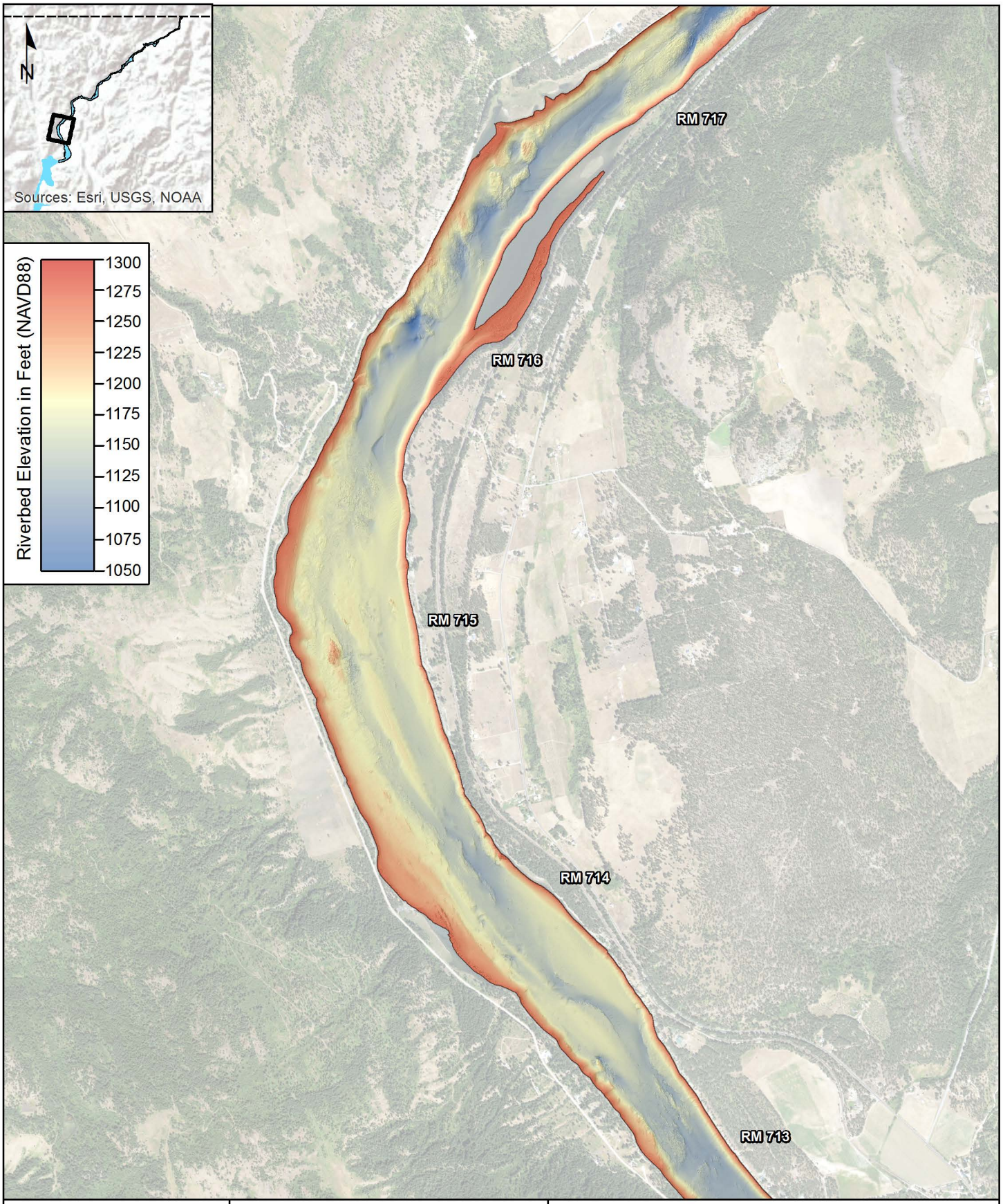
Map 5-1a. **Bathymetry DEM for RM 709-713 Including Evans AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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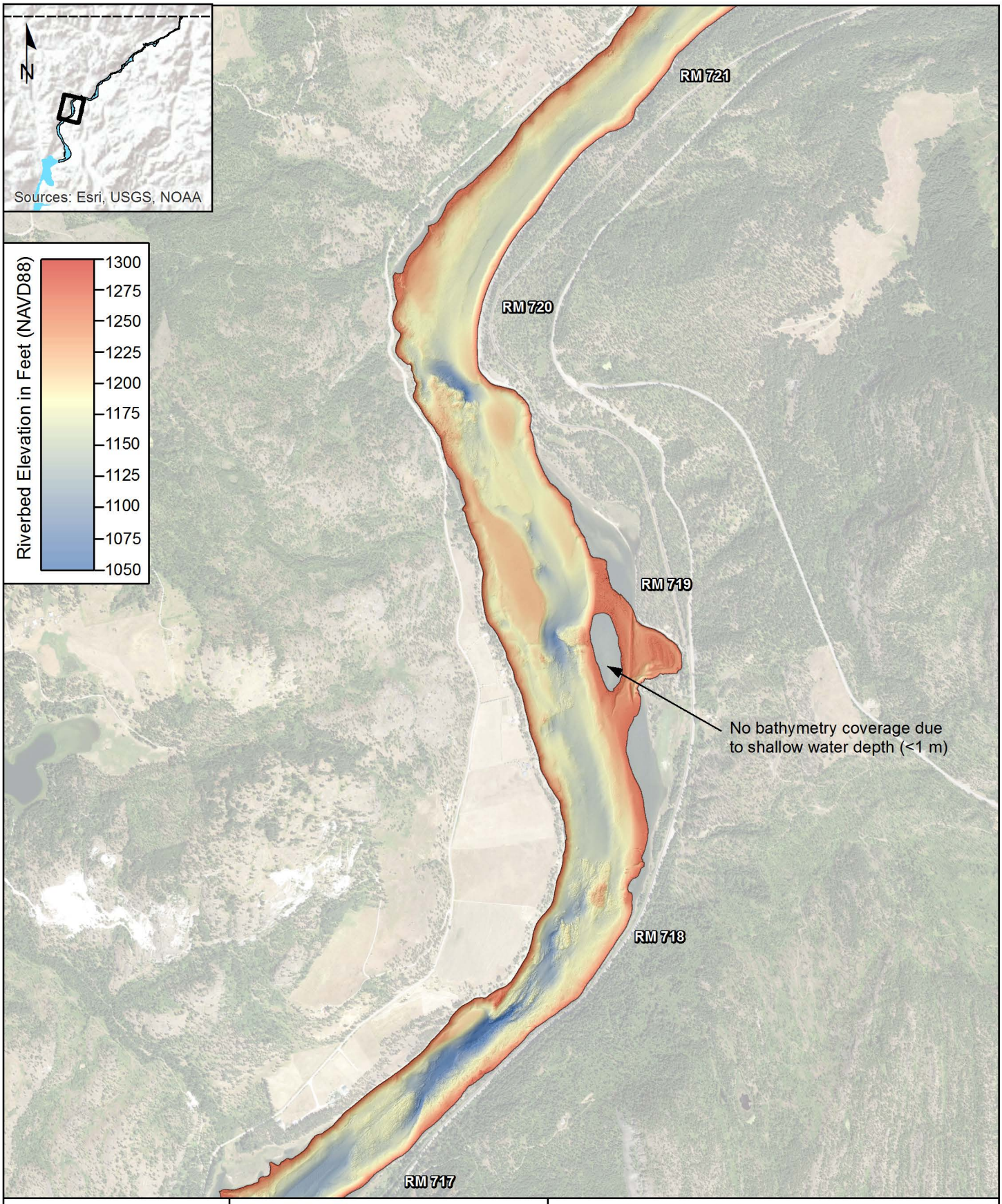
Map 5-1b. **Bathymetry DEM for RM 713-717**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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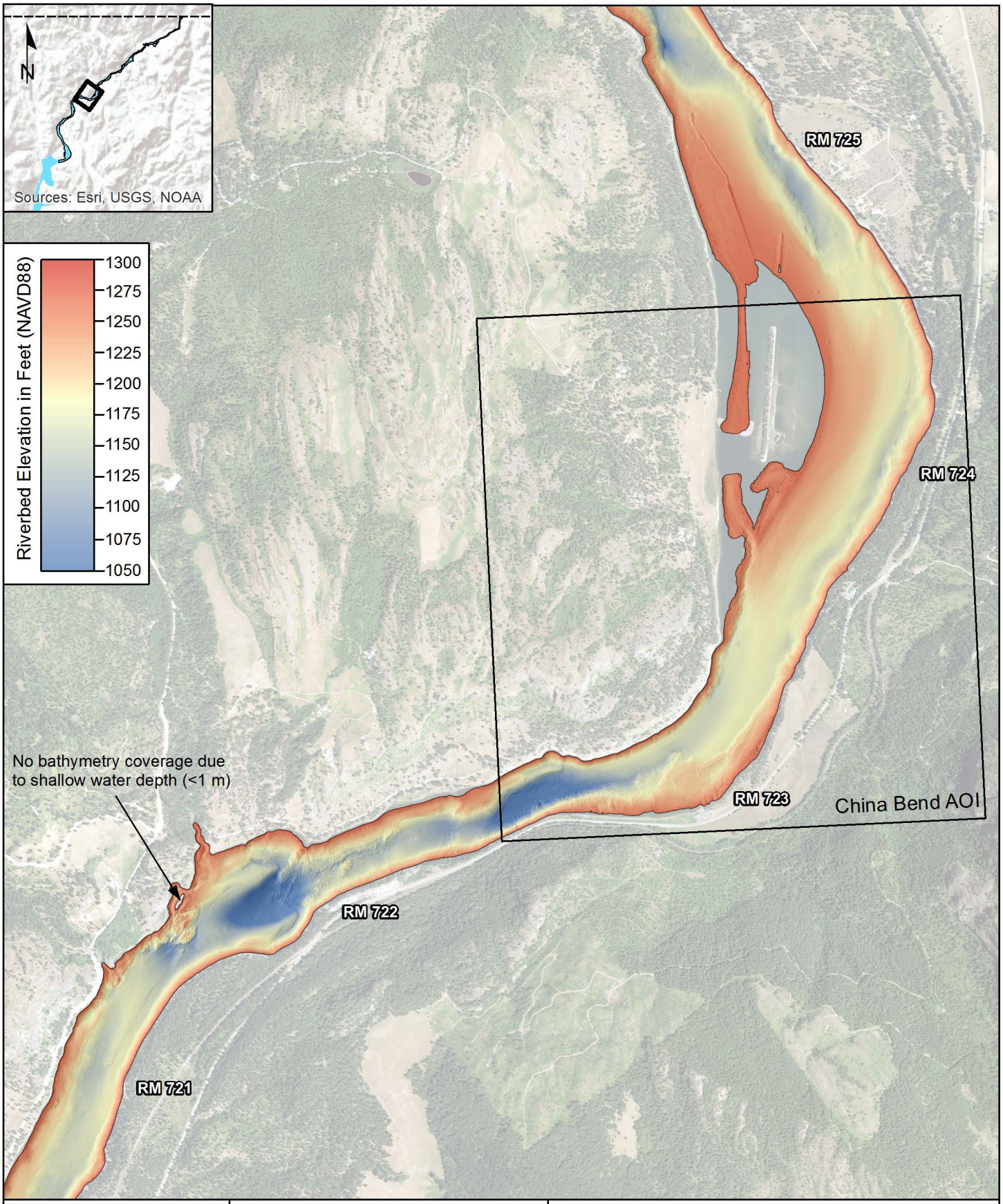
Map 5-1c. **Bathymetry DEM for RM 717-721**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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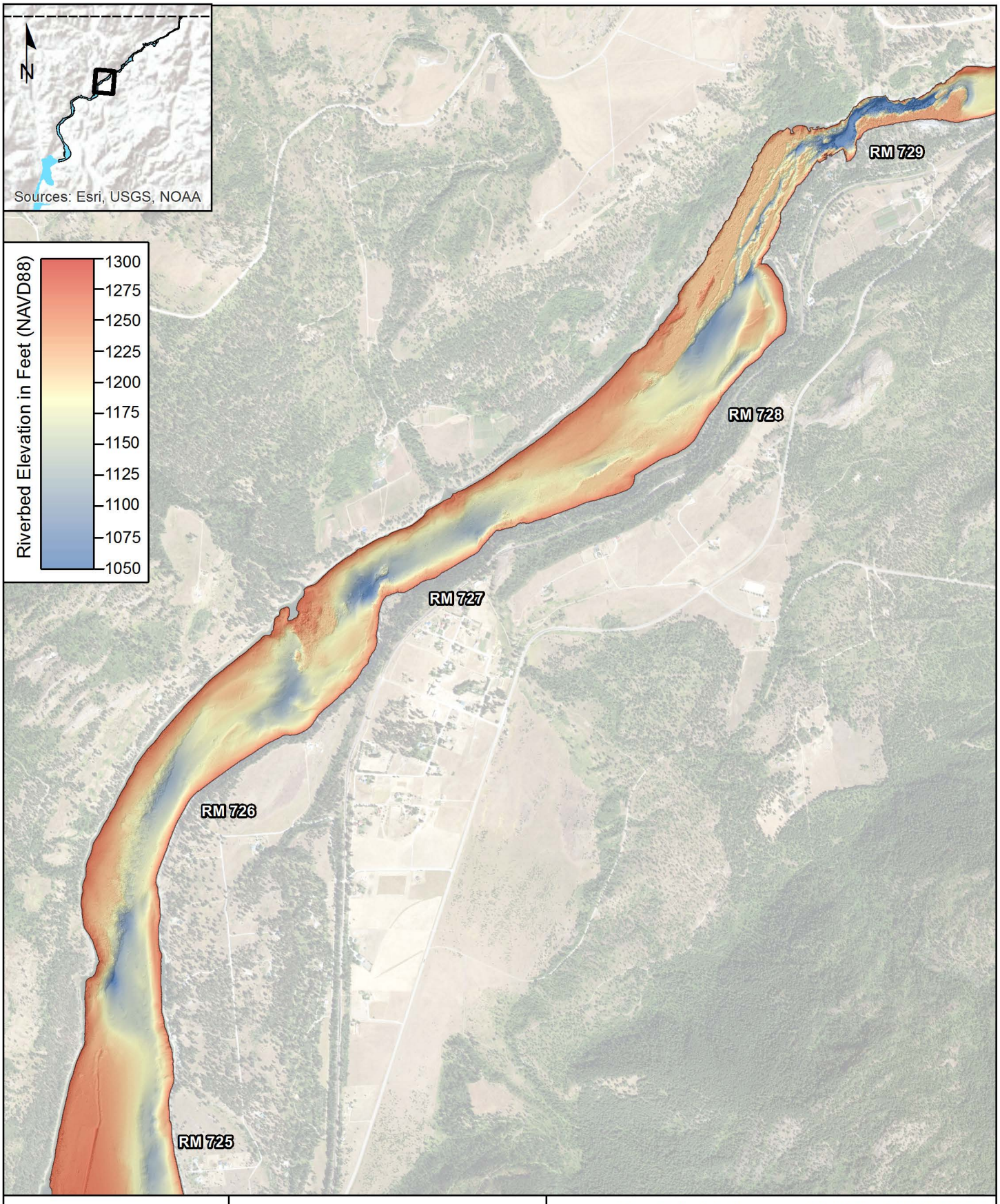
Map 5-1d. **Bathymetry DEM for RM 721-725 Including China Bend AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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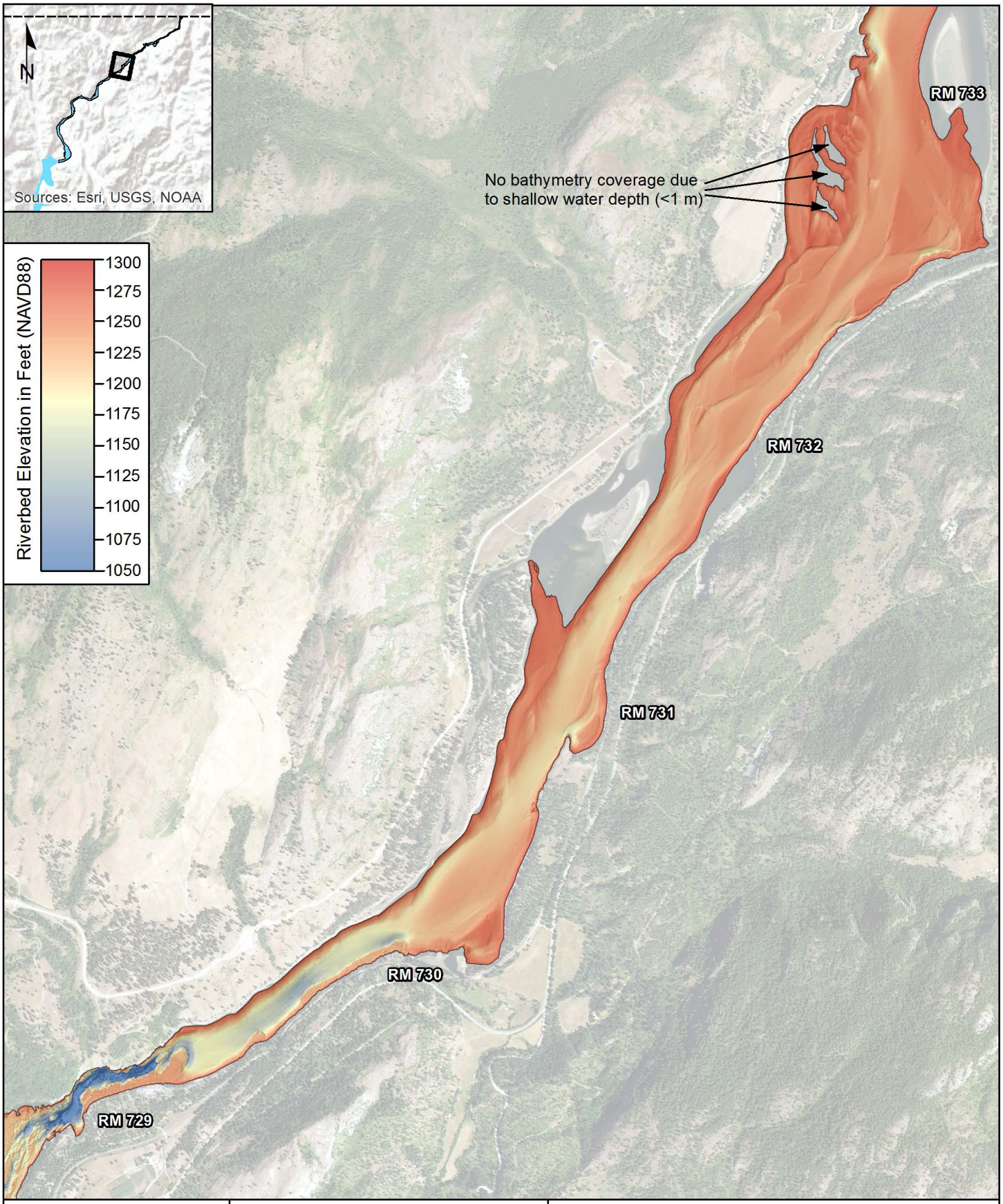
Map 5-1e. **Bathymetry DEM for RM 725-729**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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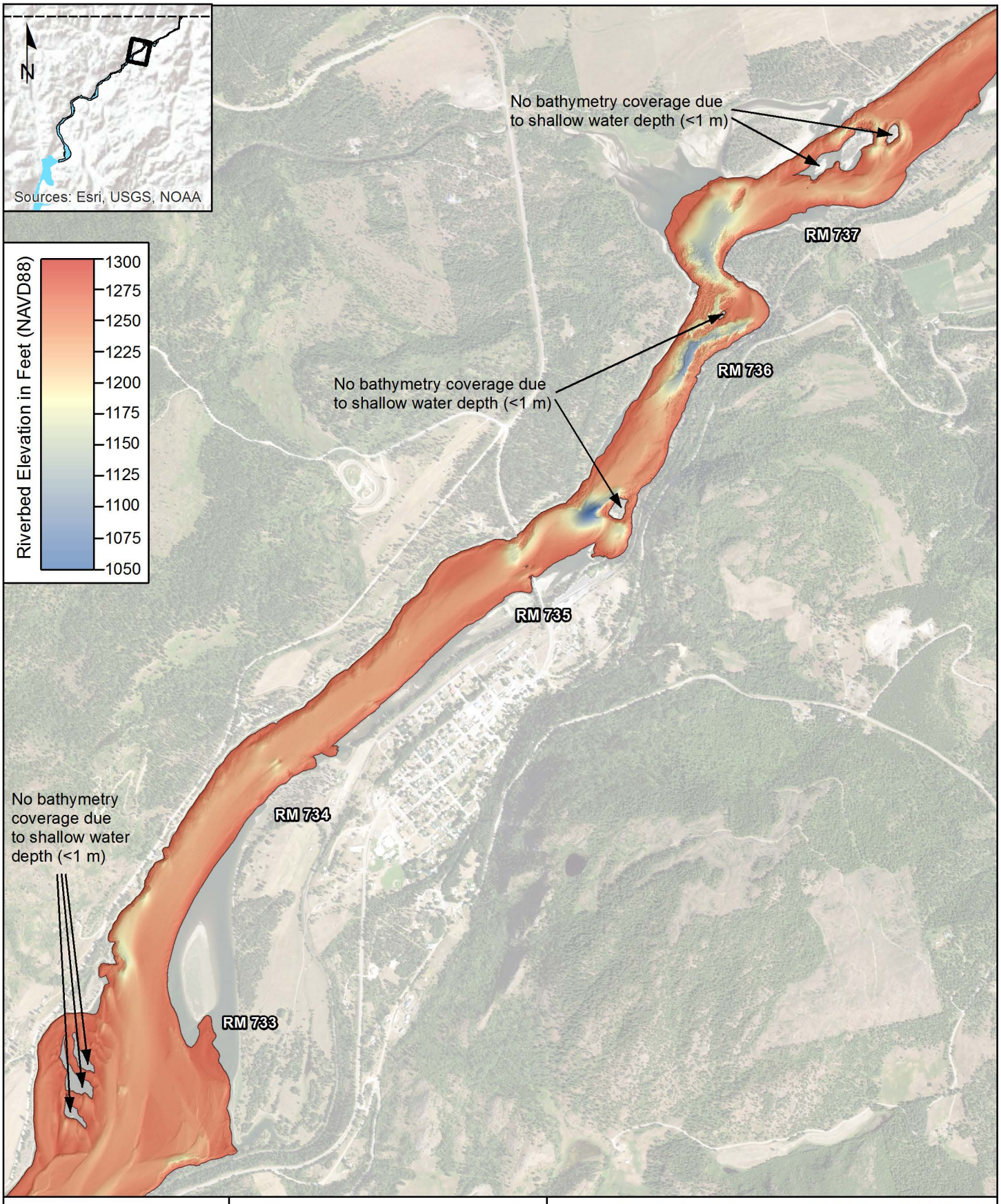
Map 5-1f. **Bathymetry DEM for RM 729-733**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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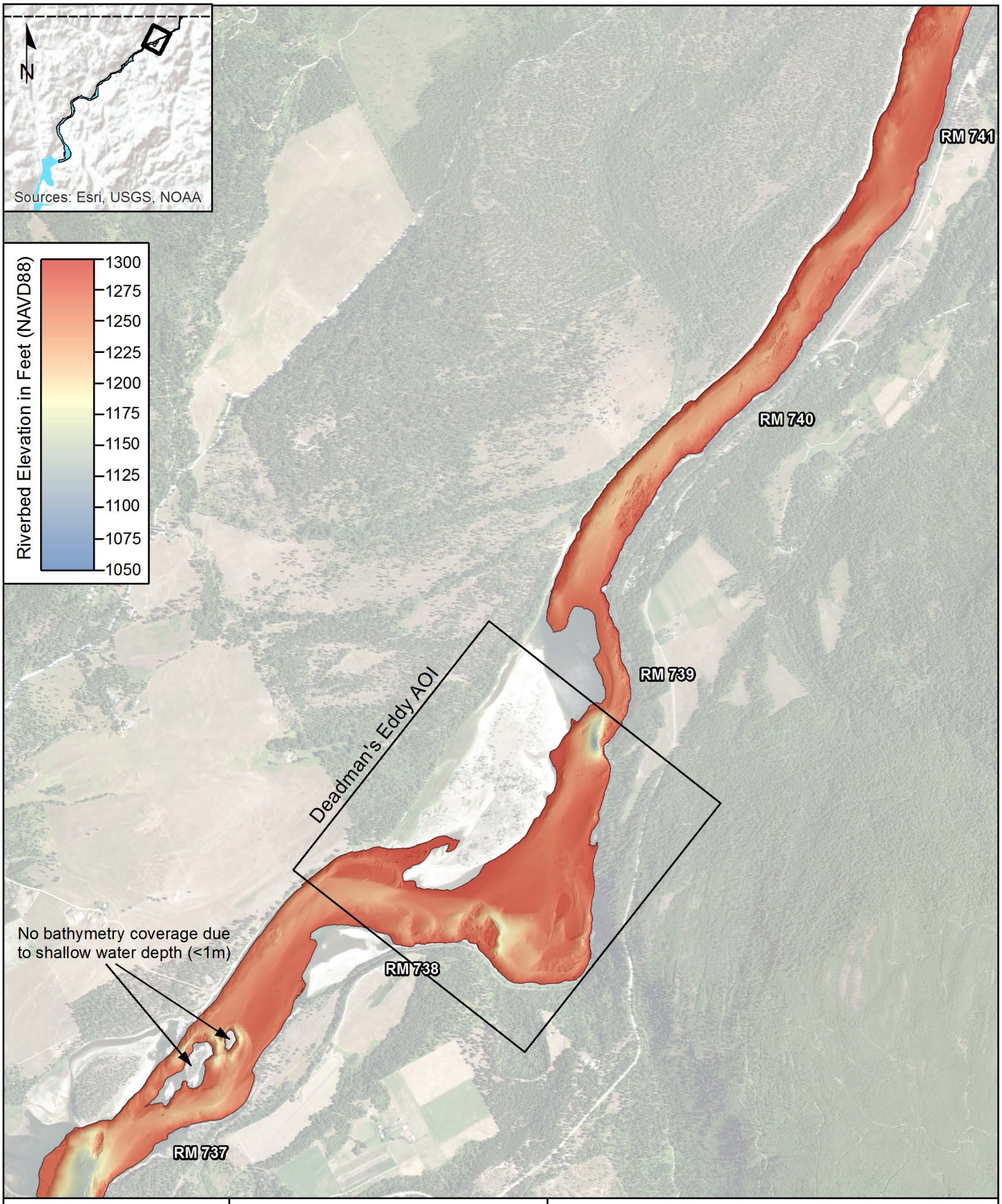
Map 5-1g. **Bathymetry DEM for RM 733-737**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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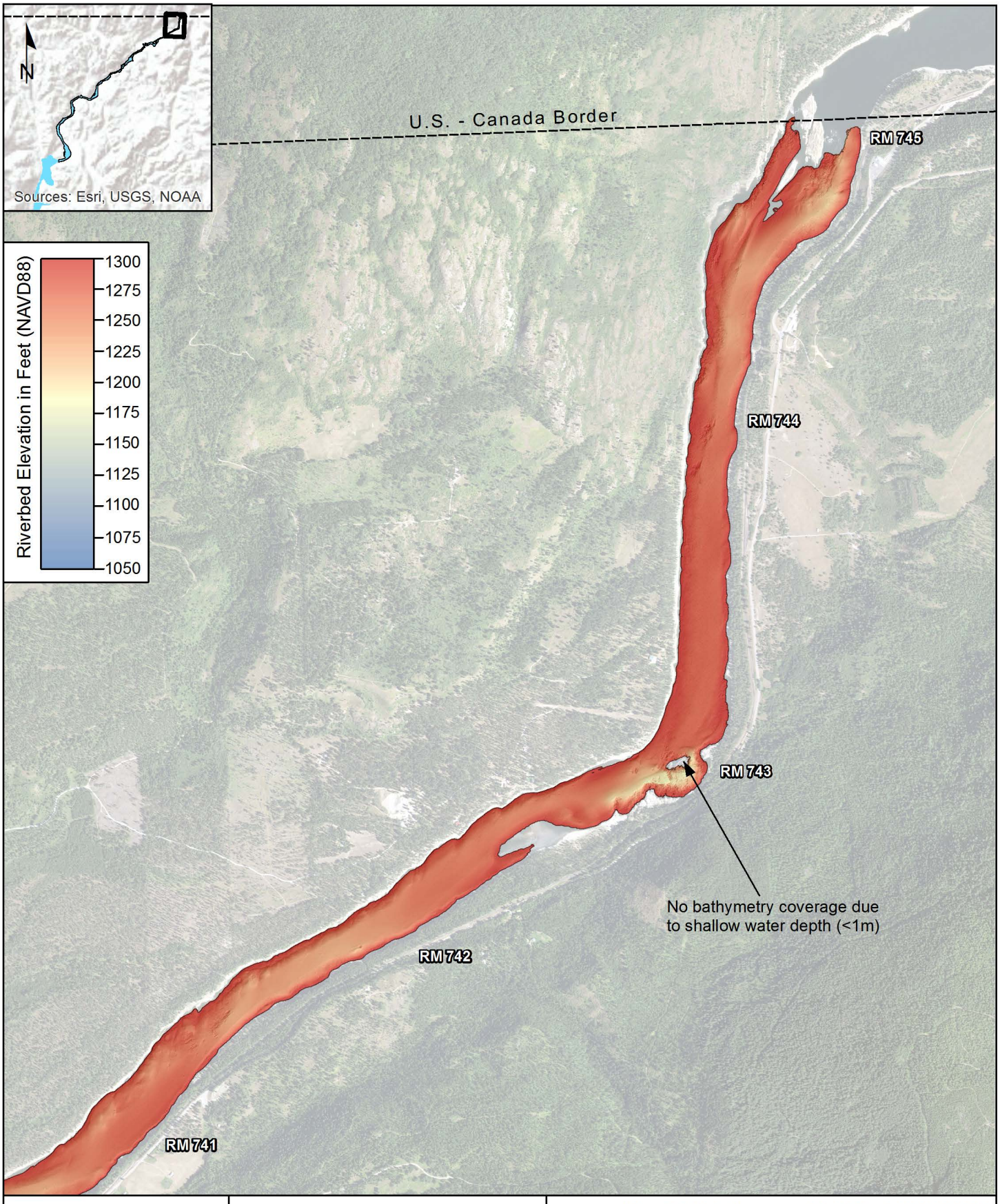
Map 5-1h. **Bathymetry DEM for RM 737-741 Including Deadman's Eddy AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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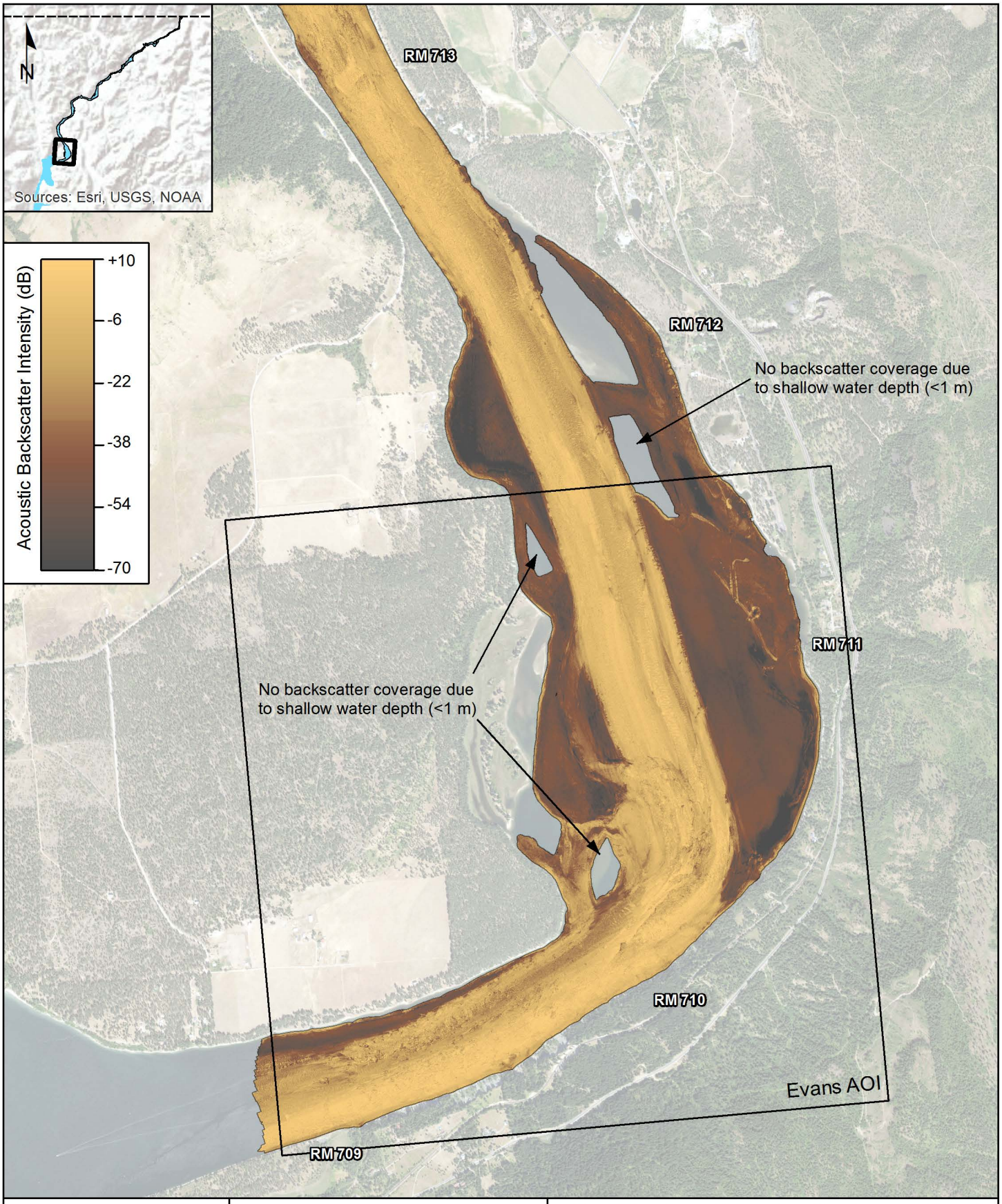
Map 5-1i. **Bathymetry DEM for RM 741-745**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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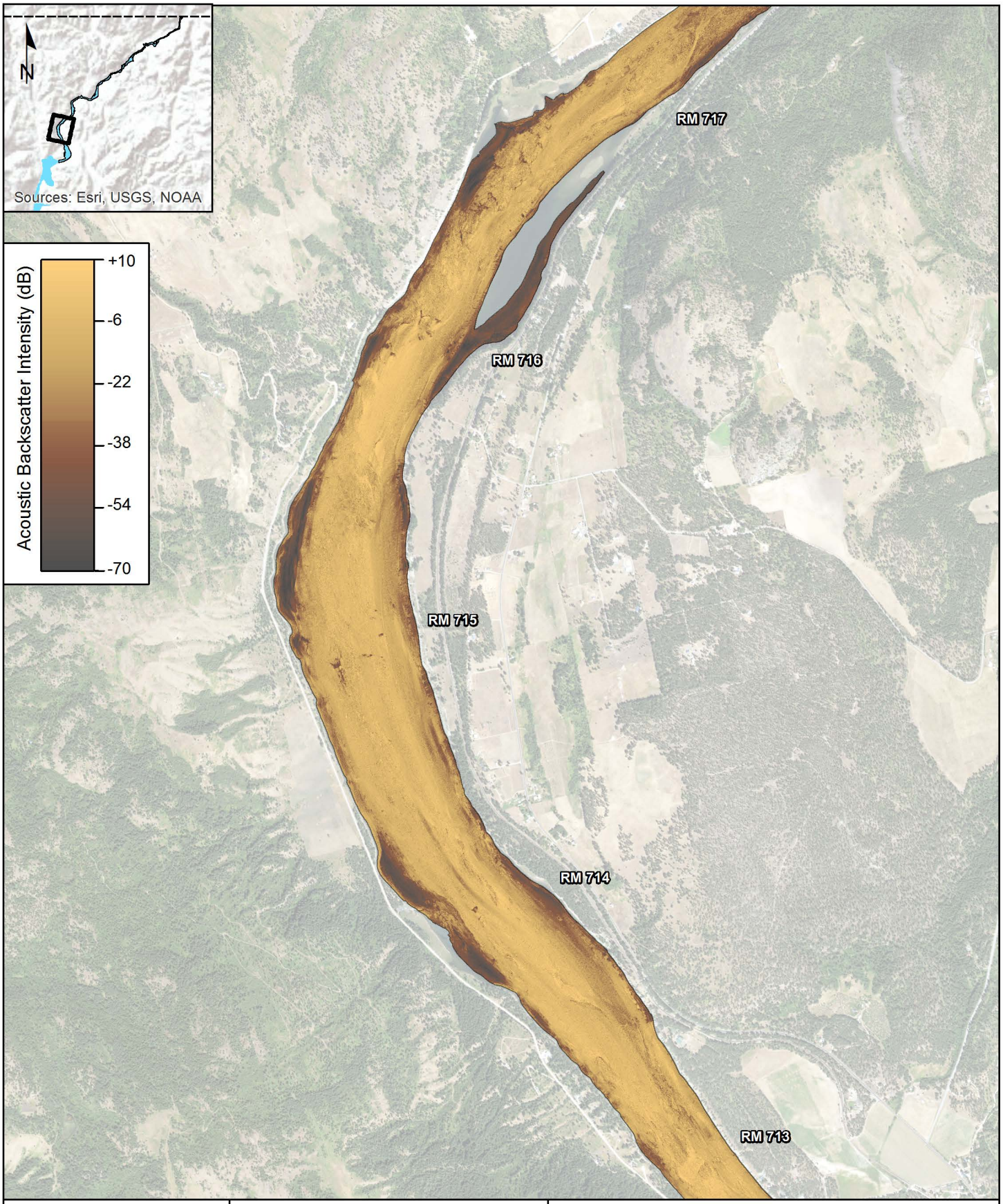
Map 5-2a. **Acoustic Backscatter Imagery Mosaic for RM 709-713 Including Evans AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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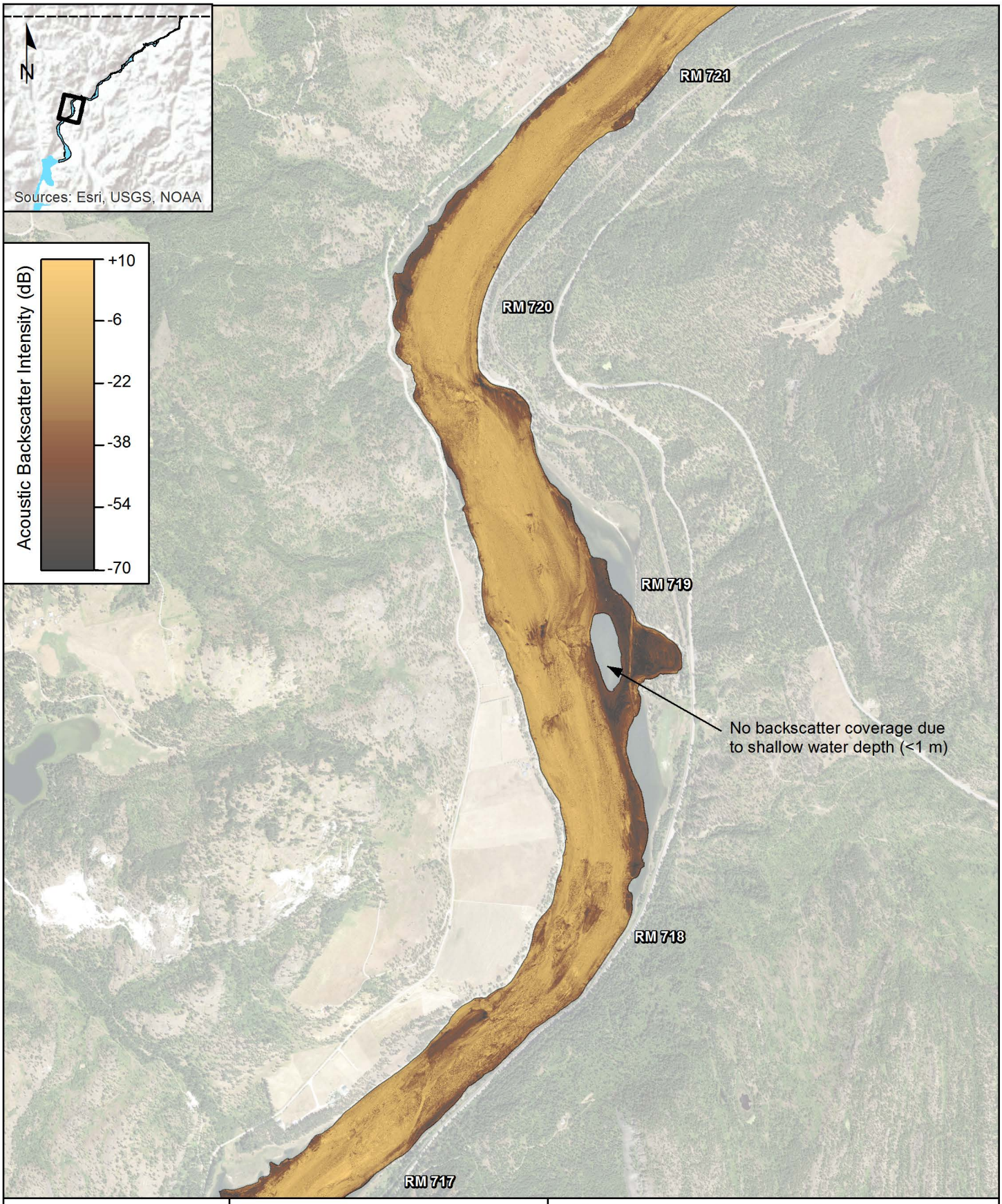
Map 5-2b. **Acoustic Backscatter Imagery Mosaic for RM 713-717**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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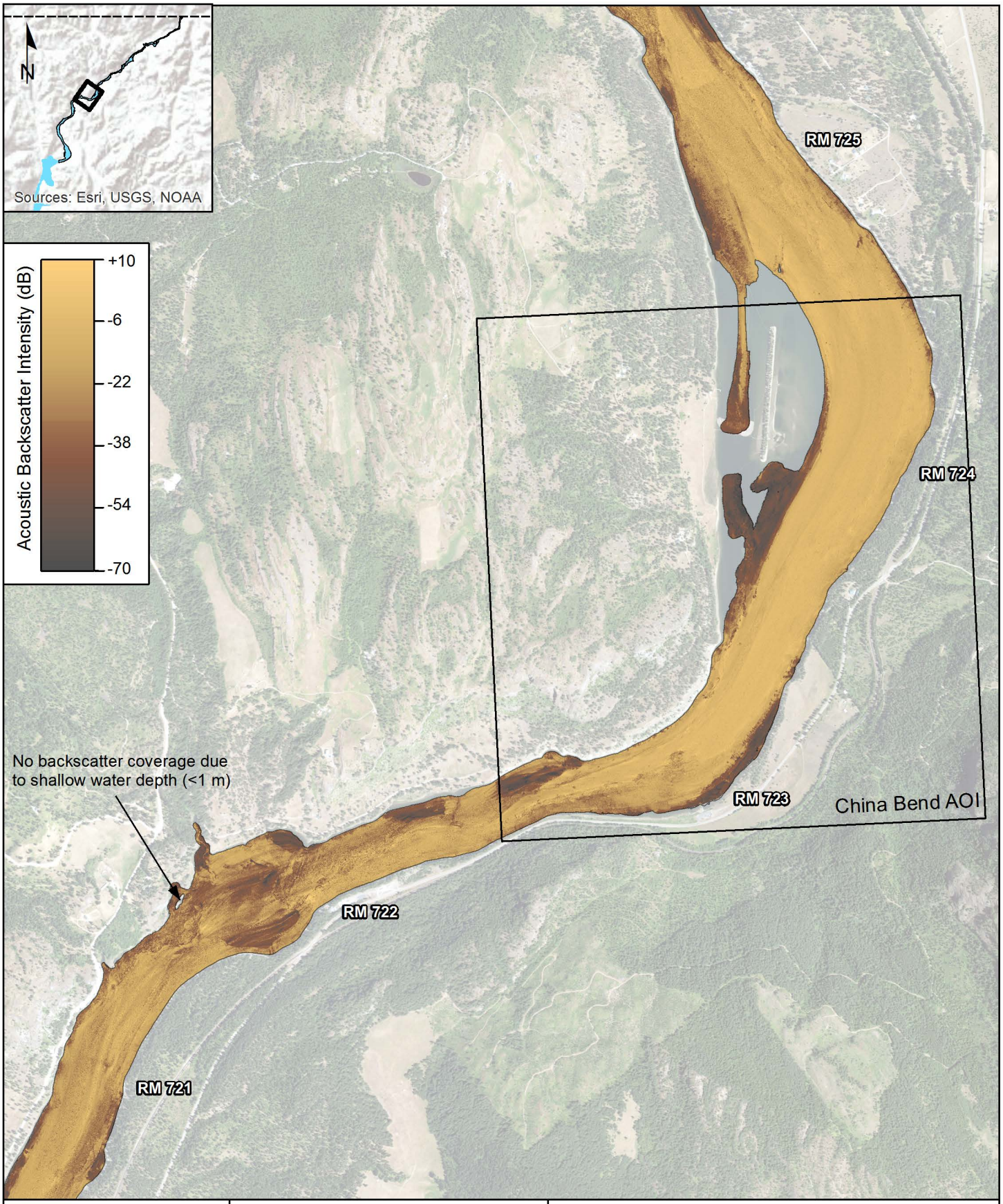
0 0.25 0.5 Kilometers

N

Map 5-2c. **Acoustic Backscatter Imagery Mosaic for RM 717-721**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

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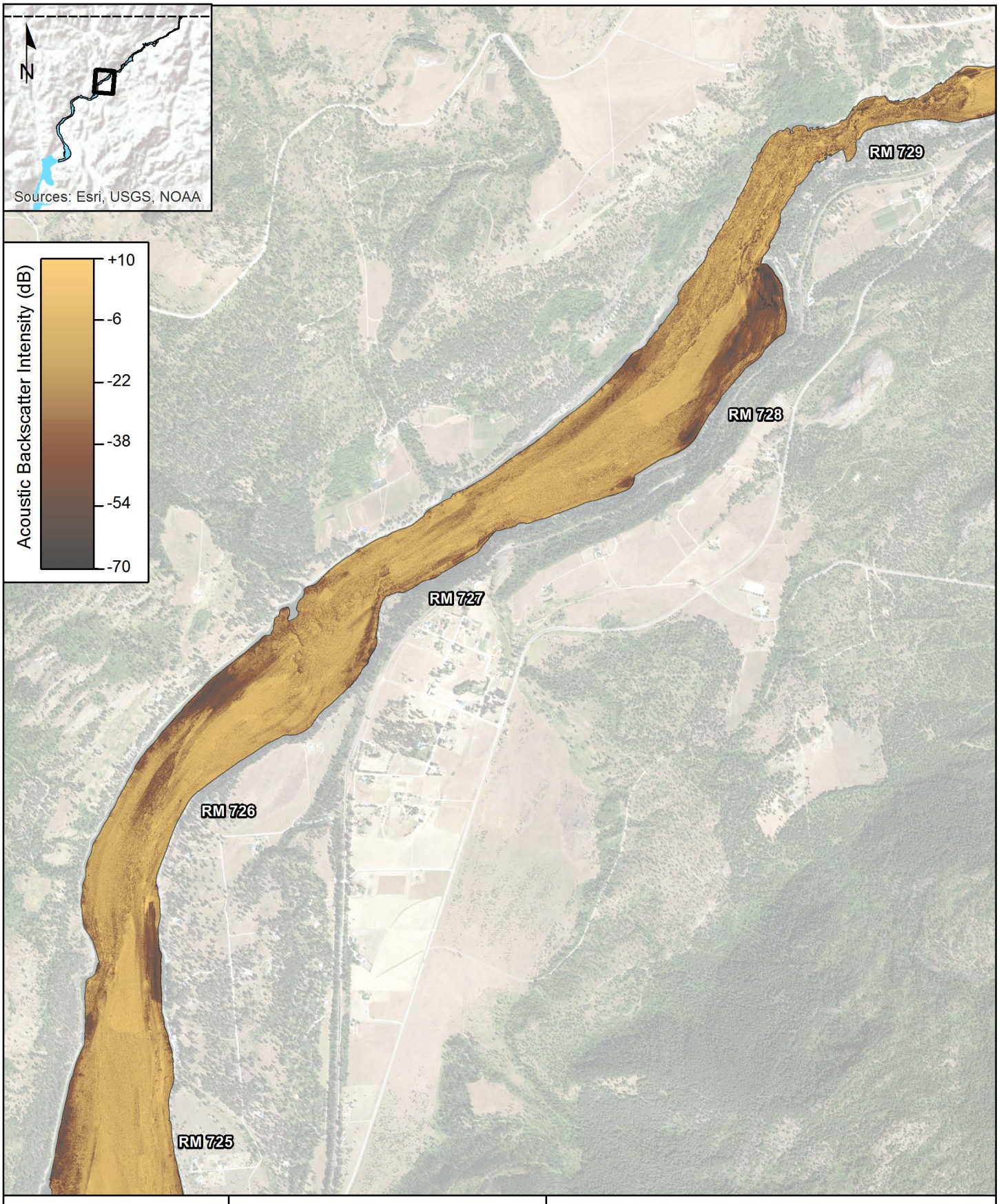
Map 5-2d. **Acoustic Backscatter Imagery Mosaic for RM 721-725 Including China Bend AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

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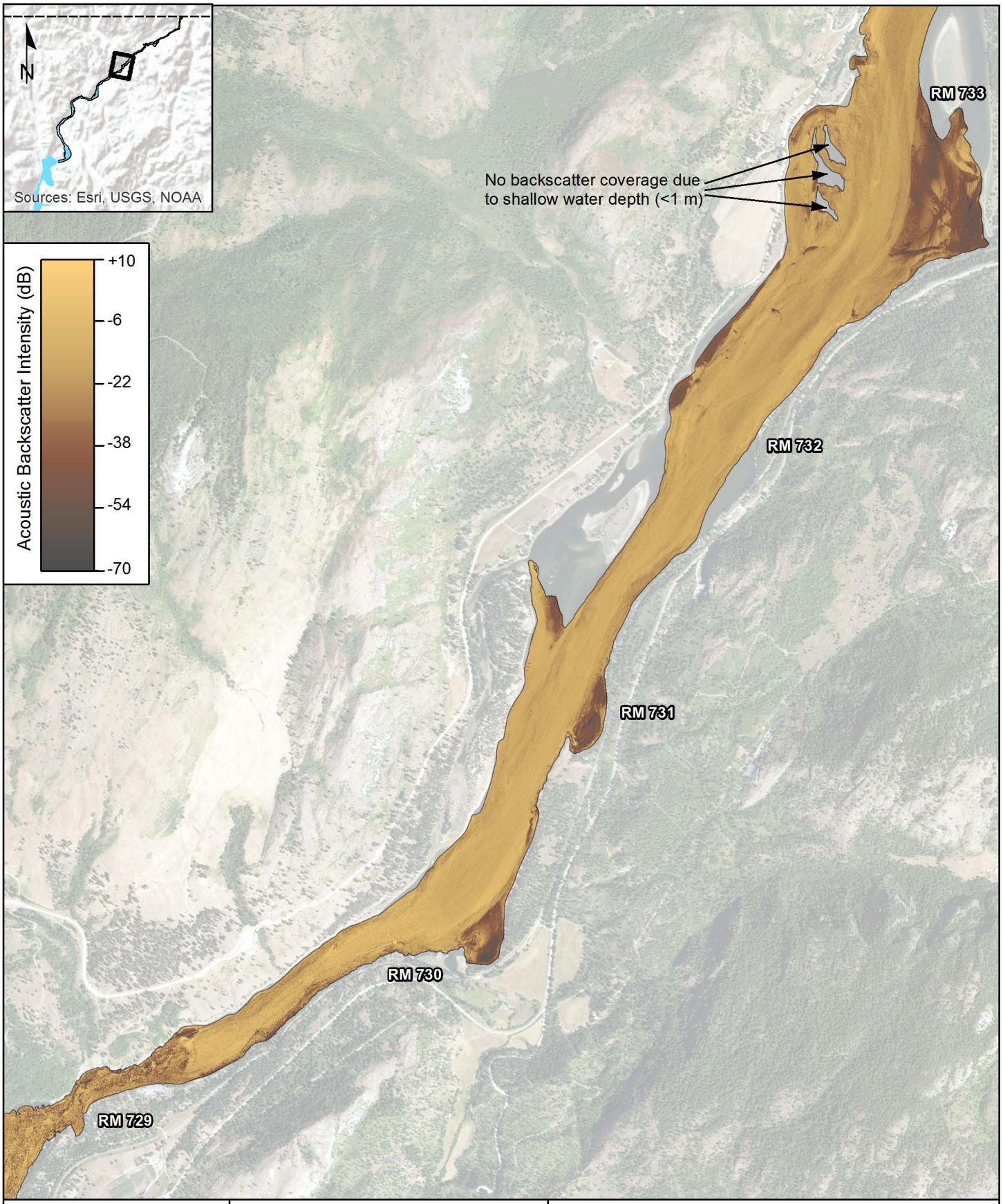
Map 5-2e. **Acoustic Backscatter Imagery Mosaic for RM 725-729**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

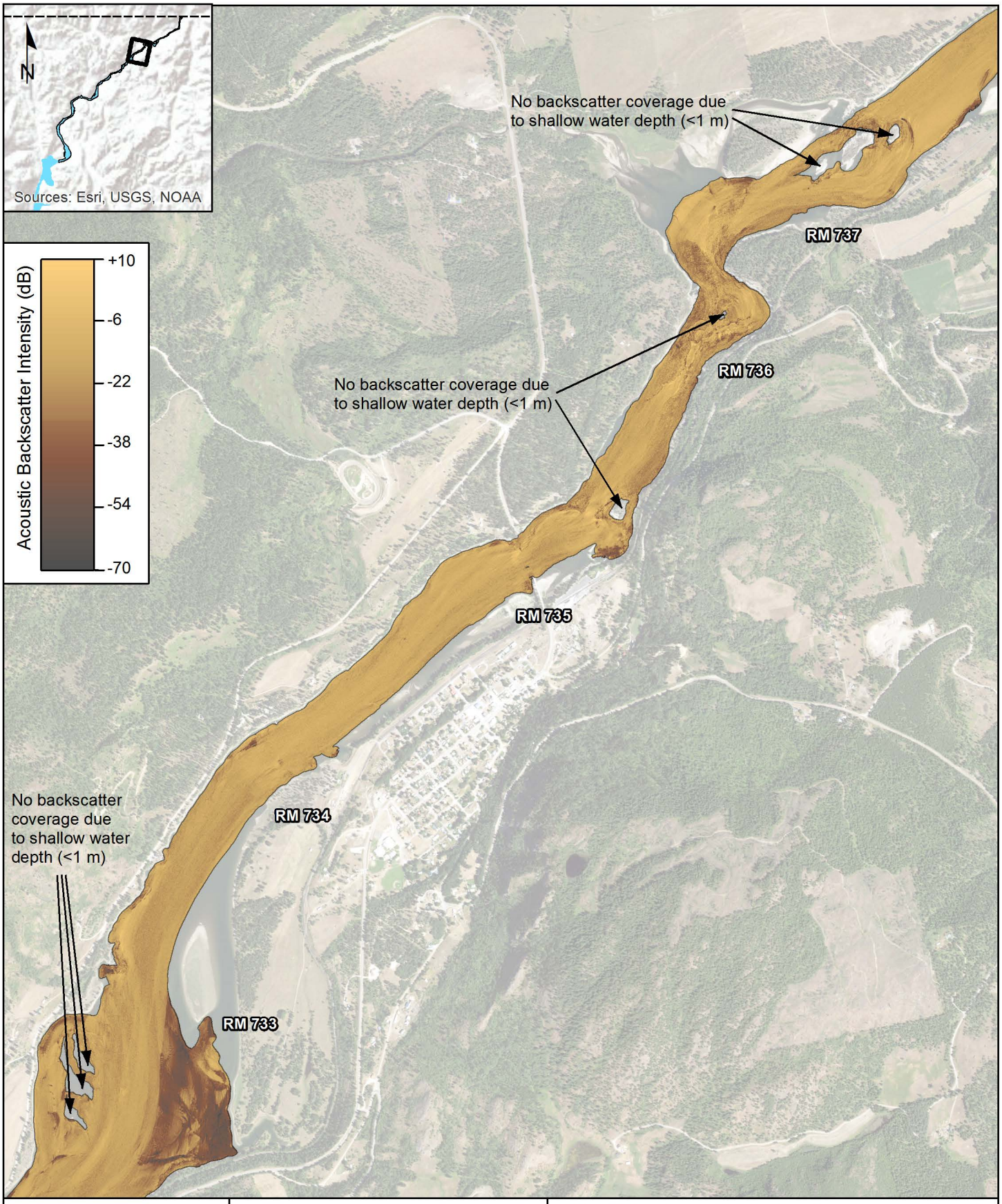
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-2f. **Acoustic Backscatter Imagery Mosaic for RM 729-733**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

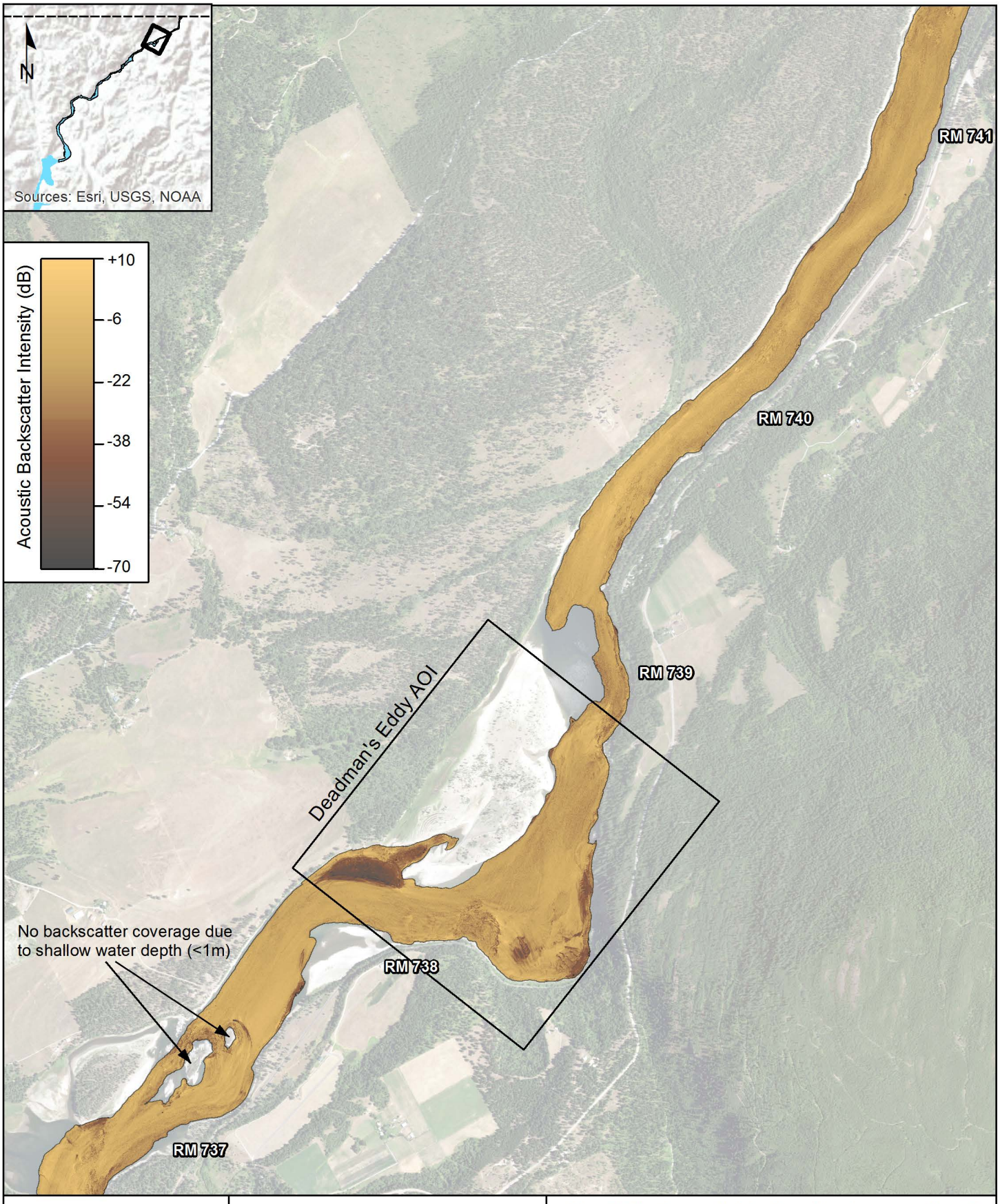
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-2g. **Acoustic Backscatter Imagery Mosaic for RM 733-737**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

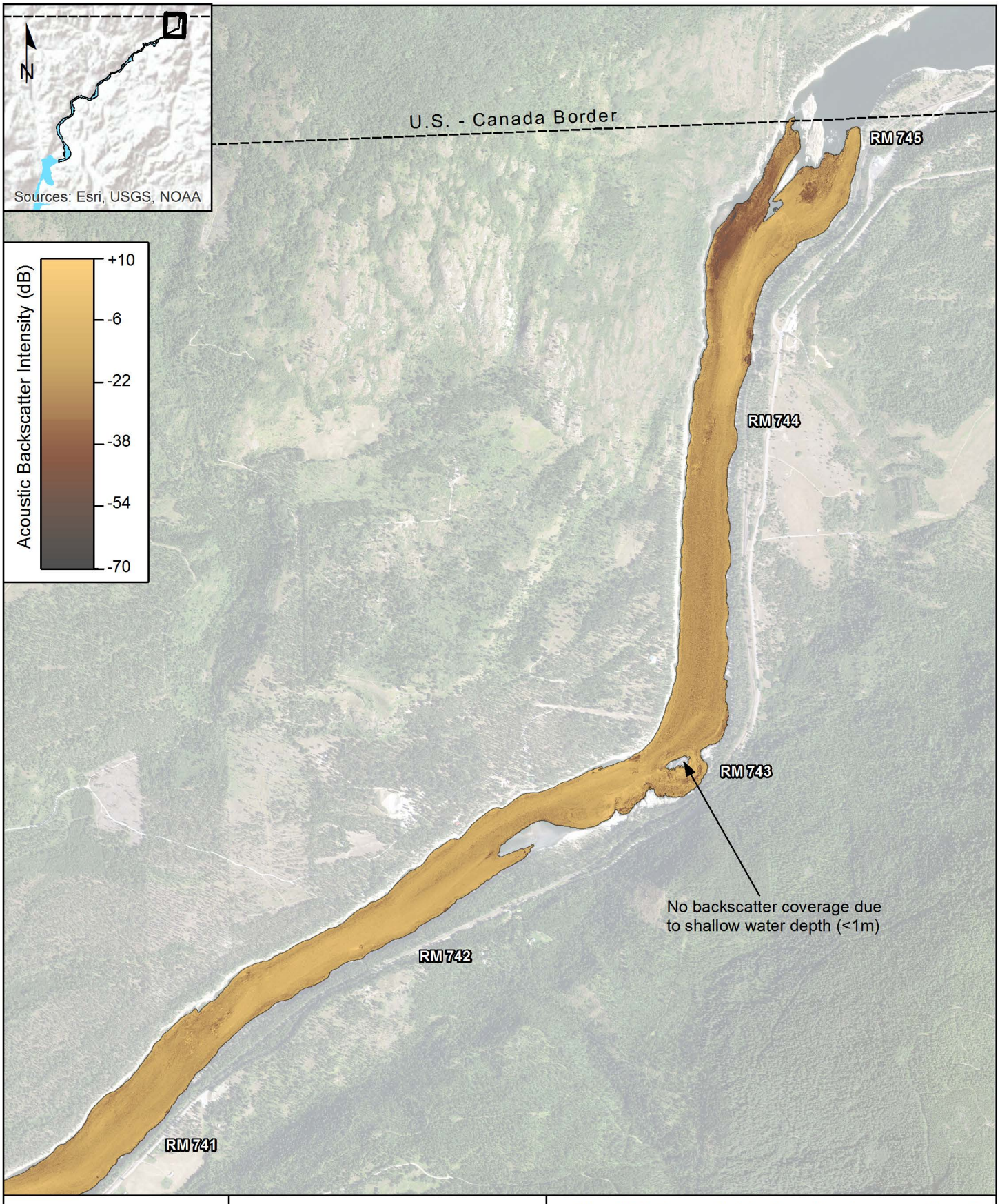
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-2h. **Acoustic Backscatter Imagery Mosaic for RM 737-741 Including Deadman's Eddy AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

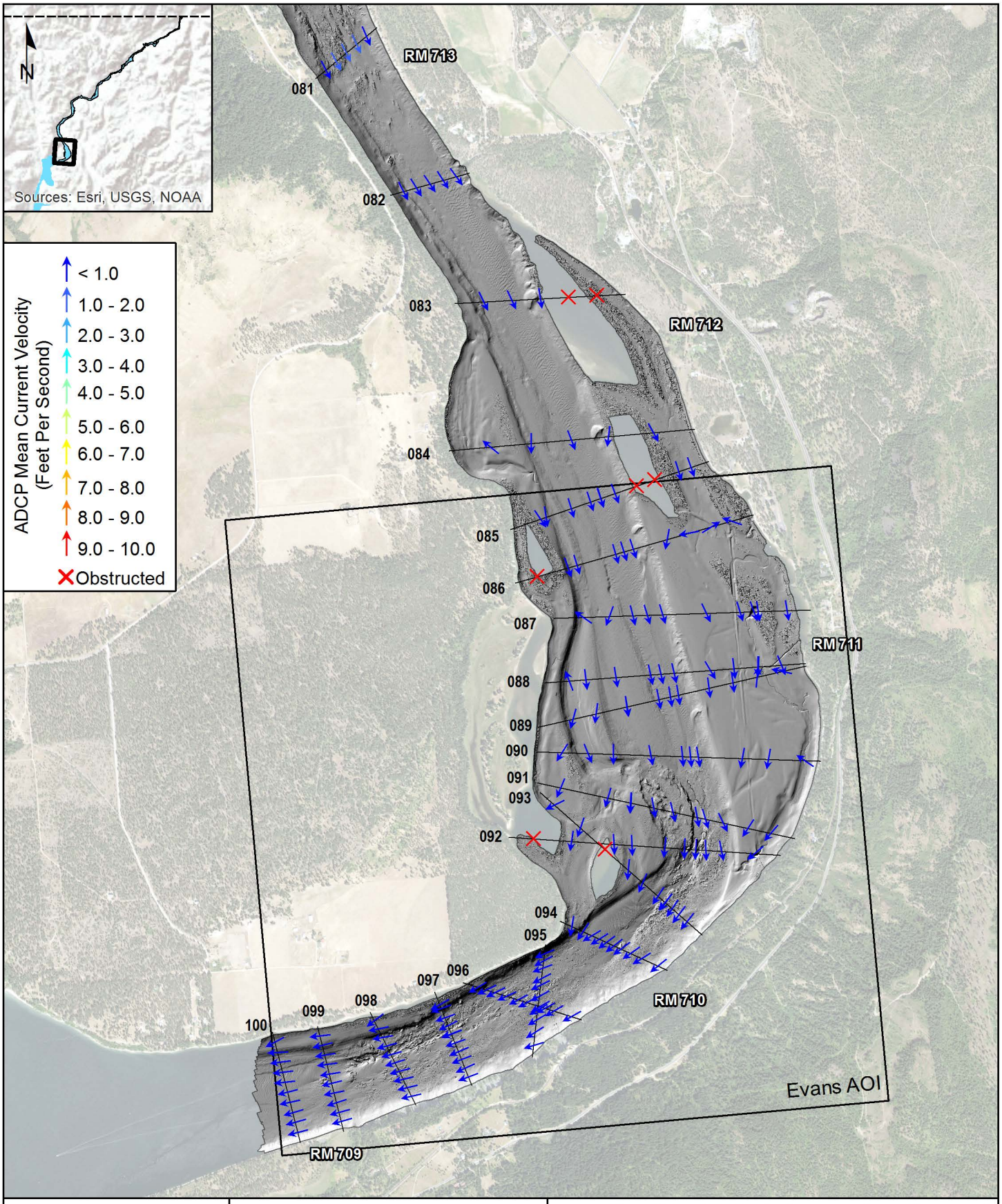
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-2i. **Acoustic Backscatter Imagery Mosaic for RM 741-745**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

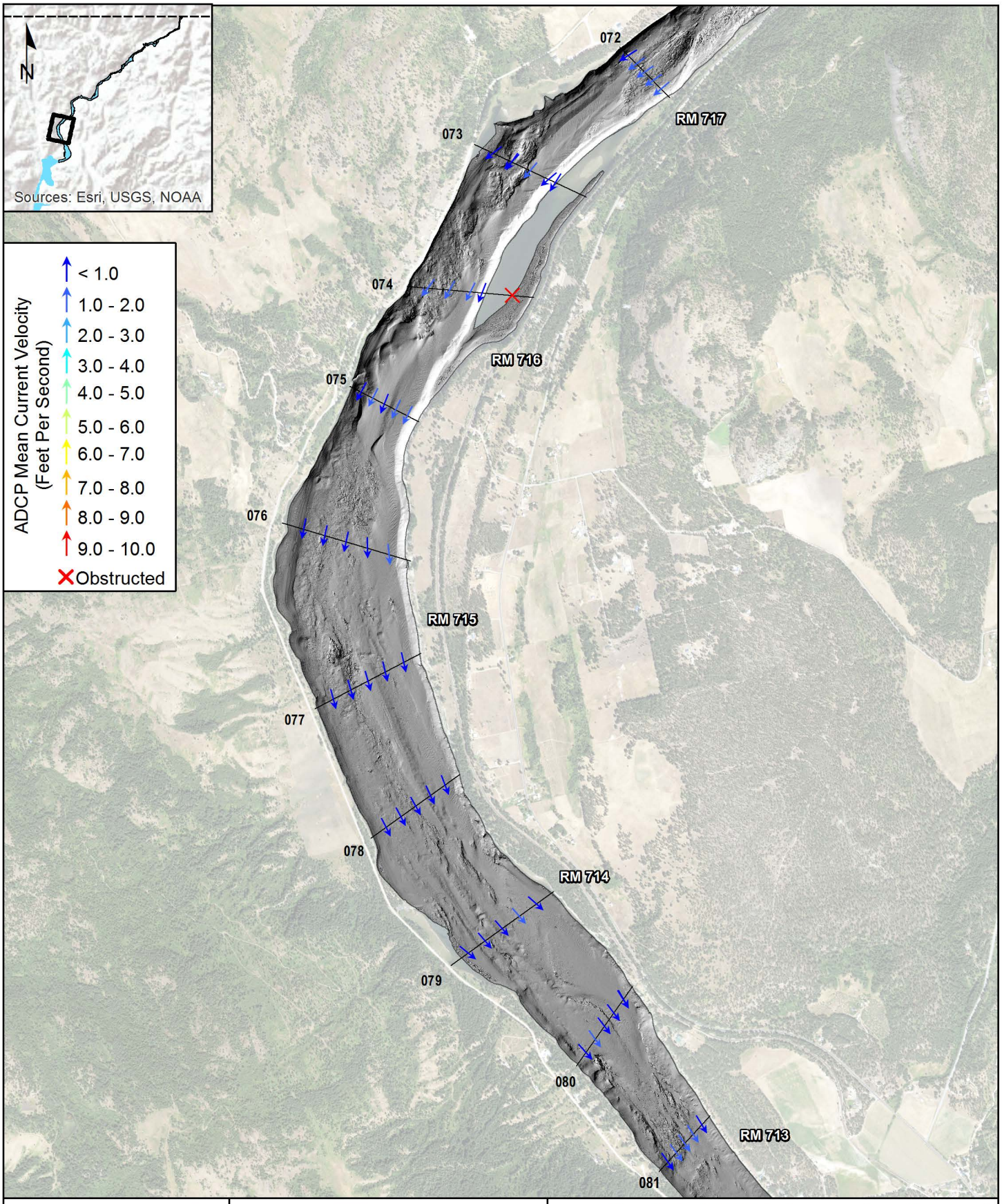
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3a. **ADCP Deployment Locations and Mean Current Velocity for RM 709-713 Including Evans AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

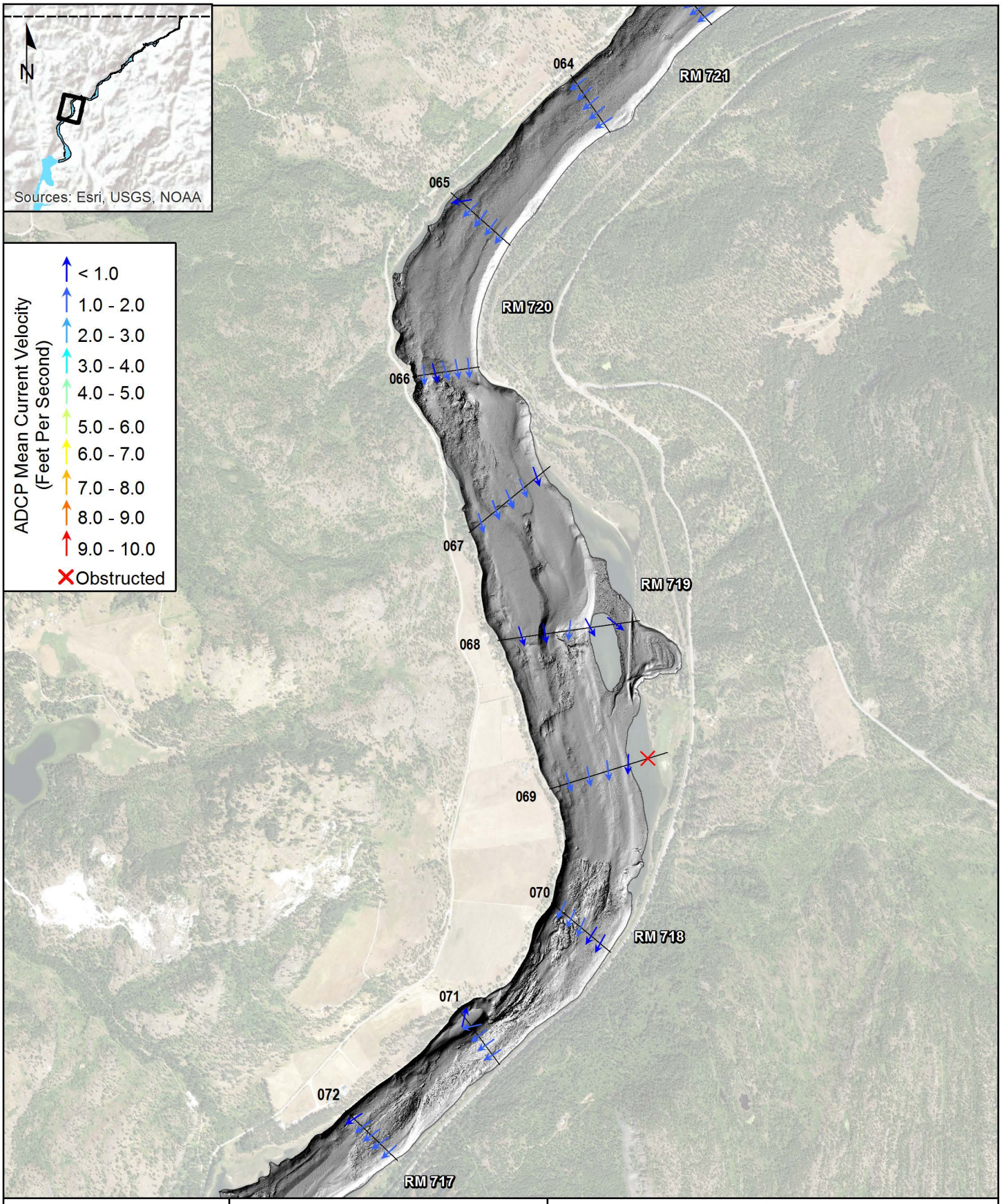
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3b. **ADCP Deployment Locations and Mean Current Velocity for RM 713-717**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

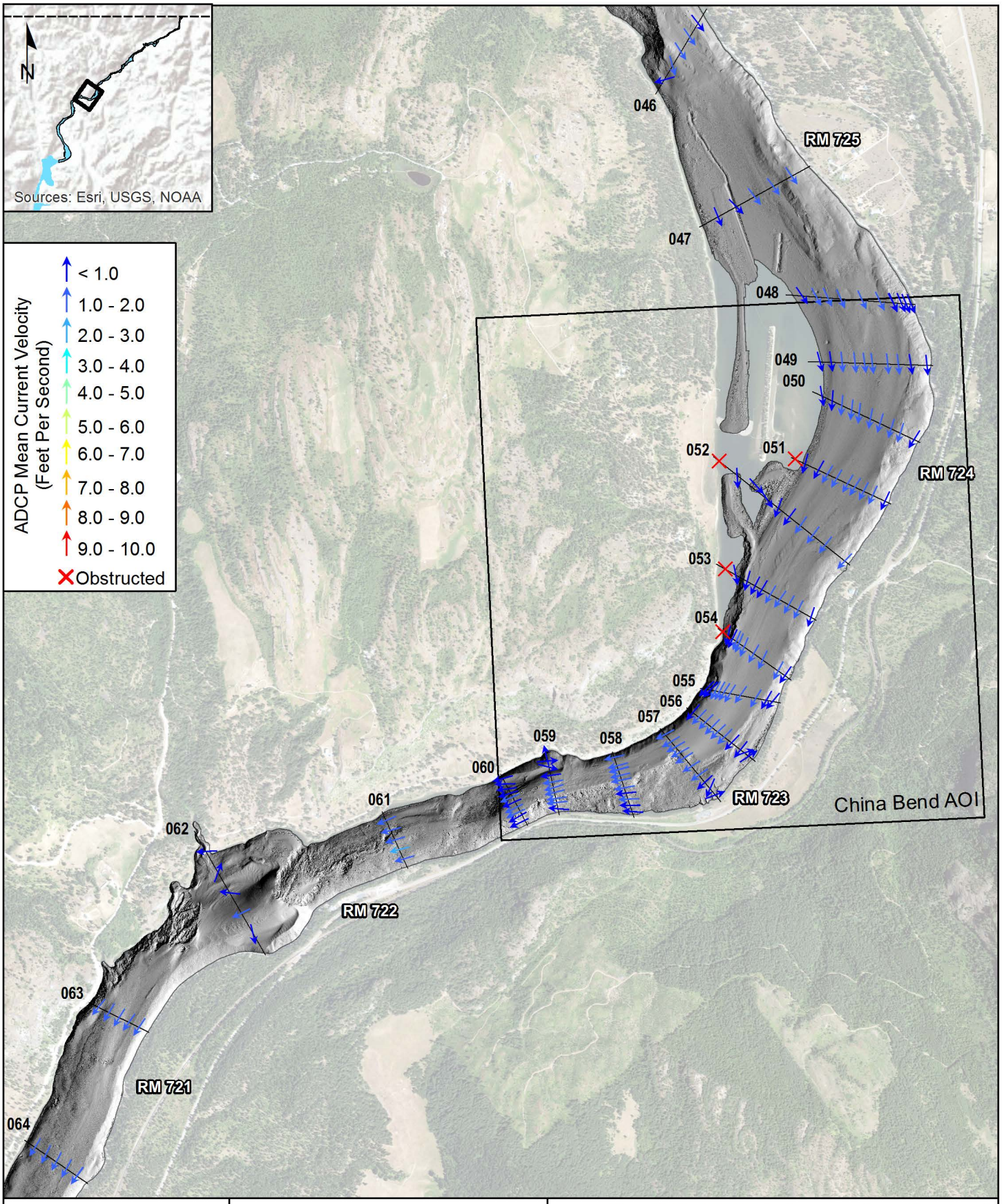
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3c. **ADCP Deployment Locations and Mean Current Velocity for RM 717-721**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

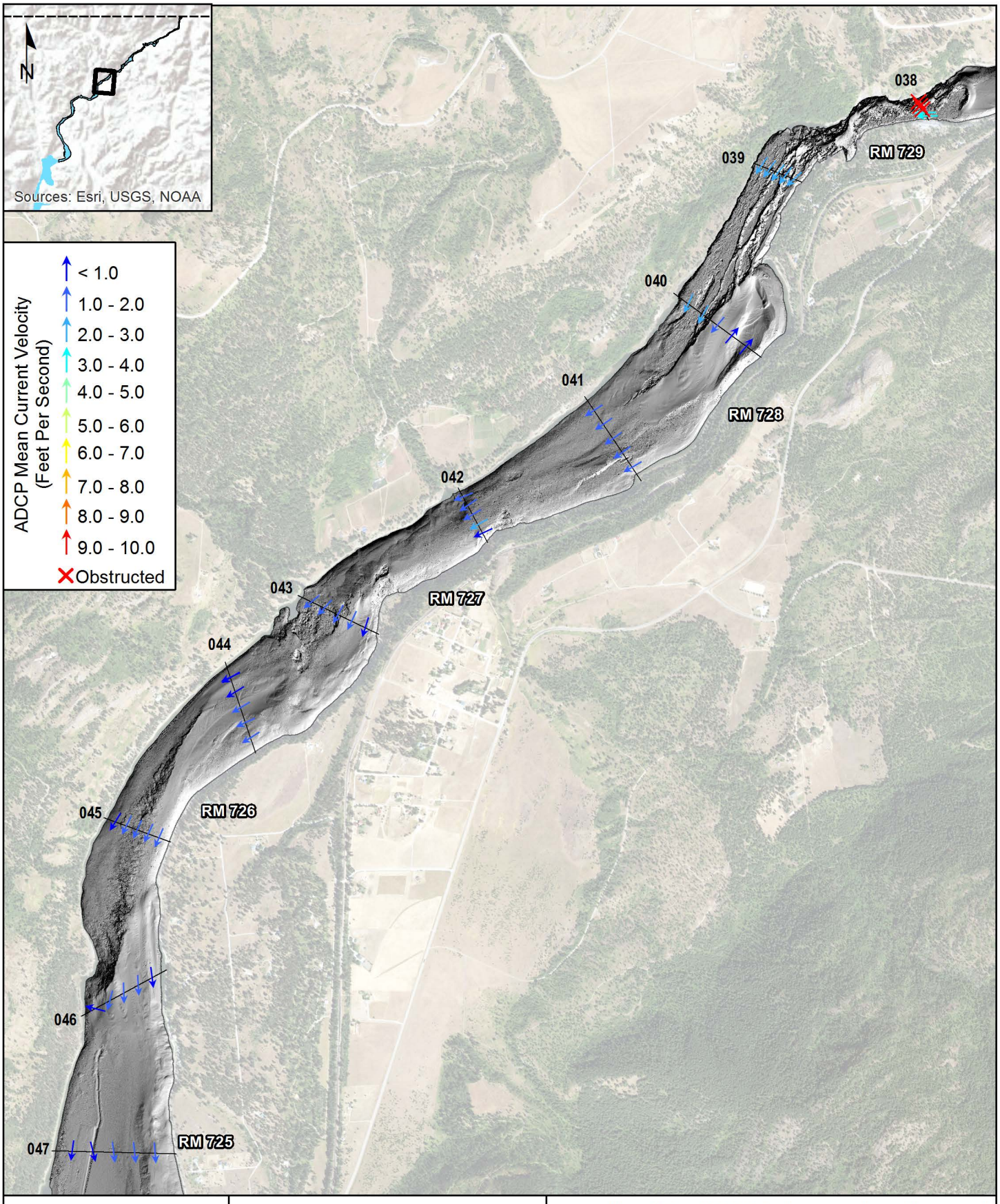
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3d. **ADCP Deployment Locations and Mean Current Velocity for RM 721-725 Including China Bend AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

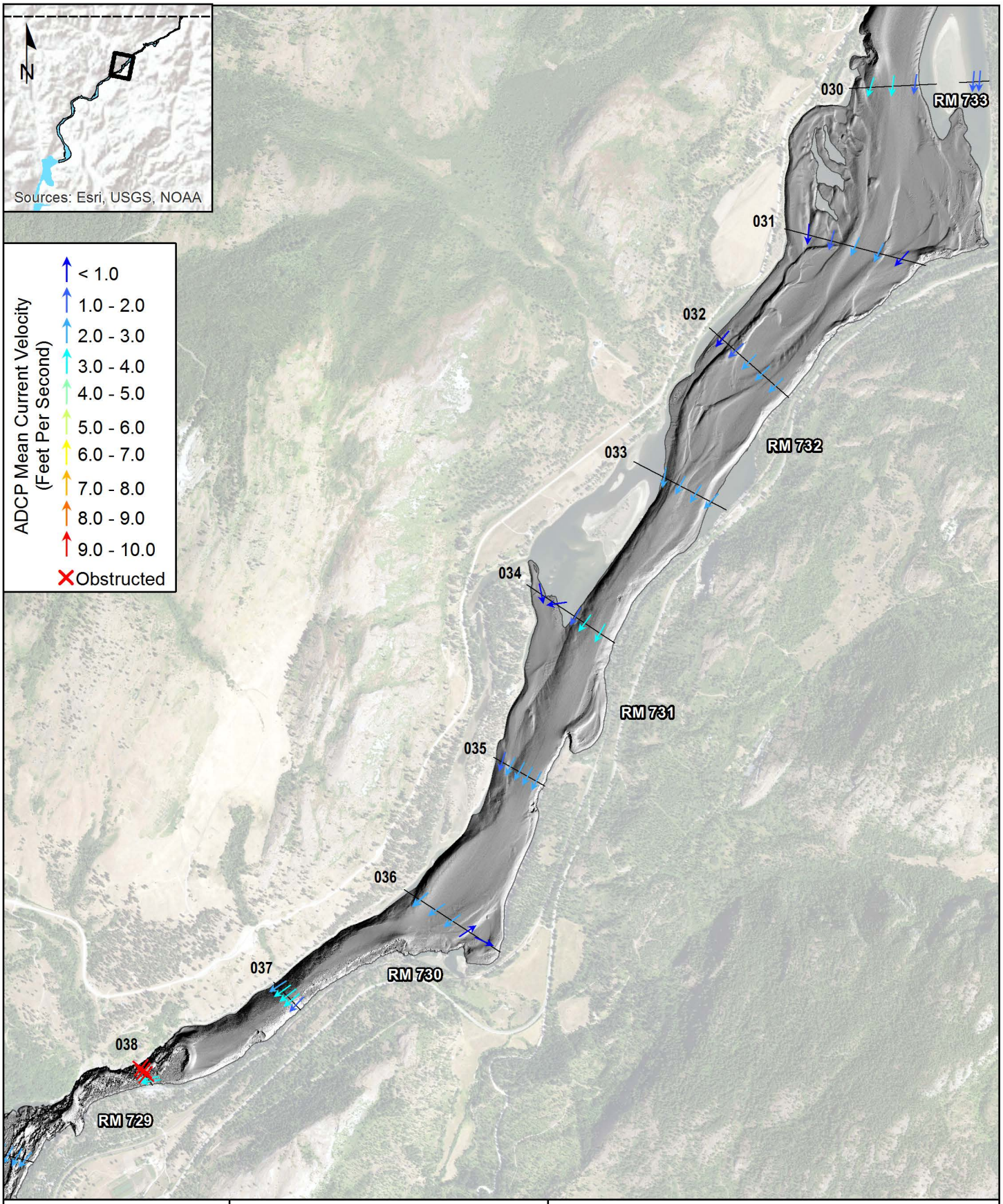
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3e. **ADCP Deployment Locations and Mean Current Velocity for RM 725-729**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

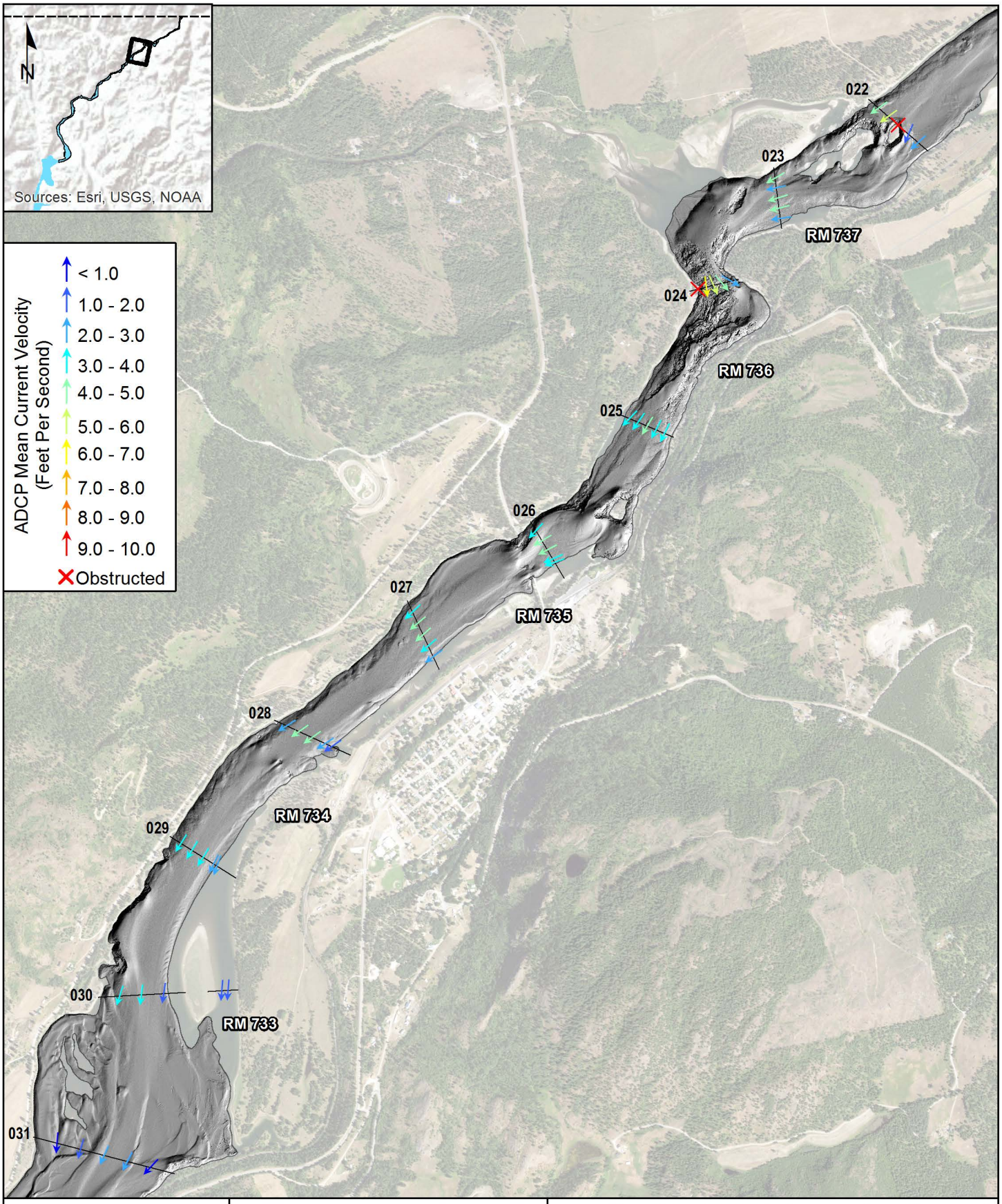
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3f. **ADCP Deployment Locations and Mean Current Velocity for RM 729-733**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

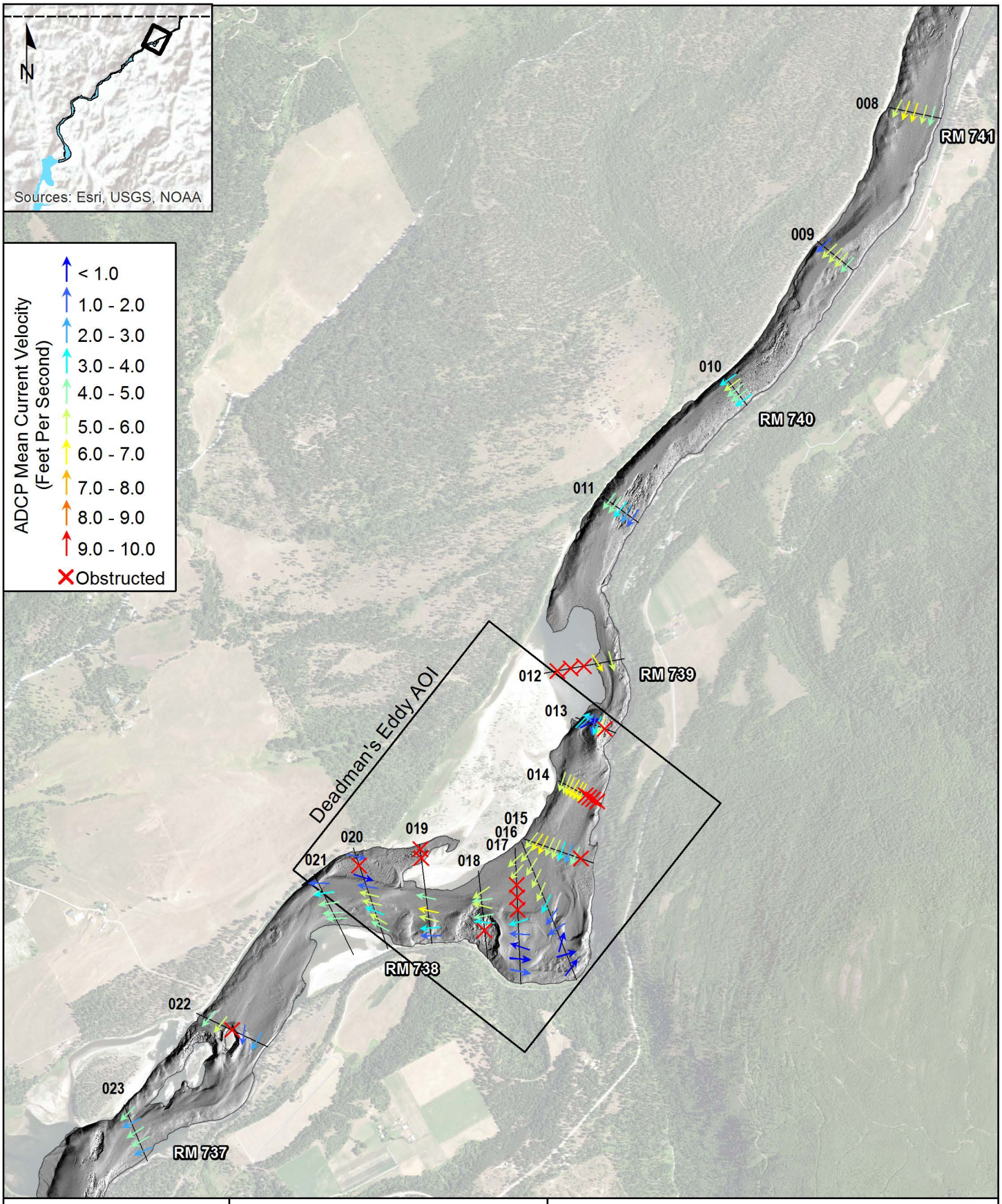
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3g. **ADCP Deployment Locations and Mean Current Velocity for RM 733-737**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

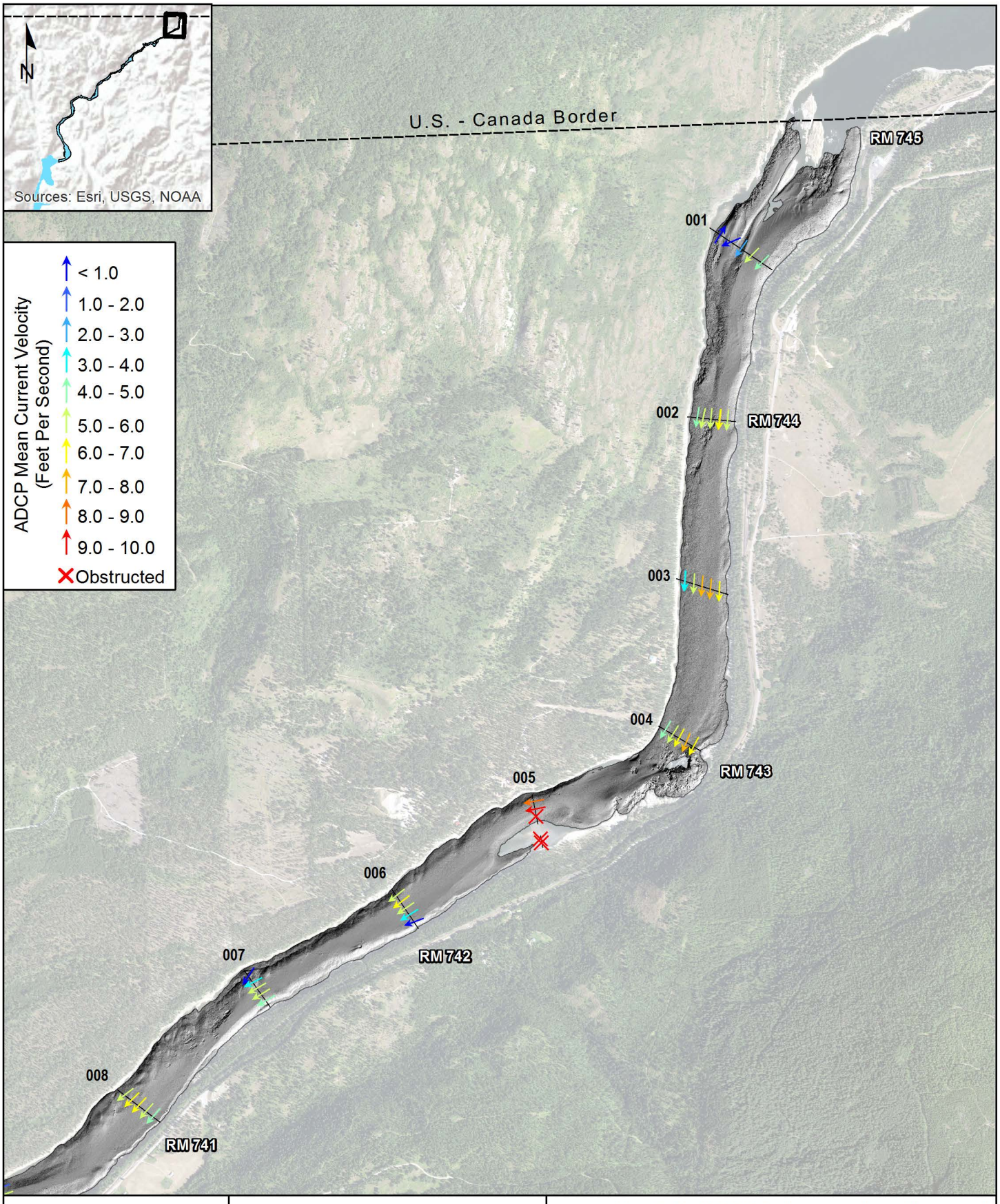
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3h. **ADCP Deployment Locations and Mean Current Velocity for RM 737-741 Including Deadman's Eddy AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

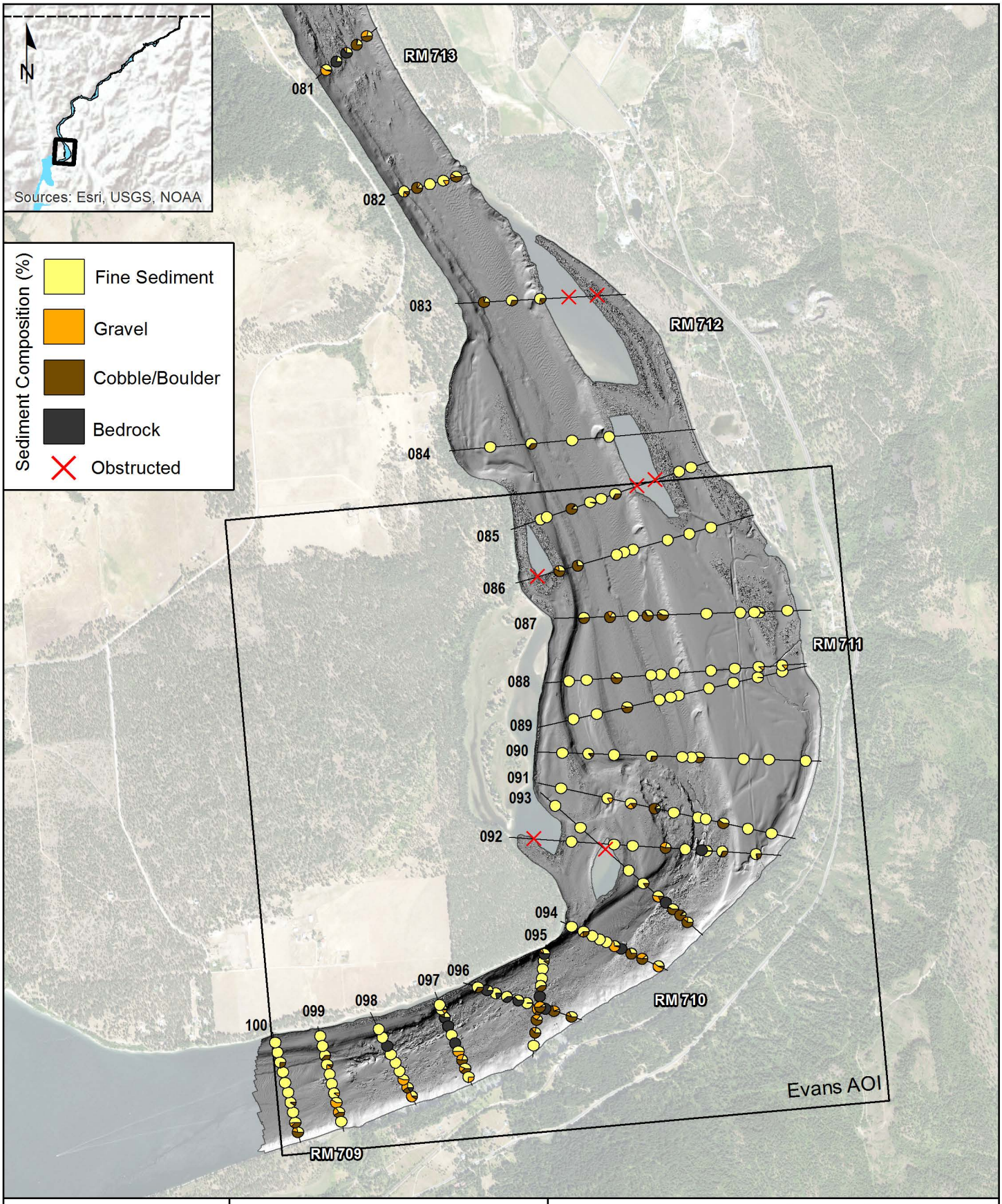
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-3i. **ADCP Deployment Locations and Mean Current Velocity for RM 741-745**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

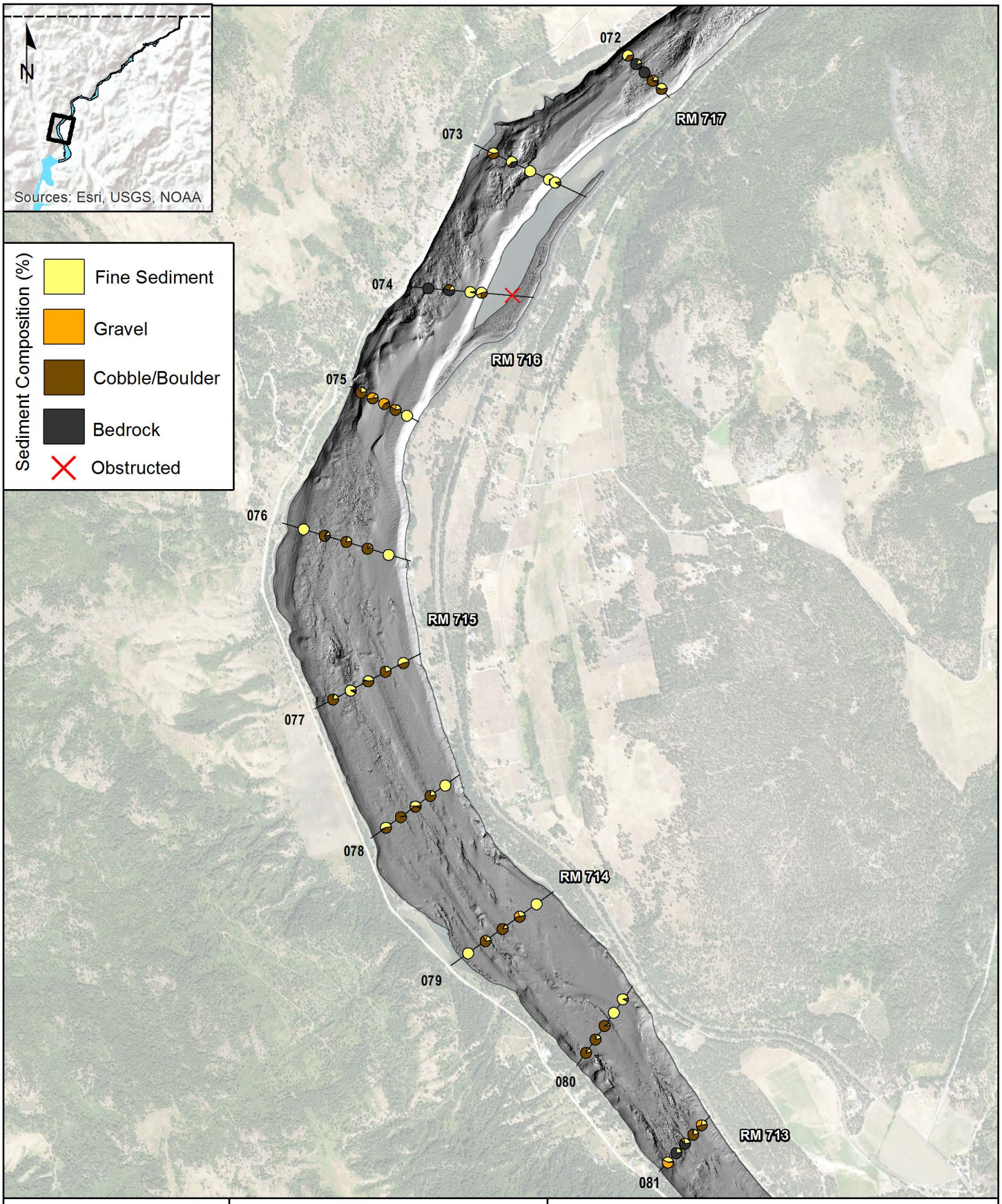
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4a. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 709-713 Including Evans AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

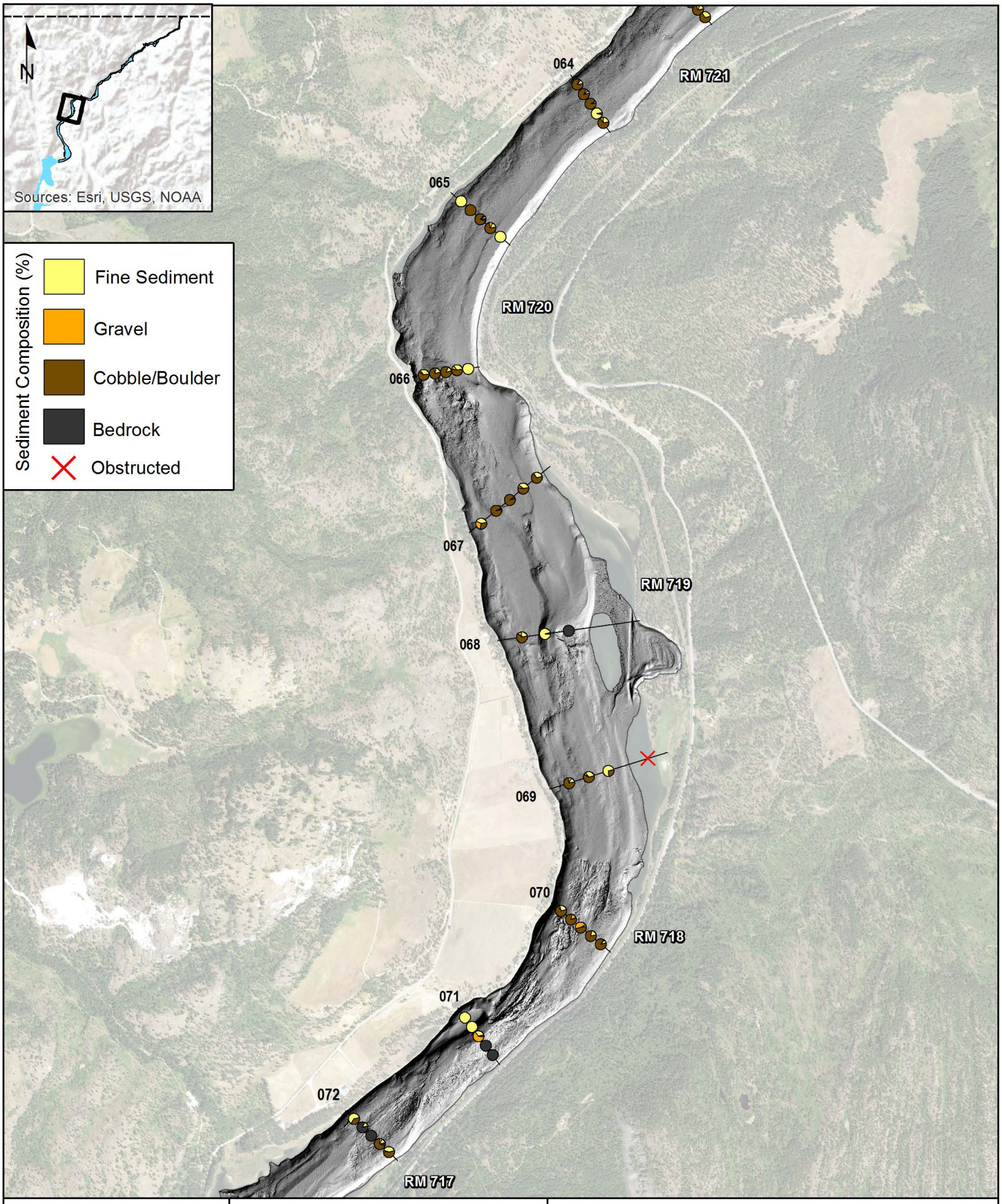
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4b. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 713-717**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

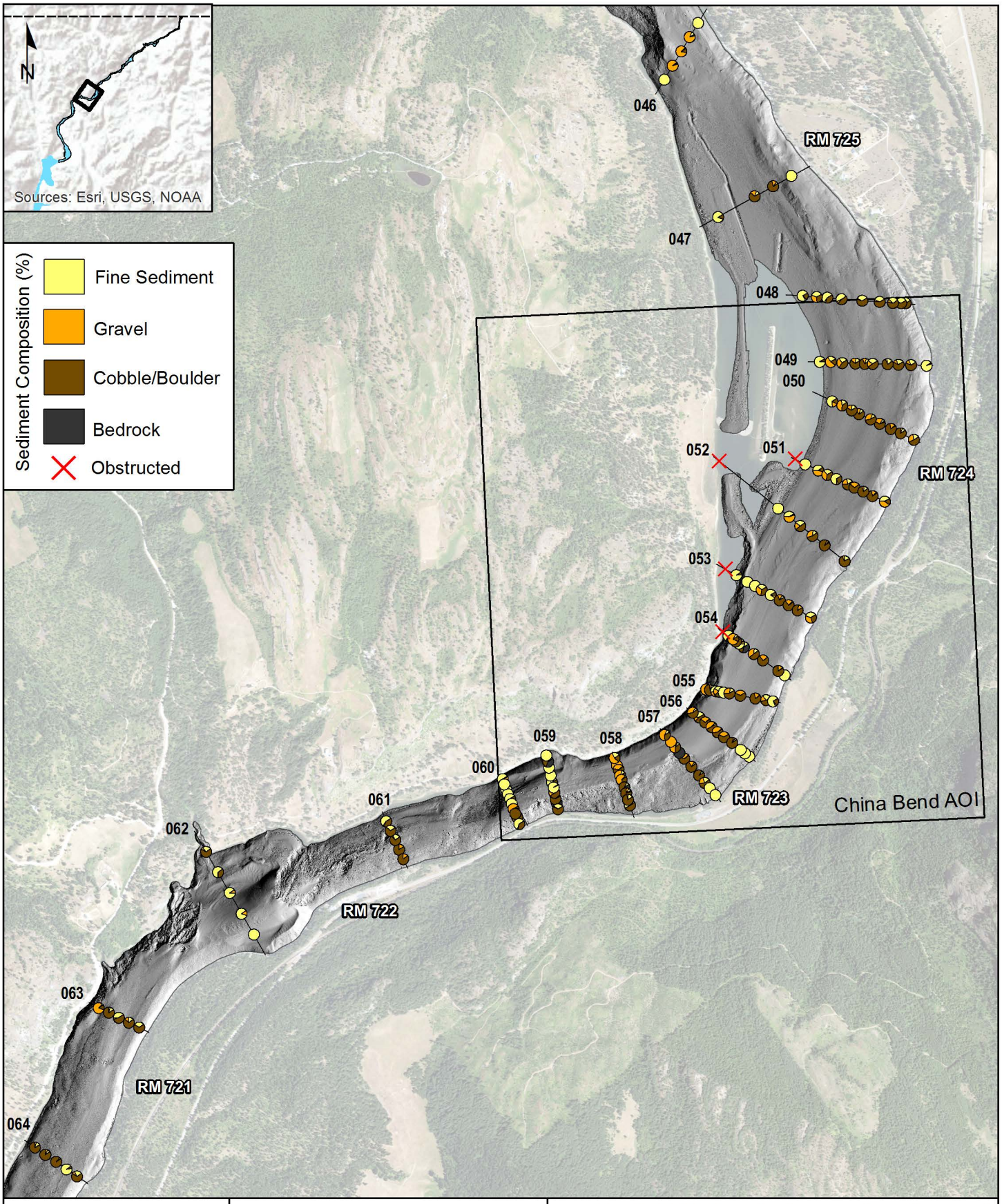
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4c. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 717-721**

Upper Columbia River, WA



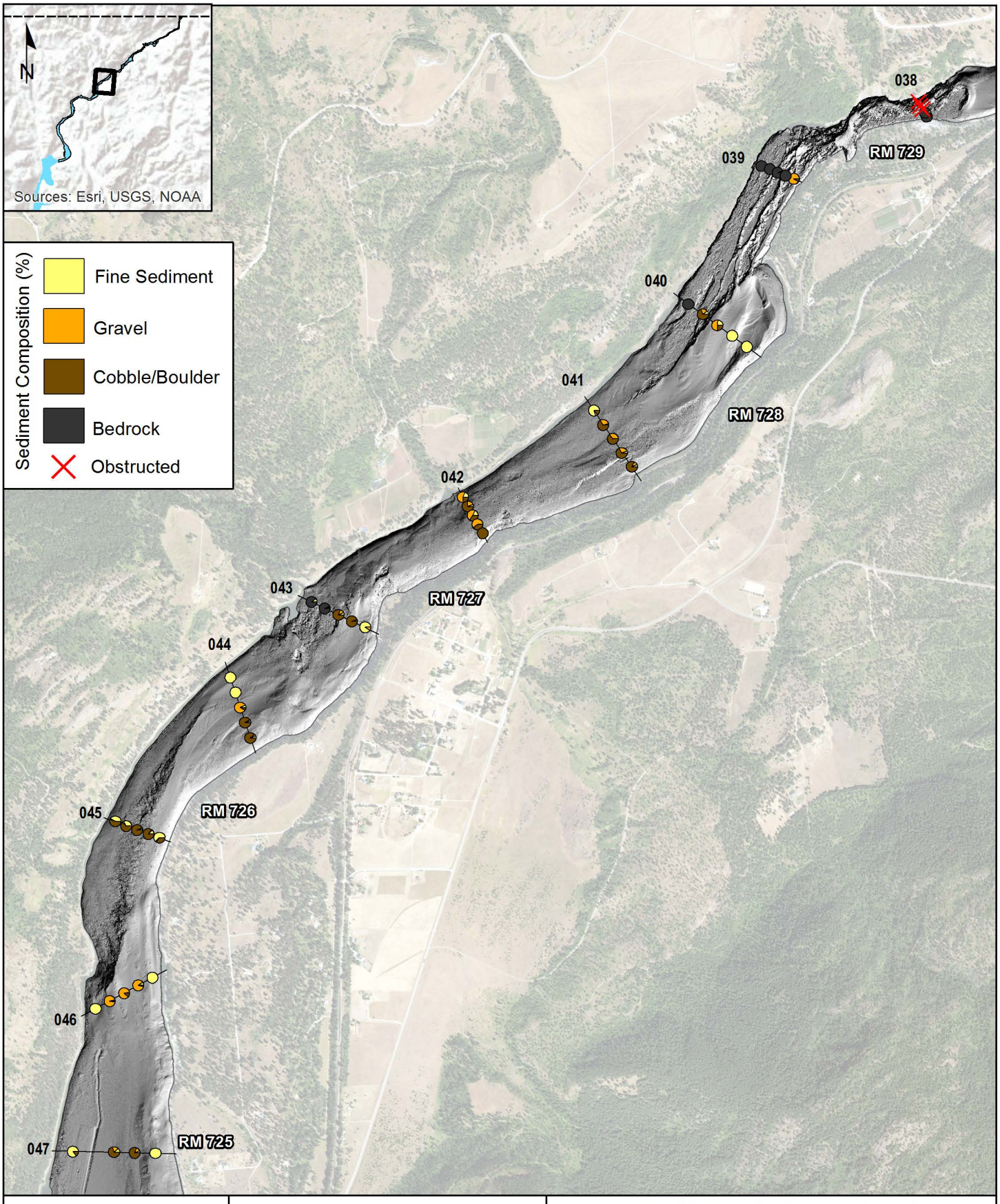
DAVID EVANS AND ASSOCIATES INC.

0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

Map 5-4d. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 721-725 Including China Bend AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

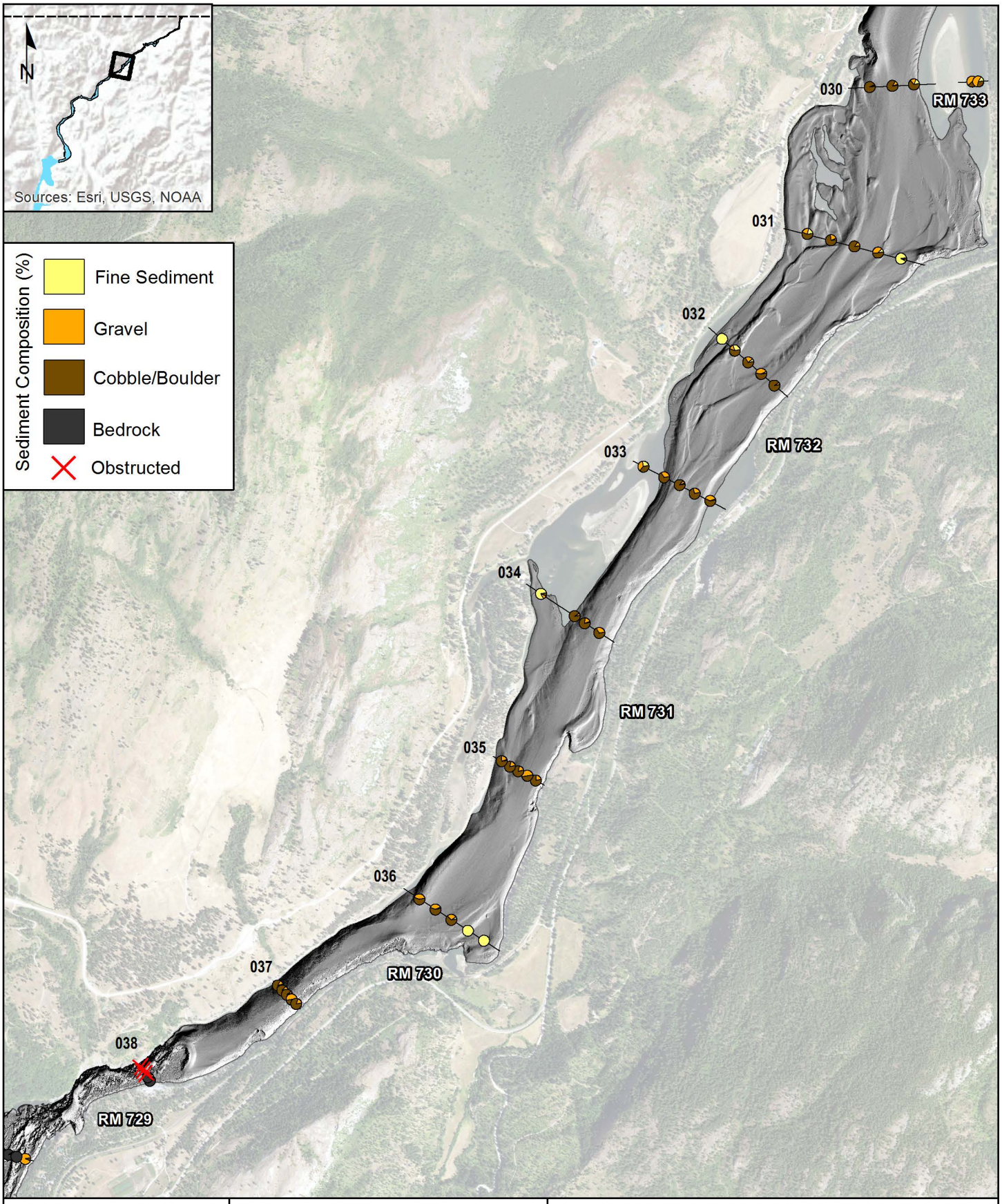
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4e. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 725-729**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

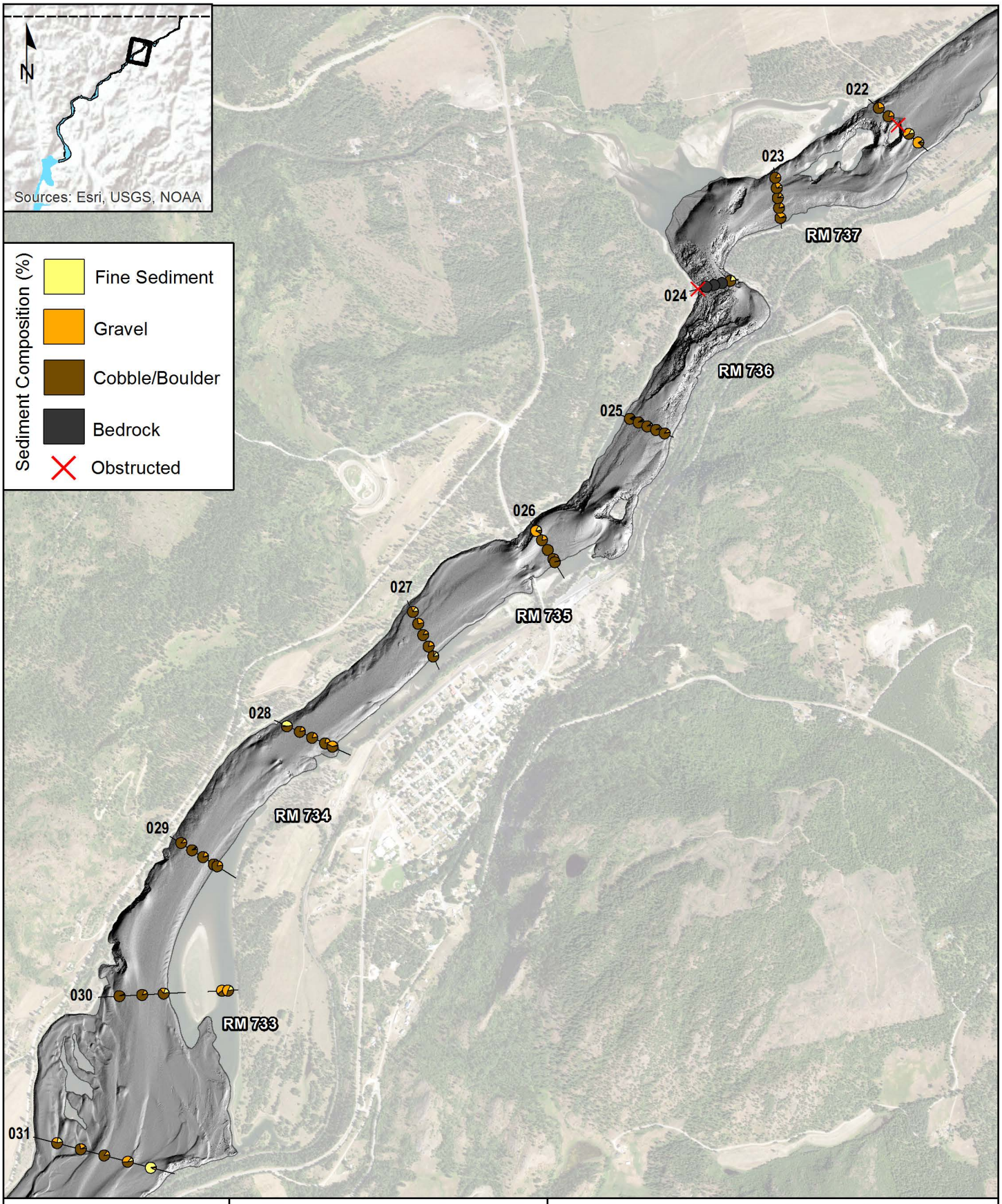
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4f. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 729-733**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

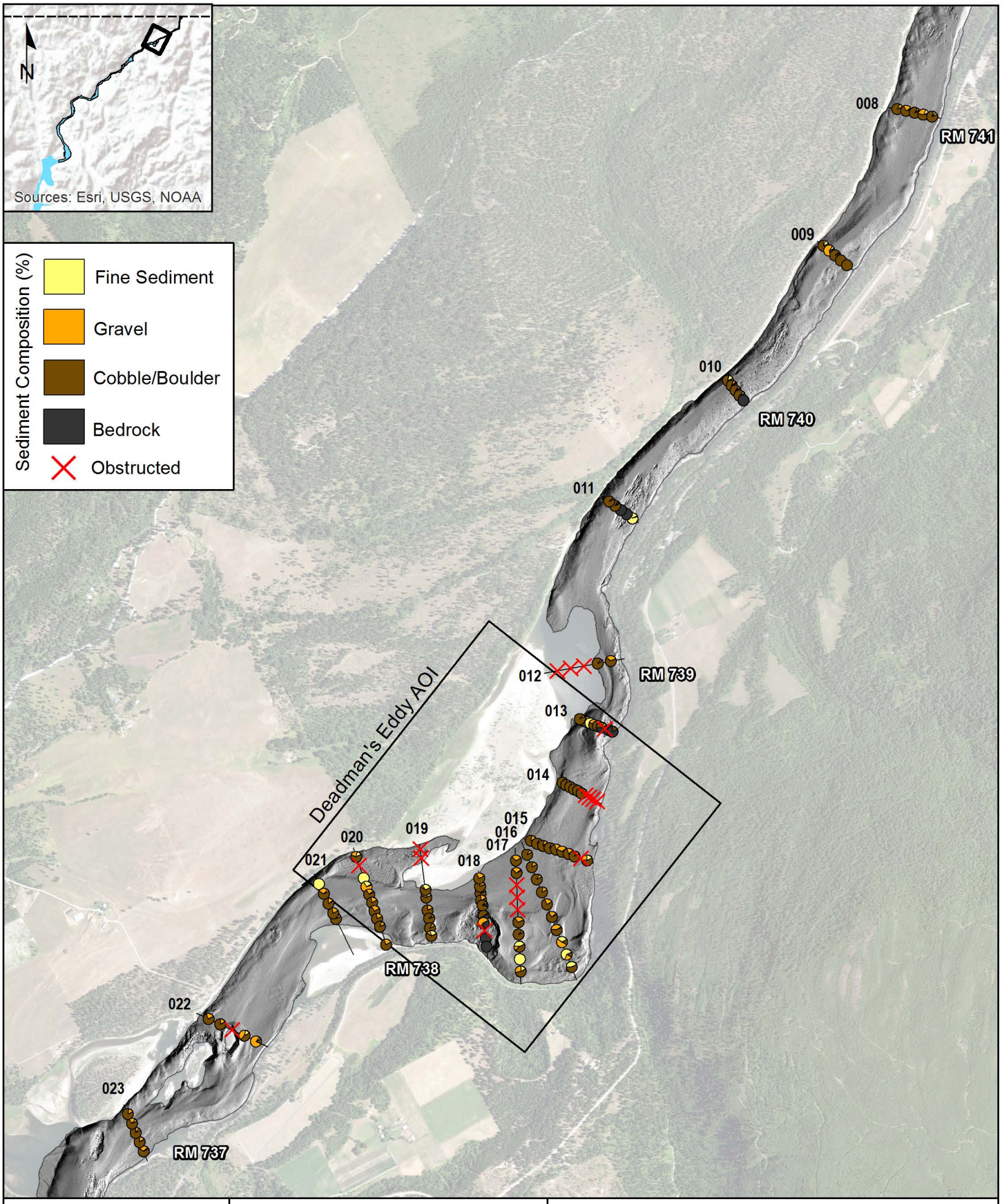
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4g. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 733-737**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

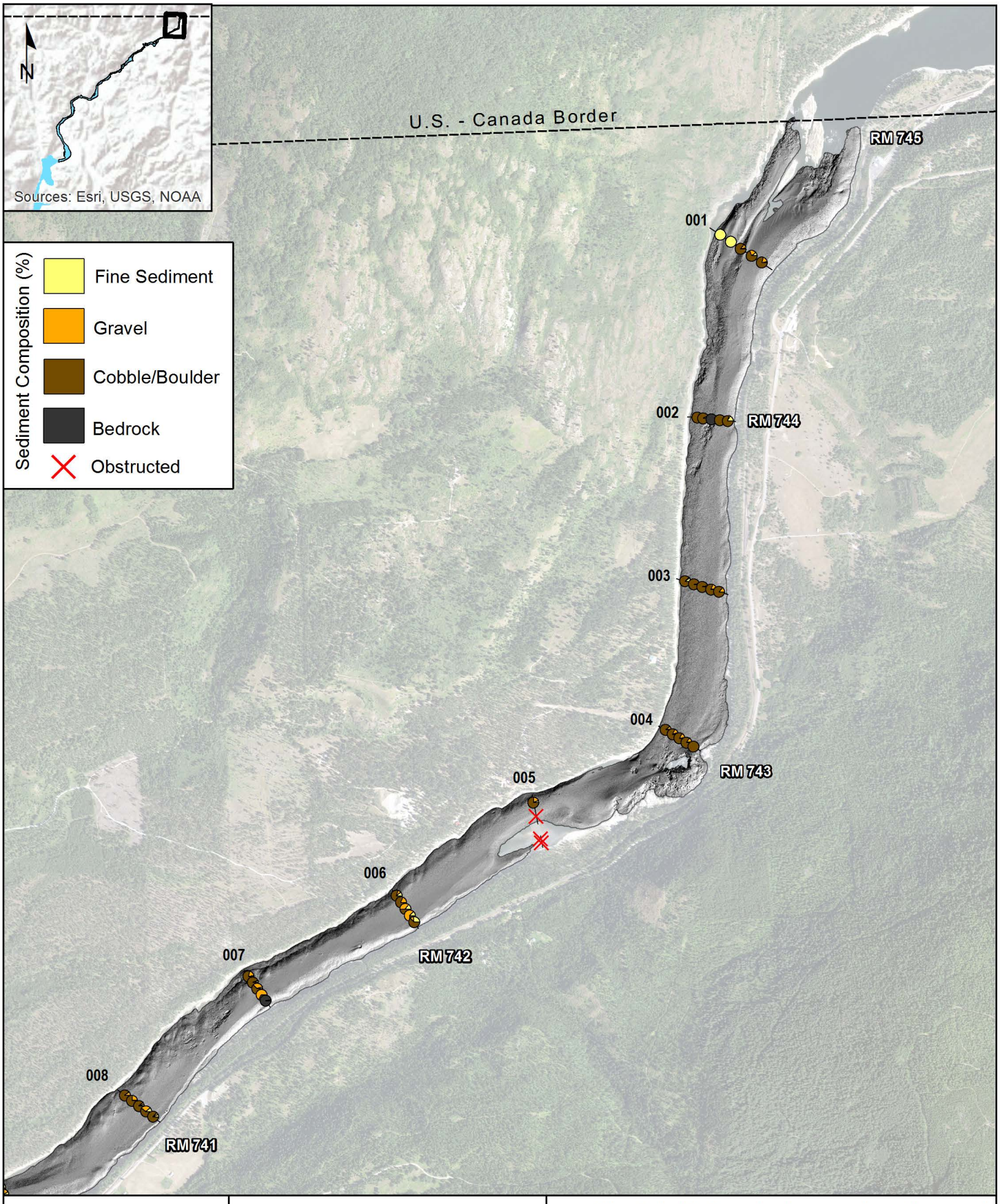
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4h. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 737-741 Including Deadman's Eddy AOI**

Upper Columbia River, WA



DAVID EVANS AND ASSOCIATES INC.

0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

Map 5-4i. **Underwater Imagery Locations and Interpreted Sediment Composition for RM 741-745**

Upper Columbia River, WA

TABLES

Table 4-1. Summary of MBES Crossline Analysis and Surface Difference Results

Results	Meters	U.S. Survey Feet
Mean Surface Difference	-0.008	-0.027
Standard Deviation (95% Confidence Interval)	0.090	0.294

Notes:
Mean Surface Difference: Mean difference between crosslines and reference surfaces
Standard Deviation: Standard deviation of the mean surface difference presented at two sigma or 95% Confidence Interval

Table 4-2. MBES Crossline Statistical Analysis by Beam

Beam Angle	Beam Count	Maximum (m)	Minimum (m)	Mean (m)	Std Dev (m)	Special Order (%)
-55.0 to -54.0	57	0.118	-0.156	0.006	0.071	100
-54.0 to -53.0	31	0.178	-0.169	0.022	0.079	100
-53.0 to -52.0	75	0.122	-0.083	0.018	0.045	100
-52.0 to -51.0	47	0.075	-0.116	-0.011	0.052	100
-51.0 to -50.0	47	0.094	-0.044	0.023	0.032	100
-50.0 to -49.0	77	0.095	-0.049	0.018	0.034	100
-49.0 to -48.0	38	0.099	-0.069	0.014	0.048	100
-48.0 to -47.0	55	0.093	-0.051	0.012	0.036	100
-47.0 to -46.0	75	0.171	-0.059	0.017	0.038	100
-46.0 to -45.0	29	0.053	-0.218	-0.032	0.061	100
-45.0 to -44.0	63	0.108	-0.097	0.005	0.041	100
-44.0 to -43.0	73	0.123	-0.109	0.005	0.042	100
-43.0 to -42.0	29	0.056	-0.065	-0.005	0.028	100
-42.0 to -41.0	59	0.09	-0.108	0.013	0.041	100
-41.0 to -40.0	70	0.07	-0.080	-0.004	0.033	100
-40.0 to -39.0	28	0.041	-0.049	0.001	0.023	100
-39.0 to -38.0	58	0.074	-0.100	-0.005	0.037	100
-38.0 to -37.0	67	0.061	-0.050	-0.003	0.025	100
-37.0 to -36.0	31	0.054	-0.099	0.004	0.032	100
-36.0 to -35.0	57	0.042	-0.066	-0.013	0.027	100
-35.0 to -34.0	66	0.077	-0.086	-0.015	0.039	100
-34.0 to -33.0	34	0.08	-0.075	-0.023	0.036	100
-33.0 to -32.0	55	0.094	-0.097	-0.006	0.044	100
-32.0 to -31.0	64	0.106	-0.062	0.006	0.038	100
-31.0 to -30.0	45	0.073	-0.061	0.004	0.032	100
-30.0 to -29.0	48	0.067	-0.103	-0.006	0.032	100
-29.0 to -28.0	60	0.087	-0.101	0.006	0.038	100
-28.0 to -27.0	52	0.135	-0.152	0.017	0.058	100
-27.0 to -26.0	47	0.151	-0.062	0.033	0.048	100
-26.0 to -25.0	53	0.181	-0.115	0.017	0.049	100
-25.0 to -24.0	55	0.107	-0.042	0.024	0.036	100
-24.0 to -23.0	50	0.073	-0.102	-0.004	0.044	100
-23.0 to -22.0	46	0.082	-0.141	0.002	0.045	100
-22.0 to -21.0	60	0.099	-0.123	-0.002	0.047	100
-21.0 to -20.0	56	0.21	-0.086	0.005	0.056	100
-20.0 to -19.0	34	0.195	-0.291	-0.011	0.099	100
-19.0 to -18.0	68	0.183	-0.145	0.000	0.069	100
-18.0 to -17.0	50	0.066	-0.066	0.000	0.031	100
-17.0 to -16.0	34	0.151	-0.214	-0.026	0.093	100

Table 4-2. MBES Crossline Statistical Analysis by Beam

Beam Angle	Beam Count	Maximum (m)	Minimum (m)	Mean (m)	Std Dev (m)	Special Order (%)
-16.0 to -15.0	67	0.103	-0.134	-0.002	0.059	100
-15.0 to -14.0	52	0.091	-0.091	0.003	0.042	100
-14.0 to -13.0	43	0.073	-0.097	-0.021	0.042	100
-13.0 to -12.0	57	0.061	-0.077	0.001	0.037	100
-12.0 to -11.0	56	0.063	-0.069	-0.007	0.033	100
-11.0 to -10.0	46	0.066	-0.072	-0.005	0.029	100
-10.0 to -9.0	48	0.075	-0.107	-0.014	0.035	100
-9.0 to -8.0	59	0.056	-0.104	-0.007	0.031	100
-8.0 to -7.0	49	0.075	-0.076	0.000	0.032	100
-7.0 to -6.0	41	0.058	-0.084	-0.006	0.035	100
-6.0 to -5.0	70	0.066	-0.086	-0.015	0.038	100
-5.0 to -4.0	51	0.057	-0.091	-0.016	0.039	100
-4.0 to -3.0	31	0.074	-0.066	-0.003	0.040	100
-3.0 to -2.0	66	0.087	-0.095	-0.011	0.035	100
-2.0 to -1.0	52	0.08	-0.120	-0.014	0.046	100
-1.0 to 0.0	41	0.119	-0.098	0.006	0.050	100
0.0 to 1.0	55	0.12	-0.184	-0.005	0.055	100
1.0 to 2.0	55	0.157	-0.171	0.008	0.058	100
2.0 to 3.0	45	0.095	-0.093	-0.010	0.040	100
3.0 to 4.0	45	0.305	-0.205	0.013	0.077	100
4.0 to 5.0	59	0.169	-0.175	-0.024	0.058	100
5.0 to 6.0	44	0.233	-0.134	-0.009	0.059	100
6.0 to 7.0	39	0.045	-0.086	-0.009	0.033	100
7.0 to 8.0	64	0.073	-0.171	-0.006	0.051	100
8.0 to 9.0	50	0.08	-0.142	0.000	0.049	100
9.0 to 10.0	35	0.1	-0.125	0.011	0.040	100
10.0 to 11.0	58	0.104	-0.068	0.013	0.038	100
11.0 to 12.0	57	0.089	-0.102	0.014	0.046	100
12.0 to 13.0	36	0.09	-0.075	0.026	0.041	100
13.0 to 14.0	51	0.099	-0.101	0.010	0.044	100
14.0 to 15.0	54	0.091	-0.093	0.008	0.038	100
15.0 to 16.0	37	0.064	-0.119	0.002	0.044	100
16.0 to 17.0	45	0.082	-0.103	-0.005	0.038	100
17.0 to 18.0	57	0.069	-0.085	-0.014	0.033	100
18.0 to 19.0	42	0.117	-0.093	0.005	0.042	100
19.0 to 20.0	38	0.091	-0.100	0.007	0.048	100
20.0 to 21.0	56	0.139	-0.092	-0.007	0.050	100
21.0 to 22.0	47	0.076	-0.092	-0.011	0.038	100
22.0 to 23.0	32	0.107	-0.073	-0.002	0.045	100

Table 4-2. MBES Crossline Statistical Analysis by Beam

Beam Angle	Beam Count	Maximum (m)	Minimum (m)	Mean (m)	Std Dev (m)	Special Order (%)
23.0 to 24.0	55	0.102	-0.100	-0.015	0.039	100
24.0 to 25.0	50	0.086	-0.117	-0.006	0.047	100
25.0 to 26.0	32	0.044	-0.092	-0.016	0.036	100
26.0 to 27.0	49	0.087	-0.102	0.002	0.046	100
27.0 to 28.0	53	0.057	-0.103	-0.017	0.041	100
28.0 to 29.0	34	0.065	-0.105	-0.001	0.035	100
29.0 to 30.0	40	0.04	-0.202	-0.047	0.061	100
30.0 to 31.0	53	0.069	-0.102	-0.021	0.040	100
31.0 to 32.0	30	0.052	-0.063	-0.006	0.031	100
32.0 to 33.0	41	0.055	-0.109	-0.026	0.043	100
33.0 to 34.0	49	0.082	-0.102	-0.012	0.043	100
34.0 to 35.0	32	0.063	-0.118	-0.028	0.052	100
35.0 to 36.0	41	0.037	-0.115	-0.030	0.036	100
36.0 to 37.0	46	0.067	-0.115	-0.032	0.049	100
37.0 to 38.0	31	0.064	-0.228	-0.050	0.066	100
38.0 to 39.0	43	0.037	-0.184	-0.037	0.055	100
39.0 to 40.0	38	0.05	-0.096	-0.033	0.036	100
40.0 to 41.0	31	0.078	-0.123	-0.034	0.042	100
41.0 to 42.0	45	0.085	-0.091	-0.007	0.045	100
42.0 to 43.0	37	0.067	-0.095	-0.032	0.045	100
43.0 to 44.0	29	0.031	-0.098	-0.028	0.036	100
44.0 to 45.0	45	0.031	-0.083	-0.029	0.031	100
45.0 to 46.0	33	0.082	-0.122	-0.037	0.051	100
46.0 to 47.0	29	0.021	-0.118	-0.047	0.035	100
47.0 to 48.0	44	0.15	-0.164	-0.038	0.052	100
48.0 to 49.0	30	0.062	-0.155	-0.032	0.054	100
49.0 to 50.0	31	0.032	-0.146	-0.062	0.049	100
50.0 to 51.0	39	0.126	-0.135	-0.024	0.060	100
51.0 to 52.0	28	0.029	-0.139	-0.042	0.040	100
52.0 to 53.0	30	0.116	-0.203	-0.036	0.072	100
53.0 to 54.0	32	0.109	-0.170	-0.057	0.059	100
54.0 to 55.0	28	0.134	-0.095	-0.023	0.061	100

Notes:
Beam Angle: Swath angle binned in 1 degree increments
Beam Count: Total number of soundings in bin
Maximum: Maximum distance of soundings above surface
Minimum: Maximum distance of soundings below surface
Mean: Mean difference of soundings to surface
Std Dev: Standard deviation of differences, presented at one sigma or 68% confidence interval
Special Order: Percentage of soundings that fall within the International Hydrographic Organization's most rigorous "Special Order" survey classification

Table 4-3. Analysis of Duplicate ADCP Measurements

Station ID	Apparent Roughness Height[a]	Apparent Roughness Height RPD (%)	Coefficient of Friction	Coefficient of Friction RPD (%)
002-02	0.33	6	0.00	-7
002-02-DUP	0.31		0.00	
002-04	0.22	16	0.00	-6
002-04-DUP	0.19		0.00	
003-01	0.51	34	0.01	-36
003-01-DUP	0.36		0.01	
016-08	0.15	-72	21.78	84
016-08-DUP	0.31		8.90	
016-09	0.23	-87	234.95	101
016-09-DUP	0.57		77.38	
017-09	0.00	48	22.18	-49
017-09-DUP	0.00		36.57	
017-10	0.01	186	2.89	-34
017-10-DUP	0.00		4.05	
021-02	0.58	136	0.01	-141
021-02-DUP	0.11		0.05	
021-03	0.25	48	0.01	-54
021-03-DUP	0.15		0.01	
031-03	0.15	100	0.12	-89
031-03-DUP	0.05		0.31	
031-04	0.06	-100	0.64	55
031-04-DUP	0.18		0.37	
036-01	0.09	34	0.21	4
036-01-DUP	0.07		0.20	
044-01[b]	1.71E+82	200	5.61E+04	200
044-01-DUP[b]	56.63		17.98	
048-07	0.09	-64	8.44	29
048-07-DUP	0.17		6.30	
050-05	0.09	19	6.77	11
050-05-DUP	0.07		6.04	
055-02	0.53	17	2.61	-30
055-02-DUP	0.45		3.54	
058-03	0.01	161	21.13	-99
058-03-DUP	0.01		14.34	
064-05[b]	0.12	194	2.48	-148
064-05-DUP[b]	0.00		16.69	
065-03	0.59	120	1.02	-52
065-03-DUP	0.15		1.74	

Table 4-3. Analysis of Duplicate ADCP Measurements

Station ID	Apparent Roughness Height[a]	Apparent Roughness Height RPD (%)	Coefficient of Friction	Coefficient of Friction RPD (%)
067-01	0.07	-110	5.07	68
067-01-DUP	0.25		2.50	
067-02	0.52	-2	1.40	8
067-02-DUP	0.53		1.29	
067-03	0.09	-45	2.38	-7
067-03-DUP	0.14		2.54	
073-02[b]	68.37	200	8.32	-116
073-02-DUP[b]	0.00		31.38	
074-01[b]	0.68	18	0.39	-35
074-01-DUP[b]	0.57		0.56	
080-05	0.03	-153	22.55	75
080-05-DUP	0.26		10.29	
085-05	0.09	-64	18.43	31
085-05-DUP	0.17		13.47	
088-09[b]	19.05	-71	86.16	-39
088-09-DUP[b]	40.24		128.33	
089-03	0.04	-97	52.21	55
089-03-DUP	0.10		29.59	
091-03	0.04	-57	80.61	21
091-03-DUP	0.07		65.26	
093-07[b]	89.92	31	30.78	26
093-07-DUP[b]	66.04		23.67	
097-05	0.10	-90	36.37	70
097-05-DUP	0.25		17.44	

Notes:

[a] Apparent roughness height values are dimensionless.

[b] indicates nonlogarithmic velocity profile

n = 31/632 = 4.9%

RPD – relative percent difference (refer to the sediment facies mapping QAPP [ERM et al. 2018] for formula)

DUP – duplicate

Table 4-4. Analysis of Duplicate Measurements

Station ID	Fine Grained Sediment Composition (%)	Fine Grained Sediment Composition RPD (%)
002-02	0.00	0
002-02-DUP	0.00	
002-04	0.00	0
002-04-DUP	0.00	
003-01	10.00	0
003-01-DUP	10.00	
016-08	33.33	0
016-08-DUP	33.33	
016-09	62.50	0
016-09-DUP	62.50	
017-09	100.00	0
017-09-DUP	100.00	
017-10	17.02	0
017-10-DUP	17.02	
021-02	6.25	0
021-02-DUP	6.25	
021-03	2.08	0
021-03-DUP	2.08	
031-03	0.00	0
031-03-DUP	0.00	
031-04	10.64	0
031-04-DUP	10.64	
036-01	0.00	0
036-01-DUP	0.00	
044-01	100.00	0
044-01-DUP	100.00	
048-07	29.17	0
048-07-DUP	29.17	
050-05	10.42	0
050-05-DUP	10.42	
055-02	10.42	0
055-02-DUP	10.42	
58-03	2.08	0
058-03-DUP	2.08	
064-05	22.92	0
064-05-DUP	22.92	
065-03	6.25	0
065-03-DUP	6.25	

Table 4-4. Analysis of Duplicate Measurements

Station ID	Fine Grained Sediment Composition (%)	Fine Grained Sediment Composition RPD (%)
067-01	39.58	0
067-01-DUP	39.58	
067-02	2.08	0
067-02-DUP	2.08	
067-03	2.08	0
067-03-DUP	2.08	
073-02	60.42	0
073-02-DUP	60.42	
074-01	0.00	0
074-01-DUP	0.00	
080-05	89.58	0
080-05-DUP	89.58	
085-05	100.00	0
085-05-DUP	100.00	
088-09	89.58	0
088-09-DUP	89.58	
089-03	44.68	0
089-03-DUP	44.68	
091-03	60.42	0
091-03-DUP	60.42	
093-07	0.00	0
093-07-DUP	0.00	
097-05	100.00	0
097-05-DUP	100.00	

Notes:
n = 31/632 = 4.9%
RPD – relative percent difference (refer to the sediment facies mapping QAPP [ERM et al. 2018] for formula)
DUP – duplicate

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
001-01	0.60	32	0.46	18.75	0.8099	Non-logarithmic
001-02	0.11	247	24.42	3.42	0.9842	Non-logarithmic
001-03	2.29	215	0.23	0.14	0.9757	
001-04	5.13	224	0.39	0.01	0.9782	
001-05	4.01	224	0.03	0.06	0.7945	
002-01	4.27	189	0.48	0.00	0.9619	
002-02	5.34	193	0.33	0.00	0.9828	
002-03	5.75	185	0.36	0.00	0.9984	
002-04	6.14	186	0.22	0.00	0.9688	
002-05	5.62	186	0.42	0.00	0.9788	
003-01	3.64	182	0.51	0.01	0.9695	
003-02	5.84	184	0.35	0.00	0.9969	
003-03	7.29	185	0.35	0.00	0.9956	
003-04	7.59	185	0.30	0.00	0.9985	
003-05	6.77	182	0.29	0.00	0.9971	
004-01	4.82	211	0.32	0.00	0.9996	
004-02	5.84	212	0.21	0.00	0.9817	
004-03	6.69	208	0.32	0.00	0.9953	
004-04	7.02	203	0.38	0.00	0.9948	
004-05	6.83	208	0.31	0.00	0.9973	
005-01	8.34	259	0.64	0.00	0.9975	
005-02	9.07	258	0.13	0.00	0.9760	
006-01	5.47	231	0.18	0.01	0.9800	
006-02	6.55	232	0.21	0.00	0.9881	
006-03	5.80	235	0.32	0.00	0.9866	
006-04	3.88	238	0.19	0.03	0.9740	
006-05	0.93	250	0.13	1.06	0.7211	
007-01	0.17	213	406.23	13.75	0.1554	Non-logarithmic
007-02	3.46	243	1.37	0.00	0.9678	
007-03	5.20	240	0.35	0.01	0.9903	
007-04	5.11	238	0.14	0.01	0.9839	
007-05	4.45	239	0.07	0.03	0.9138	
008-01	5.82	232	0.35	0.00	0.9887	
008-02	6.71	225	0.36	0.00	0.9963	
008-03	6.26	223	0.26	0.00	0.9907	
008-04	5.51	221	0.20	0.01	0.9962	
008-05	4.73	222	0.28	0.01	0.9956	
009-01	1.97	250	0.15	0.29	0.8314	Non-logarithmic

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
009-02	5.01	252	0.28	0.01	0.9606	
009-03	5.94	248	0.21	0.00	0.9833	
009-04	5.92	247	0.43	0.00	0.9894	
009-05	4.93	245	0.40	0.01	0.9902	
010-01	3.11	260	0.07	0.12	0.8576	
010-02	5.42	258	0.10	0.01	0.9815	
010-03	4.93	255	0.01	0.04	0.9880	
010-04	4.68	258	0.22	0.01	0.9873	
010-05	3.57	258	0.35	0.01	0.7922	
011-01	4.15	243	0.13	0.03	0.9633	
011-02	4.67	242	0.13	0.02	0.9805	
011-03	3.54	245	0.71	0.01	0.9865	
011-04	2.33	235	0.13	0.19	0.8771	
011-05	1.07	238	0.65	0.33	0.9341	
012-04	6.15	172	0.16	0.00	0.9949	
012-05	5.88	189	0.28	0.00	0.9899	
013-02	3.36	69	0.13	0.06	0.2150	Non-logarithmic
013-03	2.38	73	17.39	0.04	0.9528	Non-logarithmic
013-04	0.95	89	23.75	0.33	0.4656	Non-logarithmic
013-05	1.05	217	40.66	0.89	0.7527	Non-logarithmic
013-06	3.08	228	7.34	0.00	0.9841	Non-logarithmic
013-07	5.16	226	7.84	0.00	0.9921	Non-logarithmic
014-01	5.75	223	0.01	0.02	0.9745	
014-02	5.75	226	0.13	0.01	0.9638	
014-03	6.16	230	0.21	0.00	0.9864	
014-04	6.30	234	0.19	0.00	0.9798	
014-05	6.76	236	0.14	0.00	0.9830	
014-06	6.42	232	0.16	0.00	0.9881	
015-01	5.69	244	0.27	0.00	0.9876	
015-02	6.47	239	0.33	0.00	0.9981	
015-03	6.30	232	0.42	0.00	0.9862	
015-04	5.84	230	0.25	0.00	0.9949	
015-05	5.44	228	0.18	0.01	0.9938	
015-06	3.92	225	0.35	0.01	0.9762	
015-07	2.94	226	0.58	0.02	0.9642	
015-08	4.83	232	0.09	0.01	0.9953	
016-01	5.70	244	0.28	0.00	0.9995	
016-02	6.00	236	0.23	0.00	0.9953	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
016-03	5.54	230	0.26	0.00	0.9941	
016-04	5.23	228	0.17	0.01	0.9942	
016-05	3.90	231	0.35	0.01	0.9787	
016-06	1.68	239	0.50	0.12	0.9495	
016-07	1.63	259	337.73	2.64	0.8053	Non-logarithmic
016-08	0.22	40	0.15	21.78	0.9101	
016-09	0.36	98	0.23	234.95	0.9716	
016-10	0.16	61	0.03	1.33E+04	0.8249	Non-logarithmic
017-01	5.35	251	0.11	0.01	0.9789	
017-02	5.82	246	0.30	0.00	0.9940	
017-06	3.44	278	0.18	0.04	0.9551	
017-07	1.99	298	0.04	0.56	0.7135	
017-08	0.63	313	18.47	4.84	0.4572	Non-logarithmic
017-09	0.92	117	0.00	22.18	0.5465	
017-10	1.64	125	0.01	2.89	0.7940	
018-03	5.07	260	0.22	0.01	0.9859	
018-04	4.73	287	0.58	0.00	0.9816	
018-05	5.53	309	0.12	0.00	0.8419	Non-logarithmic
018-06	4.17	284	0.56	0.01	0.9775	
018-07	3.84	300	0.73	0.01	0.8782	Non-logarithmic
019-04	4.85	308	0.27	0.01	0.9918	
019-05	6.16	306	0.47	0.00	0.9918	
019-06	5.00	310	0.50	0.00	0.9875	
019-07	3.38	291	0.21	0.04	0.9439	
019-08	1.71	295	0.30	0.26	0.9598	
020-01	1.63	128	0.45	0.19	0.9837	
020-03	0.45	132	0.00	41.32	0.9232	
020-04	1.93	305	0.00	2.19	0.6792	Non-logarithmic
020-05	5.23	308	0.39	0.01	0.9806	
020-06	5.66	308	0.22	0.01	0.9852	
020-07	3.83	317	0.54	0.01	0.9890	
020-08	5.10	325	0.29	0.01	0.9874	
020-09	4.20	324	0.16	0.02	0.9972	
021-01	1.42	296	0.62	0.27	0.9366	
021-02	4.10	290	0.58	0.01	0.9854	
021-03	5.13	287	0.25	0.01	0.9869	
021-04	4.24	291	0.10	0.03	0.9824	
021-05	4.12	291	0.35	0.01	0.9937	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
022-01	4.31	243	0.22	0.02	0.9863	
022-02	5.31	243	0.42	0.00	0.9956	
022-04	1.47	213	1.22	0.02	0.9635	
022-05	2.07	237	0.18	0.23	0.8154	Non-logarithmic
023-01	4.34	249	0.02	0.05	0.9300	
023-02	2.74	267	0.29	0.07	0.9527	
023-03	4.75	262	0.58	0.00	0.9919	
023-04	4.86	265	0.52	0.00	0.9935	Non-logarithmic
023-05	2.87	271	0.26	0.04	0.9574	
024-02	6.03	182	0.09	0.01	0.9884	
024-03	5.44	165	2.08	0.00	0.8682	
024-04	4.20	149	33.87	0.01	0.9182	Non-logarithmic
024-05	2.61	129	0.81	0.02	0.9514	
025-01	3.01	233	0.17	0.05	0.9879	
025-02	3.60	224	0.38	0.01	0.9742	
025-03	4.28	220	0.32	0.01	0.9827	
025-04	3.79	217	0.27	0.03	0.9648	
025-05	3.25	215	0.53	0.02	0.9795	
026-01	3.19	232	0.00	0.49	0.8526	
026-02	4.86	249	0.37	0.01	0.9586	
026-03	4.80	251	0.29	0.01	0.9947	
026-04	3.89	255	0.51	0.01	0.9906	
026-05	3.64	259	0.32	0.01	0.9699	
027-01	3.03	236	0.11	0.10	0.9787	
027-02	4.11	239	0.20	0.02	0.9721	
027-03	4.58	237	0.20	0.01	0.9833	
027-04	3.76	239	0.09	0.05	0.9239	
027-05	2.46	242	0.20	0.09	0.9799	
028-01	2.89	247	0.26	0.06	0.9768	
028-02	4.42	244	0.22	0.02	0.9699	
028-03	4.13	243	0.30	0.02	0.9776	
028-04	2.80	245	0.26	0.07	0.9823	
028-05	1.47	245	0.01	2.02	0.8501	Non-logarithmic
029-01	3.46	222	0.54	0.02	0.9988	
029-02	3.77	221	0.47	0.02	0.9514	
029-03	3.79	221	0.26	0.03	0.9886	
029-04	2.68	216	0.19	0.09	0.9934	
029-05	2.21	209	0.12	0.20	0.9740	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
030-01	3.55	207	0.01	0.13	0.9771	
030-02	3.12	196	0.24	0.06	0.9895	
030-03	1.44	198	0.00	5.31	1.0000	Non-logarithmic
030-04	1.19	194	0.10	3.43	0.9921	
030-05	1.93	194	0.03	1.21	0.8625	Non-logarithmic
031-01	0.81	194	0.15	11.16	0.9818	
031-02	1.64	205	0.01	2.50	0.9015	
031-03	2.84	214	0.15	0.12	0.9678	
031-04	2.00	216	0.06	0.64	0.9040	
031-05	0.25	232	0.02	47.50	0.3395	Non-logarithmic
032-01	0.82	229	0.25	9.22	0.9658	
032-02	1.20	236	0.01	8.63	0.7093	
032-03	2.27	233	0.14	0.27	0.9622	
032-04	2.47	234	0.14	0.22	0.9283	
032-05	2.44	235	0.74	0.06	0.9686	
033-02	2.04	199	0.00	1.74	0.7284	
033-03	2.87	217	0.20	0.11	0.9614	
033-04	2.93	221	0.08	0.17	0.9181	
033-05	2.24	232	0.02	0.77	0.9012	
034-01	0.50	178	0.30	42.79	0.9928	
034-02	0.07	271	0.31	2.87E+03	0.8411	
034-03	1.50	220	0.12	1.33	0.9907	
034-04	3.28	225	0.16	0.08	0.8655	Non-logarithmic
034-05	3.40	219	0.63	0.02	0.9941	
035-01	1.92	206	0.56	0.17	0.9839	
035-02	2.72	216	0.33	0.08	0.9859	
035-03	3.00	218	0.35	0.06	0.9887	
035-04	2.97	218	0.20	0.11	0.9816	
035-05	2.81	217	0.04	0.30	0.9692	
036-01	2.58	236	0.09	0.21	0.9039	
036-02	2.56	244	0.13	0.18	0.9433	
036-03	2.25	242	0.45	0.11	0.9457	
036-04	0.36	65	180.14	8.73	0.2326	Non-logarithmic
036-05	0.28	124	0.24	302.78	0.9368	
037-01	2.08	246	0.21	0.26	0.9257	
037-02	3.02	244	0.14	0.10	0.9684	
037-03	3.11	242	0.16	0.11	0.9748	
037-04	3.10	239	0.10	0.10	0.9738	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
037-05	1.17	232	14.41	1.44	0.9351	Non-logarithmic
038-04	3.66	269	0.33	0.02	0.9650	
038-05	3.73	271	0.26	0.03	0.9576	
039-01	2.29	217	0.01	0.88	0.8789	
039-02	2.52	218	0.56	0.06	0.9288	
039-03	2.36	220	1.58	0.01	0.9501	
039-04	2.53	218	0.85	0.03	0.9593	
039-05	2.04	229	0.29	0.21	0.5424	Non-logarithmic
040-01	2.28	207	0.47	0.10	0.9756	
040-02	2.22	211	0.56	0.11	0.9614	
040-03	1.36	222	0.17	1.97	0.8113	Non-logarithmic
040-04	0.09	42	7.24E+10	1.11E+03	0.0106	Non-logarithmic
040-05	0.49	43	29.03	5.14	0.8916	Non-logarithmic
041-01	1.27	239	0.03	4.53	0.8112	
041-02	1.83	238	0.06	1.05	0.9090	
041-03	1.77	236	0.05	1.41	0.8891	
041-04	1.54	236	0.95	0.25	0.9574	
041-05	1.02	242	0.30	1.80	0.8893	
042-01	1.30	250	0.10	2.38	0.8625	
042-02	1.51	237	0.37	0.72	0.9430	
042-03	1.79	241	0.42	0.41	0.9704	
042-04	2.00	242	0.22	0.43	0.9656	
042-05	0.98	247	0.52	0.97	0.6512	Non-logarithmic
043-01	1.09	232	0.33	1.08	0.9363	
043-02	1.50	225	0.03	2.57	0.7913	
043-03	1.86	211	0.50	0.27	0.9374	
043-04	1.91	207	0.03	1.39	0.7015	
043-05	0.48	199	65.39	11.18	0.6667	Non-logarithmic
044-01	0.43	241	1.71E+82	5.61E+04	0.0004	Non-logarithmic
044-02	0.90	241	0.01	15.38	0.6858	
044-03	1.38	241	0.02	3.04	0.4823	Non-logarithmic
044-04	1.29	248	0.02	4.81	0.2777	Non-logarithmic
044-05	1.22	240	1.11E+05	22.10	0.5081	Non-logarithmic
045-01	0.89	214	0.43	1.42	0.8446	
045-02	1.10	208	0.02	7.69	0.7838	
045-03	1.72	207	0.47	0.41	0.9462	
045-04	1.93	207	0.09	0.71	0.9749	
045-05	1.71	205	0.02	1.53	0.8088	Non-logarithmic

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
046-01	0.27	287	821.32	43.99	0.5509	Non-logarithmic
046-02	1.46	197	0.00	13.60	0.5206	
046-03	1.72	181	0.32	0.52	0.9263	
046-04	1.38	179	0.01	6.33	0.5959	
046-05	0.76	175	512.63	25.68	0.6091	Non-logarithmic
047-01	0.63	190	0.21	31.81	0.9941	
047-02	0.82	168	0.36	4.48	0.9784	
047-03	1.09	175	0.29	2.88	0.9740	
047-04	1.27	176	0.58	1.16	0.9725	
047-05	1.28	178	0.10	3.62	0.8293	
048-01	0.75	178	0.23	13.45	0.9903	
048-02	1.08	184	0.04	10.13	0.9151	
048-03	1.09	188	0.16	4.96	0.9436	
048-04	1.21	189	0.23	2.84	0.9451	
048-05	1.21	188	0.14	3.89	0.9412	
048-06	1.11	187	0.06	8.43	0.9093	
048-07	0.95	190	0.09	8.44	0.8680	
048-08	0.63	189	1.76E+03	105.96	0.6351	Non-logarithmic
048-09	0.50	190	0.00	331.66	0.2871	Non-logarithmic
048-10	0.21	190	0.45	310.58	0.9460	
049-01	0.61	197	0.18	27.25	0.9943	
049-02	0.84	204	0.30	8.86	0.9795	
049-03	1.15	207	0.09	5.42	0.9411	
049-04	1.18	206	0.45	1.59	0.9495	
049-05	1.30	205	0.11	3.30	0.9632	
049-06	1.33	206	0.56	0.66	0.9650	
049-07	1.11	207	0.13	5.56	0.9243	
049-08	1.04	206	0.45	2.69	0.9592	
049-09	0.89	203	0.18	7.16	0.8736	
049-10	0.42	207	6.12E+03	163.03	0.4250	Non-logarithmic
050-01	0.50	203	0.44	19.44	0.9884	
050-02	0.83	217	0.04	21.37	0.8265	
050-03	1.08	218	0.24	2.87	0.9103	
050-04	1.09	220	0.21	3.89	0.9255	
050-05	1.07	219	0.09	6.77	0.8683	
050-06	1.13	223	0.22	2.75	0.8360	
050-07	1.09	229	0.08	7.45	0.8453	
050-08	1.23	230	0.31	1.86	0.8899	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
050-09	1.24	230	0.00	15.22	0.7098	
050-10	0.75	245	0.56	3.29	0.8255	Non-logarithmic
051-02	0.09	228	0.41	1.75E+03	0.9107	Non-logarithmic
051-03	0.83	242	0.05	19.40	0.8070	
051-04	1.02	244	0.15	5.83	0.8939	
051-05	1.11	243	0.06	8.19	0.8891	
051-06	1.23	243	0.09	4.78	0.8617	
051-07	1.16	245	0.16	4.31	0.9583	
051-08	1.41	240	0.26	1.37	0.9216	
051-09	1.52	238	0.06	2.00	0.8283	
051-10	0.98	238	0.10	8.51	0.8145	
052-02	0.20	209	0.44	148.28	0.8601	
052-03	0.06	170	0.46	2.30E+03	0.9397	
052-04	0.07	179	0.24	464.88	0.8487	Non-logarithmic
052-05	0.14	233	0.87	572.97	0.9871	
052-06	0.75	249	0.10	14.29	0.7485	
052-07	1.10	248	0.05	9.57	0.8850	
052-08	1.26	249	0.15	3.29	0.9725	
052-09	1.50	250	0.36	0.78	0.9564	
052-10	1.07	256	0.14	6.03	0.8924	
053-02	0.18	201	0.14	1.61E+03	0.9237	
053-03	0.38	228	208.23	96.17	0.7164	Non-logarithmic
053-04	0.72	239	0.00	81.37	0.4735	
053-05	0.97	244	0.08	10.91	0.8720	
053-06	1.20	243	0.07	5.69	0.8975	
053-07	1.24	248	0.05	5.06	0.7422	
053-08	1.63	242	0.31	0.71	0.9530	
053-09	1.70	240	0.45	0.32	0.9756	
053-10	0.72	231	0.10	19.80	0.7390	
054-02	0.68	225	0.16	15.88	0.7796	Non-logarithmic
054-03	0.99	238	0.28	3.90	0.8264	
054-04	1.06	235	0.76	1.43	0.8791	
054-05	1.17	236	1.09	0.59	0.9846	
054-06	1.35	235	0.10	3.17	0.8891	
054-07	1.26	242	0.45	1.54	0.9269	
054-08	1.48	238	0.11	2.11	0.9601	
054-09	1.27	241	0.26	1.84	0.9298	
054-10	0.60	248	0.14	27.83	0.7192	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
055-01	0.84	257	0.49	3.19	0.9834	
055-02	0.92	258	0.53	2.61	0.8748	
055-03	1.36	241	0.48	1.14	0.9264	
055-04	1.43	242	0.59	0.74	0.9621	
055-05	1.54	245	0.09	1.97	0.8876	
055-06	1.63	245	0.21	0.99	0.9435	
055-07	1.42	248	0.10	2.63	0.9218	
055-08	1.73	244	0.32	0.51	0.9348	
055-09	0.93	243	0.06	14.45	0.8024	
055-10	0.34	253	0.01	192.81	0.6422	
056-01	0.86	253	222.32	14.89	0.7492	Non-logarithmic
056-02	1.04	257	0.00	31.86	0.4893	
056-03	1.08	257	0.14	3.46	0.7666	Non-logarithmic
056-04	1.13	257	0.16	3.45	0.9033	
056-05	1.06	259	0.23	3.58	0.8781	
056-06	1.05	257	0.02	12.83	0.8386	
056-07	0.76	256	0.45	4.00	0.9194	
056-08	0.43	251	0.05	100.93	0.7353	Non-logarithmic
056-09	0.07	105	0.15	93.24	0.8383	
056-10	0.08	89	0.67	1.62E+03	0.7742	Non-logarithmic
057-01	1.07	275	103.60	3.86	0.5917	Non-logarithmic
057-02	1.03	271	0.03	11.10	0.8865	
057-03	1.06	273	0.38	1.98	0.9205	
057-04	1.16	274	2.29	0.02	0.8428	Non-logarithmic
057-05	1.07	270	0.40	2.46	0.8801	
057-06	1.37	270	0.01	5.60	0.7763	
057-07	1.04	268	0.16	3.00	0.8519	
057-08	0.67	260	217.52	15.41	0.6541	Non-logarithmic
057-09	0.19	236	0.09	20.20	0.4757	Non-logarithmic
057-10	0.15	102	972.21	99.04	0.6089	Non-logarithmic
058-01	1.14	289	0.13	2.43	0.6103	Non-logarithmic
058-02	1.06	288	0.05	7.17	0.6193	Non-logarithmic
058-03	1.05	287	0.01	21.13	0.6786	
058-04	1.12	289	0.14	4.68	0.8297	
058-05	1.08	291	0.37	2.85	0.8901	
058-06	1.10	292	0.13	5.40	0.8580	
058-07	0.95	297	0.43	3.18	0.9275	
058-08	1.08	300	0.44	1.68	0.7648	
058-09	0.83	302	0.04	11.48	0.7983	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
058-10	0.56	307	1.47	0.05	0.4628	Non-logarithmic
059-01	0.10	19	0.02	50.61	0.5643	
059-02	0.57	118	0.08	24.51	0.5206	
059-03	0.32	137	26.09	12.59	0.4686	Non-logarithmic
059-04	0.50	295	1.04	2.61	0.8719	Non-logarithmic
059-05	1.11	293	0.93	1.22	0.9375	
059-06	1.22	286	0.51	1.12	0.9016	
059-07	1.35	289	0.18	1.93	0.7764	
059-08	1.34	294	0.44	1.53	0.5158	
059-09	1.07	296	1.50	0.69	0.9306	
059-10	0.56	307	0.91	0.81	0.5249	Non-logarithmic
060-01	0.36	287	0.04	38.86	0.5923	
060-02	0.47	301	0.06	17.47	0.3763	Non-logarithmic
060-03	0.52	295	0.16	22.65	0.6831	
060-04	0.88	285	0.88	2.56	0.8390	
060-05	1.14	279	0.03	8.92	0.6077	
060-06	0.99	278	0.04	13.53	0.7882	
060-07	1.29	276	0.13	2.89	0.7206	
060-08	1.10	278	104.33	2.96	0.8286	Non-logarithmic
060-09	0.45	272	1.90	0.56	0.5802	Non-logarithmic
060-10	0.22	276	7.60E+03	185.43	0.3260	Non-logarithmic
061-01	1.24	279	0.31	1.84	0.9595	
061-02	1.81	287	0.16	0.82	0.9729	
061-03	1.81	285	0.68	0.25	0.9700	
061-04	2.04	288	0.15	0.38	0.8078	
061-05	1.98	286	0.15	0.64	0.8908	
062-01	0.11	299	0.12	103.81	0.5092	Non-logarithmic
062-02	0.75	53	1.73E+03	65.31	0.5120	Non-logarithmic
062-03	0.98	309	0.21	3.36	0.8566	
062-04	1.25	276	1.10	0.69	0.7253	Non-logarithmic
062-05	0.33	199	59.35	12.46	0.6600	Non-logarithmic
063-01	1.51	252	0.24	1.17	0.9434	
063-02	1.48	244	0.26	1.06	0.9110	
063-03	1.59	244	0.40	0.61	0.9437	
063-04	1.65	248	0.16	0.76	0.9632	
063-05	1.55	246	450.10	3.33	0.8370	Non-logarithmic
064-01	1.36	244	0.12	2.69	0.9534	
064-02	1.76	240	0.33	0.58	0.9797	
064-03	1.63	241	0.45	0.49	0.9335	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
064-04	1.45	241	0.26	1.23	0.8906	
064-05	1.28	248	0.12	2.48	0.8382	Non-logarithmic
065-01	0.12	272	0.26	47.08	0.9034	
065-02	1.36	238	0.46	0.87	0.9551	
065-03	1.25	229	0.59	1.02	0.8014	
065-04	1.58	227	0.17	1.21	0.9472	
065-05	1.41	227	0.18	1.56	0.8564	
066-01	1.05	188	0.56	1.77	0.9415	
066-02	0.97	176	0.85	1.52	0.9560	
066-03	1.19	172	0.68	0.73	0.7982	Non-logarithmic
066-04	1.30	181	0.19	2.37	0.9496	
066-05	1.47	186	0.01	4.50	0.7524	
067-01	1.16	176	0.07	5.07	0.8183	
067-02	1.19	172	0.52	1.40	0.9096	
067-03	1.42	170	0.09	2.38	0.8899	
067-04	1.17	168	0.08	4.64	0.9181	
067-05	0.81	173	1.07E+04	51.64	0.4134	Non-logarithmic
068-01	0.82	174	0.61	3.36	0.8671	
068-02	0.67	181	1.09	3.30	0.9026	
068-03	1.01	197	38.97	3.41	0.8488	Non-logarithmic
068-04	0.79	163	0.09	12.11	0.9822	
068-05	0.30	140	0.31	71.52	0.8008	
069-01	1.19	172	0.21	2.90	0.8622	
069-02	1.00	181	0.15	6.48	0.8385	
069-03	1.00	185	0.01	22.21	0.7391	
069-04	0.30	193	0.22	319.29	0.9484	
070-01	1.30	217	0.27	1.65	0.9650	
070-02	1.22	216	0.87	0.87	0.9748	
070-03	1.27	214	0.10	3.68	0.8318	
070-04	0.90	223	0.53	2.95	0.8660	
070-05	0.92	220	0.23	7.71	0.7995	
071-01	0.58	24	38.52	25.22	0.3845	Non-logarithmic
071-02	1.17	268	0.75	0.95	0.9073	
071-03	1.43	243	1.01	0.45	0.9507	
071-04	1.72	246	0.79	0.36	0.9590	
071-05	1.50	249	0.48	0.68	0.9646	
072-01	0.97	247	0.19	5.32	0.9122	
072-02	1.31	244	0.22	1.81	0.8869	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
072-03	1.73	245	0.08	1.37	0.8733	
072-04	1.49	245	0.38	0.92	0.9652	
072-05	1.02	239	0.55	1.42	0.7823	Non-logarithmic
073-01	0.43	242	0.28	53.53	0.7597	
073-02	0.89	235	68.37	8.32	0.4704	Non-logarithmic
073-03	1.15	229	1.01	0.73	0.7700	
073-04	0.96	240	0.14	4.49	0.7874	
073-05	0.09	222	0.10	17.89	0.8720	
074-01	1.28	227	0.68	0.39	0.8175	Non-logarithmic
074-02	1.36	219	0.00	54.97	0.3413	
074-03	1.05	217	0.33	1.87	0.8340	
074-04	0.44	211	0.10	19.29	0.2166	Non-logarithmic
075-01	0.57	218	156.41	19.44	0.5159	Non-logarithmic
075-02	1.13	217	0.01	12.62	0.6517	
075-03	1.00	211	0.00	21.33	0.5642	
075-04	1.05	215	0.13	4.13	0.7269	
075-05	1.04	217	0.07	6.99	0.6929	
076-01	0.05	201	0.01	102.68	0.4008	
076-02	0.76	202	0.78	1.34	0.9090	Non-logarithmic
076-03	0.79	202	0.21	7.39	0.8784	
076-04	0.85	189	0.32	4.56	0.7608	
076-05	1.02	184	0.19	3.75	0.9619	
077-01	0.59	175	4.71E+04	107.00	0.4105	Non-logarithmic
077-02	0.82	174	0.01	26.69	0.6103	
077-03	0.82	174	0.10	10.44	0.7943	
077-04	0.79	177	0.01	29.68	0.6631	
077-05	0.80	177	0.02	21.51	0.1223	Non-logarithmic
078-01	0.88	163	0.00	45.86	0.5080	
078-02	0.86	162	0.01	34.23	0.7340	
078-03	0.85	161	0.07	15.68	0.7928	
078-04	0.96	166	0.14	6.57	0.8340	
078-05	0.96	169	0.03	13.90	0.7403	
079-01	0.19	139	1.13	1.41	0.5110	Non-logarithmic
079-02	0.98	150	0.00	31.84	0.6919	
079-03	0.90	149	0.14	8.71	0.8773	
079-04	1.02	149	0.01	24.17	0.6713	
079-05	0.86	142	0.19	7.57	0.8920	
080-01	0.93	148	0.09	10.43	0.8839	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
080-02	1.02	155	0.11	7.04	0.9086	
080-03	0.93	153	0.05	15.29	0.7178	
080-04	0.82	153	0.09	15.86	0.7129	
080-05	0.81	160	0.03	22.55	0.7386	
081-01	0.95	155	0.76	1.54	0.9160	
081-02	1.09	154	0.51	1.69	0.9698	
081-03	1.16	155	0.85	0.52	0.9658	
081-04	1.07	157	0.39	1.70	0.8689	
081-05	0.88	159	0.19	4.21	0.7598	
082-01	0.75	155	0.01	73.25	0.5976	
082-02	0.99	150	0.34	4.92	0.9276	
082-03	0.88	148	0.07	19.04	0.8178	
082-04	0.82	149	0.46	7.15	0.8856	
082-05	0.74	146	1.41	0.40	0.6997	Non-logarithmic
083-01	0.81	157	0.41	7.98	0.8764	
083-02	0.81	157	0.07	24.64	0.8791	
083-03	0.54	173	0.75	4.39	0.9185	
084-01	0.14	311	1.78E+23	1.56E+04	0.0230	Non-logarithmic
084-02	0.53	182	55.61	19.09	0.7356	Non-logarithmic
084-03	0.75	161	0.01	61.43	0.8903	
084-04	0.22	189	0.00	282.28	0.6075	
084-05	0.03	153	1.10	0.94	0.5210	SAV
085-01	0.17	148	0.00	567.96	0.4790	
085-02	0.33	174	0.00	2.83E+04	0.0020	Non-logarithmic
085-03	0.78	165	0.23	12.70	0.9091	
085-04	0.87	164	0.15	12.78	0.7948	
085-05	0.80	164	0.09	18.43	0.8470	
085-06	0.60	162	0.03	54.84	0.6404	
085-09	0.15	165	0.29	1.03E+04	0.9597	
085-10	0.27	163	0.53	180.31	0.8506	
086-02	0.43	163	36.20	8.75	0.7405	Non-logarithmic
086-03	0.48	165	1.13E+03	65.13	0.4788	Non-logarithmic
086-04	0.75	166	4.79E+03	50.99	0.0734	Non-logarithmic
086-05	0.72	164	0.00	97.76	0.2763	
086-06	0.65	164	0.39	6.64	0.7533	
086-07	0.12	193	0.65	24.44	0.8837	
086-08	0.07	261	0.03	322.69	0.6255	
086-09	0.06	60	0.21	161.56	0.8256	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
086-10	0.01	291	0.28	93.70	0.6697	Non-logarithmic
087-01	0.16	307	11.66	33.45	0.9456	Non-logarithmic
087-02	0.59	202	0.60	16.37	0.8836	
087-03	0.77	168	0.04	15.00	0.6531	
087-04	0.74	165	0.00	50.93	0.3950	
087-05	0.64	165	0.01	56.43	0.2464	Non-logarithmic
087-06	0.38	157	0.03	155.93	0.7844	
087-07	0.07	162	19.87	49.88	0.6759	Non-logarithmic
087-08	0.23	165	204.27	218.15	0.4826	Non-logarithmic
087-09	0.07	174	0.01	345.38	0.3794	
087-10	0.14	173	0.20	53.96	0.8217	
088-01	0.08	341	130.93	212.95	0.7782	Non-logarithmic
088-02	0.27	175	1.09E+03	402.56	0.6147	Non-logarithmic
088-03	0.50	173	0.02	82.09	0.5176	
088-04	0.84	170	0.01	48.19	0.5827	
088-05	0.65	169	0.10	28.30	0.8669	
088-06	0.65	169	0.10	28.30	0.8669	
088-07	0.25	152	0.20	84.38	0.7786	
088-08	0.08	175	0.06	232.07	0.7627	
088-09	0.08	184	19.05	86.16	0.5401	Non-logarithmic
088-10	0.15	160	0.15	85.11	0.8611	
089-01	0.14	197	0.01	511.06	0.3909	
089-02	0.32	189	0.01	325.12	0.4122	
089-03	0.53	174	0.04	52.21	0.7622	
089-04	0.80	171	0.08	19.36	0.7308	
089-05	0.73	173	0.02	49.95	0.7247	
089-06	0.62	173	421.50	65.45	0.6375	Non-logarithmic
089-07	0.17	175	0.03	281.25	0.4783	
089-08	0.12	174	0.01	596.20	0.3816	
089-09	0.02	8	0.00	511.89	0.4002	
089-10	0.03	284	0.04	235.35	0.3796	Non-logarithmic
090-01	0.15	214	0.02	319.95	0.6600	
090-02	0.21	160	5.45E+03	639.15	0.4032	Non-logarithmic
090-03	0.35	182	0.33	29.33	0.7089	
090-04	0.57	171	0.79	3.57	0.8798	
090-05	0.57	176	22.66	6.97	0.8478	Non-logarithmic
090-06	0.59	176	217.96	49.06	0.6838	Non-logarithmic
090-07	0.54	172	77.44	32.39	0.7050	Non-logarithmic
090-08	0.19	193	0.19	84.64	0.5632	Non-logarithmic

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
090-09	0.16	192	0.01	434.74	0.3579	
090-10	0.02	306	1.70E+03	630.71	0.6281	Non-logarithmic
091-01	0.16	205	0.00	200.22	0.3027	
091-02	0.46	199	12.06	4.25	0.5117	Non-logarithmic
091-03	0.67	185	0.04	80.61	0.9450	
091-04	0.68	172	12.15	1.09	0.9137	Non-logarithmic
091-05	0.45	168	9.09	8.24	0.5995	Non-logarithmic
091-06	0.44	172	0.10	75.79	0.7117	
091-07	0.45	165	0.24	46.12	0.8288	
091-08	0.44	157	0.62	20.95	0.9421	
091-09	0.32	215	0.11	83.27	0.7964	
091-10	0.16	223	236.85	228.30	0.6509	Non-logarithmic
092-02	0.38	186	0.16	74.48	0.6287	
092-03	0.34	191	0.63	107.23	0.9967	
092-04	0.52	179	0.64	6.97	0.9893	
092-05	0.71	179	0.02	21.65	0.6433	
092-06	0.83	188	53.36	5.28	0.3684	Non-logarithmic
092-07	0.49	184	0.26	35.89	0.8261	
092-08	0.40	179	0.52	23.78	0.8231	
092-09	0.30	171	0.01	311.42	0.6089	
092-10	0.24	232	0.08	115.35	0.5895	
093-01	0.07	246	0.92	6.71E+03	0.7953	Non-logarithmic
093-02	0.36	201	0.34	178.72	0.9949	
093-04	0.70	187	0.20	23.30	0.9852	
093-05	0.47	205	0.14	62.27	0.7934	
093-06	0.61	215	0.32	20.02	0.8551	
093-07	0.60	218	89.92	30.78	0.6133	Non-logarithmic
093-08	0.43	216	0.02	164.79	0.6364	
093-09	0.41	219	0.01	255.30	0.3053	Non-logarithmic
093-10	0.34	221	0.22	53.36	0.8282	
094-01	0.58	191	0.11	23.66	0.7272	
094-02	0.38	215	205.31	141.35	0.5777	Non-logarithmic
094-03	0.37	241	442.52	150.18	0.6387	Non-logarithmic
094-04	0.43	240	0.03	85.49	0.6252	
094-05	0.53	235	0.00	333.21	0.0333	Non-logarithmic
094-06	0.65	234	9.41	4.03	0.3451	Non-logarithmic
094-07	0.66	235	0.17	19.80	0.6402	
094-08	0.53	237	2.04	0.63	0.3768	Non-logarithmic

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
094-09	0.51	240	0.54	11.90	0.4961	Non-logarithmic
094-10	0.51	233	0.19	35.21	0.8014	
095-01	0.43	249	15.80	19.36	0.8270	Non-logarithmic
095-02	0.47	244	0.07	67.25	0.5720	
095-03	0.64	251	0.75	4.24	0.5967	Non-logarithmic
095-04	0.69	245	0.04	44.70	0.8211	
095-05	0.71	246	0.18	18.46	0.9128	
095-06	0.75	243	0.00	115.03	0.4875	
095-07	0.79	242	0.32	9.59	0.8953	
095-08	0.87	241	0.30	7.40	0.9106	
095-09	0.99	240	0.07	12.15	0.7541	
095-10	0.42	255	1.13	6.89	0.8100	Non-logarithmic
096-01	0.32	242	0.01	366.63	0.4875	
096-02	0.52	246	0.23	37.62	0.8335	
096-03	0.58	246	0.28	22.30	0.8888	
096-04	0.65	247	0.32	12.73	0.9614	
096-05	0.72	244	0.39	8.61	0.8897	
096-06	0.73	243	0.60	7.03	0.9336	
096-07	0.82	242	0.77	3.07	0.9516	
096-08	0.85	243	0.75	2.87	0.9510	
096-09	0.93	242	0.14	11.27	0.8385	
096-10	0.99	243	0.18	6.89	0.8399	
097-01	0.32	242	0.11	85.69	0.6962	
097-02	0.39	251	11.16	16.77	0.7630	Non-logarithmic
097-03	0.48	252	0.39	29.35	0.8195	
097-04	0.57	245	0.23	30.11	0.8180	
097-05	0.64	250	0.10	36.37	0.7110	
097-06	0.60	252	0.12	40.23	0.8556	
097-07	0.57	249	0.20	35.25	0.6726	
097-08	0.69	251	0.09	33.85	0.6925	
097-09	0.69	247	0.11	28.37	0.7494	
097-10	0.94	252	0.00	42.66	0.6891	
098-01	0.08	234	2.02	0.02	0.8264	
098-02	0.40	261	0.18	53.50	0.8121	
098-03	0.41	262	0.01	206.42	0.2813	
098-04	0.43	257	0.33	41.03	0.9020	
098-05	0.46	257	0.32	43.11	0.8877	
098-06	0.52	254	0.06	83.03	0.8251	

Table 5-1. ADCP Data Processing Results

Station ID	Mean Current Magnitude (ft/s)	Mean Current Direction (degree)	Apparent Roughness Height	Coefficient of Friction	Correlation Coefficient	Flags
098-07	0.59	257	0.00	152.16	0.5622	
098-08	0.59	258	0.27	26.81	0.9051	
098-09	0.68	258	0.00	315.54	0.4313	
098-10	0.80	259	0.01	55.65	0.2827	
099-01	0.18	265	0.12	108.07	0.5582	
099-02	0.35	258	0.04	167.83	0.5709	
099-03	0.42	263	0.22	49.09	0.7388	
099-04	0.47	264	0.05	106.04	0.7467	
099-05	0.51	263	0.02	109.83	0.8901	
099-06	0.80	258	0.88	4.16	0.9418	
099-07	0.79	260	0.13	19.65	0.8686	
099-08	0.82	254	0.04	29.86	0.7310	
099-09	0.85	257	0.87	3.76	0.8624	
099-10	0.83	256	0.64	4.96	0.7912	
100-01	0.12	244	0.09	159.04	0.5733	
100-02	0.36	269	21.94	37.85	0.4689	Non-logarithmic
100-03	0.44	265	0.02	144.50	0.7244	
100-04	0.54	265	0.13	53.58	0.5502	Non-logarithmic
100-05	0.65	266	0.12	35.31	0.7724	
100-06	0.69	258	0.06	41.98	0.6639	Non-logarithmic
100-07	0.76	260	0.16	18.33	0.8917	
100-08	0.64	256	0.01	110.86	0.5295	
100-09	0.80	256	0.48	7.48	0.9361	
100-10	0.86	257	0.70	2.84	0.9294	

Notes:

Apparent roughness height values are dimensionless.

Correlation coefficient values are from a linear regression of mean velocity profiles with the logarithmic law of the wall equation given in QAPP FSP SOP-3 (ERM et al. 2018)

SAV – submerged aquatic vegetation

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/31/2018	19:09	001-01	4051	100.00	0.00	0.00	0.00	
10/31/2018	18:54	001-02	4048	100.00	0.00	0.00	0.00	
10/31/2018	18:39	001-03	4046	4.17	10.42	85.42	0.00	
10/31/2018	18:30	001-04	4044	12.50	18.75	68.75	0.00	
10/31/2018	18:23	001-05	4042	4.17	16.67	79.17	0.00	
10/31/2018	17:33	002-01	4028	2.56	0.00	97.44	0.00	
10/31/2018	17:43	002-02	4031	0.00	8.51	91.49	0.00	
10/31/2018	17:51	002-03	4034	0.00	0.00	0.00	100.00	
10/31/2018	18:02	002-04	4037	0.00	0.00	100.00	0.00	
10/31/2018	18:08	002-05	4040	16.67	4.17	79.17	0.00	
10/30/2018	22:36	003-01	4009	10.00	2.50	87.50	0.00	
10/31/2018	16:55	003-02	4015	0.00	2.13	97.87	0.00	
10/31/2018	17:03	003-03	4018	0.00	2.08	97.92	0.00	
10/31/2018	17:09	003-04	4021	2.08	16.67	81.25	0.00	
10/31/2018	17:16	003-05	4025	0.00	13.95	86.05	0.00	
10/30/2018	21:37	004-01	3995	2.13	8.51	89.36	0.00	
10/30/2018	21:46	004-02	3997	4.44	13.33	82.22	0.00	
10/30/2018	21:56	004-03	4001	2.08	14.58	83.33	0.00	
10/30/2018	22:05	004-04	4004	2.08	12.50	85.42	0.00	
10/30/2018	22:13	004-05	4006	0.00	0.00	100.00	0.00	
10/30/2018	21:10	005-01	3992	6.25	18.75	75.00	0.00	
10/30/2018	18:58	006-01	3980	10.42	10.42	79.17	0.00	
10/30/2018	19:06	006-02	3983	0.00	18.75	81.25	0.00	
10/30/2018	19:13	006-03	3985	14.58	35.42	50.00	0.00	
10/30/2018	19:19	006-04	3987	12.50	62.50	25.00	0.00	
10/30/2018	19:28	006-05	3989	27.08	10.42	62.50	0.00	
10/30/2018	18:10	007-01	3970	2.08	18.75	79.17	0.00	
10/30/2018	18:16	007-02	3972	4.17	2.08	93.75	0.00	
10/30/2018	18:26	007-03	3974	4.17	33.33	62.50	0.00	
10/30/2018	18:34	007-04	3976	0.00	66.67	33.33	0.00	
10/30/2018	18:41	007-05	3978	0.00	0.00	2.08	97.92	
10/30/2018	17:19	008-01	3957	0.00	10.42	89.58	0.00	
10/30/2018	17:27	008-02	3960	2.08	22.92	75.00	0.00	
10/30/2018	17:34	008-03	3963	4.17	6.25	89.58	0.00	
10/30/2018	17:40	008-04	3965	10.42	29.17	60.42	0.00	
10/30/2018	17:47	008-05	3967	6.52	6.52	86.96	0.00	
10/30/2018	16:35	009-01	3947	12.50	6.25	81.25	0.00	
10/30/2018	16:43	009-02	3949	8.33	62.50	29.17	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/30/2018	16:50	009-03	3951	0.00	4.17	95.83	0.00	
10/30/2018	16:57	009-04	3953	0.00	0.00	100.00	0.00	
10/30/2018	17:04	009-05	3955	0.00	0.00	100.00	0.00	
10/29/2018	23:04	010-01	3936	14.58	2.08	83.33	0.00	
10/29/2018	23:11	010-02	3938	4.17	8.33	87.50	0.00	
10/29/2018	23:19	010-03	3940	2.08	6.25	91.67	0.00	
10/29/2018	23:28	010-04	3942	6.25	0.00	93.75	0.00	
10/29/2018	23:34	010-05	3944	0.00	0.00	0.00	100.00	
10/29/2018	22:50	011-01	3934	0.00	4.17	95.83	0.00	
10/29/2018	22:43	011-02	3932	4.17	4.17	91.67	0.00	
10/29/2018	22:35	011-03	3930	0.00	0.00	0.00	100.00	
10/29/2018	22:28	011-04	3928	0.00	0.00	0.00	100.00	
10/29/2018	22:21	011-05	3926	97.92	2.08	0.00	0.00	
10/29/2018	22:04	012-04	3924	0.00	6.25	93.75	0.00	
10/29/2018	21:52	012-05	3922	0.00	31.25	68.75	0.00	
7/11/2019	12:17	013-01	4110	0.00	6.25	93.75	0.00	
10/15/2018	17:30	013-02	3145	0.00	14.29	85.71	0.00	
10/15/2018	17:45	013-03	3147	4.88	15.85	79.27	0.00	
10/15/2018	18:02	013-04	3149	67.59	32.41	0.00	0.00	
10/15/2018	21:54	013-05	3175	2.08	33.33	64.58	0.00	
10/15/2018	22:11	013-06	3177	0.00	24.39	75.61	0.00	
10/15/2018	22:27	013-07	3179	0.00	10.42	33.33	56.25	
7/11/2019	12:36	013-09	4115	0.00	0.00	0.00	100.00	
7/11/2019	12:49	013-10	4118	0.00	0.00	18.75	81.25	
10/13/2018	18:18	014-01	3091	4.17	6.25	89.58	0.00	
10/13/2018	18:55	014-02	3096	4.17	10.42	85.42	0.00	
10/13/2018	19:04	014-03	3098	0.00	12.50	87.50	0.00	
10/13/2018	19:21	014-04	3100	0.00	8.33	91.67	0.00	
10/13/2018	19:38	014-05	3106	0.00	2.08	97.92	0.00	
10/13/2018	19:52	014-06	3109	0.00	6.25	93.75	0.00	
10/13/2018	21:33	015-01	3123	0.00	14.58	85.42	0.00	
10/13/2018	21:44	015-02	3125	0.00	10.42	89.58	0.00	
10/13/2018	21:52	015-03	3128	2.13	12.77	85.11	0.00	
10/13/2018	22:01	015-04	3130	0.00	10.42	89.58	0.00	
10/13/2018	22:18	015-05	3136	0.00	22.92	77.08	0.00	
10/15/2018	16:49	015-06	3139	2.44	34.15	63.41	0.00	
10/15/2018	16:58	015-07	3141	3.23	19.35	77.42	0.00	
10/15/2018	17:09	015-08	3143	1.04	10.42	88.54	0.00	
7/11/2019	11:16	015-10	4108	18.75	22.92	58.33	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/15/2018	18:28	016-01	3152	0.00	10.42	89.58	0.00	
10/15/2018	18:38	016-02	3154	0.00	14.58	85.42	0.00	
10/15/2018	18:51	016-03	3156	0.00	10.64	89.36	0.00	
10/15/2018	19:03	016-04	3159	0.00	14.58	85.42	0.00	
10/15/2018	19:13	016-05	3161	0.00	25.00	75.00	0.00	
10/15/2018	19:57	016-06	3163	4.26	23.40	72.34	0.00	
10/15/2018	20:08	016-07	3165	2.08	39.58	58.33	0.00	
10/15/2018	20:28	016-08	3167	33.33	52.08	14.58	0.00	
10/15/2018	20:52	016-09	3170	62.50	22.92	14.58	0.00	
10/15/2018	21:14	016-10	3173	43.75	0.00	56.25	0.00	
10/13/2018	21:20	017-01	3120	0.00	31.25	68.75	0.00	
10/13/2018	21:10	017-02	3118	4.17	27.08	68.75	0.00	
10/13/2018	20:51	017-06	3115	0.00	29.17	70.83	0.00	
10/13/2018	20:32	017-07	3113	0.00	6.25	93.75	0.00	
10/12/2018	22:55	017-08	3079	41.67	14.58	43.75	0.00	
10/12/2018	22:38	017-09	3076	100.00	0.00	0.00	0.00	
10/12/2018	22:15	017-10	3070	17.02	29.79	53.19	0.00	
7/11/2019	14:01	018-01	4125	27.08	6.25	66.67	0.00	
7/11/2019	13:54	018-02	4122	0.00	16.67	83.33	0.00	
10/12/2018	20:56	018-03	3060	4.17	12.50	83.33	0.00	
10/12/2018	21:11	018-04	3062	0.00	18.75	81.25	0.00	
10/12/2018	21:29	018-05	3064	0.00	6.67	82.22	11.11	
10/12/2018	21:43	018-06	3066	0.00	2.08	50.00	47.92	
10/12/2018	21:55	018-07	3068	0.00	56.25	12.50	31.25	
7/11/2019	14:12	018-08	4127	0.00	0.00	0.00	0.00	SAV
7/11/2019	14:18	018-09	4129	0.00	0.00	0.00	100.00	
7/11/2019	14:24	018-10	4131	0.00	0.00	0.00	100.00	SAV
7/11/2019	13:42	019-03	4120	27.08	6.25	66.67	0.00	
10/12/2018	18:59	019-04	3050	12.50	25.00	62.50	0.00	
10/12/2018	19:13	019-05	3052	0.00	17.00	83.00	0.00	
10/12/2018	19:28	019-06	3054	0.00	6.25	93.75	0.00	
10/12/2018	19:45	019-07	3056	0.00	10.42	89.58	0.00	
10/12/2018	19:56	019-08	3058	22.92	10.42	66.67	0.00	
10/12/2018	16:57	020-01	3028	14.58	22.92	62.50	0.00	
10/12/2018	17:10	020-03	3031	100.00	0.00	0.00	0.00	
10/12/2018	17:20	020-04	3033	27.08	70.83	2.08	0.00	
10/12/2018	17:35	020-05	3036	4.17	22.92	72.92	0.00	
10/12/2018	17:52	020-06	3038	0.00	20.83	79.17	0.00	
10/12/2018	18:03	020-07	3041	0.00	27.08	72.92	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/12/2018	18:21	020-08	3045	0.00	20.00	80.00	0.00	
10/12/2018	18:32	020-09	3048	0.00	12.50	87.50	0.00	
7/11/2019	14:34	020-10	4133	0.00	25.00	75.00	0.00	
10/29/2018	21:31	021-01	3920	100.00	0.00	0.00	0.00	
10/29/2018	21:19	021-02	3917	6.25	29.17	64.58	0.00	
10/29/2018	21:06	021-03	3914	2.08	16.67	81.25	0.00	
10/29/2018	20:53	021-04	3912	0.00	20.83	79.17	0.00	
10/29/2018	20:44	021-05	3910	0.00	8.33	91.67	0.00	
10/29/2018	18:46	022-01	3901	0.00	25.00	75.00	0.00	
10/29/2018	18:55	022-02	3903	0.00	16.67	83.33	0.00	
10/29/2018	19:08	022-04	3905	14.58	41.67	43.75	0.00	
10/29/2018	19:17	022-05	3907	6.25	79.17	14.58	0.00	
10/29/2018	18:24	023-01	3899	0.00	14.58	85.42	0.00	
10/29/2018	18:15	023-02	3897	6.25	20.83	72.92	0.00	
10/29/2018	18:08	023-03	3895	6.38	10.64	82.98	0.00	
10/29/2018	17:59	023-04	3893	2.08	14.58	83.33	0.00	
10/29/2018	17:50	023-05	3891	4.17	29.17	66.67	0.00	
10/29/2018	17:37	024-02	3889	0.00	0.00	0.00	100.00	
10/29/2018	17:28	024-03	3886	0.00	0.00	0.00	100.00	
10/29/2018	17:18	024-04	3884	0.00	0.00	0.00	100.00	
10/29/2018	17:10	024-05	3882	18.18	4.55	77.27	0.00	
10/29/2018	16:13	025-01	3872	2.08	4.17	85.42	8.33	
10/29/2018	16:24	025-02	3874	4.17	4.17	91.67	0.00	
10/29/2018	16:33	025-03	3876	6.25	2.08	91.67	0.00	
10/29/2018	16:42	025-04	3878	0.00	6.25	93.75	0.00	
10/29/2018	16:50	025-05	3880	2.08	10.42	87.50	0.00	
10/26/2018	22:59	026-01	3843	14.58	75.00	10.42	0.00	
10/26/2018	23:06	026-02	3845	0.00	18.75	81.25	0.00	
10/26/2018	23:13	026-03	3847	0.00	0.00	100.00	0.00	
10/26/2018	23:28	026-04	3849	0.00	14.58	85.42	0.00	
10/26/2018	23:39	026-05	3851	0.00	2.08	97.92	0.00	
10/26/2018	22:45	027-01	3841	14.58	12.50	72.92	0.00	
10/26/2018	22:38	027-02	3839	0.00	25.00	75.00	0.00	
10/26/2018	22:30	027-03	3837	2.08	12.50	85.42	0.00	
10/26/2018	22:22	027-04	3835	0.00	18.75	81.25	0.00	
10/26/2018	22:12	027-05	3833	12.77	6.38	80.85	0.00	
10/26/2018	21:22	028-01	3823	44.19	4.65	51.16	0.00	SAV
10/26/2018	21:31	028-02	3825	2.08	14.58	83.33	0.00	
10/26/2018	21:41	028-03	3827	0.00	16.67	83.33	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/26/2018	21:50	028-04	3829	0.00	18.75	81.25	0.00	
10/26/2018	21:59	028-05	3831	2.13	38.30	59.57	0.00	
10/26/2018	20:30	029-01	3812	0.00	10.42	89.58	0.00	
10/26/2018	20:40	029-02	3814	4.17	4.17	91.67	0.00	
10/26/2018	20:50	029-03	3816	2.08	14.58	83.33	0.00	
10/26/2018	21:01	029-04	3819	0.00	18.75	81.25	0.00	
10/26/2018	21:08	029-05	3821	0.00	16.67	83.33	0.00	
10/25/2018	22:41	030-01	3800	2.08	2.08	95.83	0.00	
10/25/2018	22:51	030-02	3802	2.08	12.50	85.42	0.00	
10/25/2018	22:59	030-03	3804	16.67	16.67	66.67	0.00	
10/25/2018	22:19	030-04	3806	14.58	43.75	41.67	0.00	
10/25/2018	22:29	030-05	3808	14.58	54.17	31.25	0.00	
10/25/2018	21:26	031-01	3790	18.75	22.92	58.33	0.00	
10/25/2018	21:11	031-02	3787	4.17	20.83	75.00	0.00	
10/25/2018	21:51	031-03	3792	0.00	12.50	87.50	0.00	
10/25/2018	21:10	031-04	3795	10.64	38.30	51.06	0.00	
10/25/2018	22:24	031-05	3798	89.58	6.25	4.17	0.00	
10/25/2018	20:01	032-01	3784	100.00	0.00	0.00	0.00	SAV
10/25/2018	19:49	032-02	3782	27.08	14.58	58.33	0.00	
10/25/2018	19:40	032-03	3780	8.33	22.92	68.75	0.00	
10/25/2018	19:28	032-04	3778	4.17	41.67	54.17	0.00	
10/25/2018	19:18	032-05	3776	0.00	6.25	93.75	0.00	
10/25/2018	19:00	033-01	3774	25.00	35.42	39.58	0.00	
10/25/2018	18:47	033-02	3772	0.00	31.58	68.42	0.00	
10/25/2018	18:36	033-03	3770	2.08	10.42	87.50	0.00	
10/25/2018	18:25	033-04	3768	0.00	27.08	72.92	0.00	
10/25/2018	18:15	033-05	3765	2.08	39.58	58.33	0.00	
10/25/2018	17:55	034-01	3763	79.17	12.50	8.33	0.00	
10/25/2018	17:37	034-02	3761	0.00	0.00	0.00	0.00	SAV
10/20/2018	23:18	034-03	3516	0.00	6.25	93.75	0.00	
10/20/2018	23:09	034-04	3512	2.08	18.75	79.17	0.00	
10/25/2018	17:24	034-05	3759	0.00	31.25	68.75	0.00	
10/20/2018	22:56	035-01	3510	2.08	20.83	77.08	0.00	
10/20/2018	22:46	035-02	3508	0.00	18.75	81.25	0.00	
10/20/2018	22:36	035-03	3506	0.00	18.75	81.25	0.00	
10/20/2018	22:27	035-04	3504	0.00	50.00	50.00	0.00	
10/20/2018	22:14	035-05	3502	0.00	20.83	79.17	0.00	
10/20/2018	21:10	036-01	3491	0.00	41.67	58.33	0.00	
10/20/2018	21:27	036-02	3494	4.17	37.50	58.33	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/20/2018	21:38	036-03	3496	6.25	29.17	64.58	0.00	
10/20/2018	21:47	036-04	3498	100.00	0.00	0.00	0.00	
10/20/2018	21:59	036-05	3500	100.00	0.00	0.00	0.00	SAV
10/20/2018	20:48	037-01	3489	2.08	12.50	85.42	0.00	
10/22/2018	19:36	037-02	3616	0.00	10.42	89.58	0.00	
10/22/2018	19:45	037-03	3618	2.08	6.25	91.67	0.00	
10/22/2018	19:55	037-04	3620	0.00	50.00	50.00	0.00	
10/22/2018	20:04	037-05	3622	0.00	16.67	83.33	0.00	
10/20/2018	19:34	038-04	3486	6.25	0.00	0.00	93.75	
10/20/2018	19:28	038-05	3484	0.00	2.08	4.17	93.75	
10/20/2018	18:41	039-01	3476	0.00	0.00	0.00	100.00	
10/20/2018	18:49	039-02	3478	0.00	0.00	0.00	100.00	
10/20/2018	18:59	039-03	3480	4.17	0.00	2.08	93.75	
10/22/2018	19:10	039-04	3904	0.00	0.00	0.00	100.00	
10/20/2018	19:10	039-05	3482	0.00	91.67	8.33	0.00	
10/20/2018	17:57	040-01	3470	0.00	0.00	0.00	100.00	
10/20/2018	18:09	040-02	3472	10.42	18.75	70.83	0.00	
10/22/2018	18:50	040-03	3613	22.92	52.08	25.00	0.00	
10/22/2018	18:41	040-04	3611	100.00	0.00	0.00	0.00	
10/20/2018	18:23	040-05	3474	100.00	0.00	0.00	0.00	
10/20/2018	17:42	041-01	3467	79.17	6.25	14.58	0.00	
10/20/2018	17:32	041-02	3465	2.08	31.25	66.67	0.00	
10/20/2018	17:20	041-03	3463	0.00	35.42	64.58	0.00	
10/22/2018	18:23	041-04	3609	4.44	28.89	66.67	0.00	
10/20/2018	17:08	041-05	3462	6.25	10.42	83.33	0.00	
10/20/2018	16:41	042-01	3458	16.67	58.33	25.00	0.00	
10/20/2018	16:51	042-02	3460	4.17	20.83	75.00	0.00	
10/22/2018	17:47	042-03	3603	16.67	47.92	35.42	0.00	
10/22/2018	17:59	042-04	3605	0.00	60.42	39.58	0.00	
10/22/2018	18:08	042-05	3607	0.00	0.00	100.00	0.00	
10/19/2018	22:07	043-01	3451	10.42	0.00	0.00	89.58	
10/19/2018	22:17	043-02	3453	0.00	2.08	4.17	93.75	
10/22/2018	17:27	043-03	3601	6.25	12.50	81.25	0.00	
10/22/2018	17:16	043-04	3599	0.00	4.17	95.83	0.00	
10/19/2018	22:28	043-05	3455	89.58	10.42	0.00	0.00	
10/19/2018	21:48	044-01	3448	100.00	0.00	0.00	0.00	
10/19/2018	21:34	044-02	3446	100.00	0.00	0.00	0.00	
10/19/2018	21:24	044-03	3444	6.25	85.42	8.33	0.00	
10/19/2018	21:14	044-04	3442	4.17	4.17	91.67	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/19/2018	20:58	044-05	3440	4.17	6.25	89.58	0.00	
10/19/2018	20:44	045-01	3438	41.67	2.08	56.25	0.00	
10/19/2018	20:30	045-02	3436	31.25	6.25	62.50	0.00	
10/22/2018	16:33	045-03	3593	4.17	2.08	93.75	0.00	
10/22/2018	16:44	045-04	3595	12.50	2.08	85.42	0.00	
10/22/2018	16:55	045-05	3597	62.50	2.08	35.42	0.00	
10/19/2018	19:18	046-01	3433	100.00	0.00	0.00	0.00	
10/21/2018	23:37	046-02	3589	2.08	93.75	4.17	0.00	
10/21/2018	23:05	046-03	3583	2.08	85.42	12.50	0.00	
10/21/2018	23:15	046-04	3585	8.33	87.50	4.17	0.00	
10/21/2018	23:25	046-05	3587	100.00	0.00	0.00	0.00	
10/19/2018	19:04	047-01	3431	85.42	0.00	14.58	0.00	SAV
10/19/2018	18:38	047-02	3429	0.00	0.00	0.00	0.00	SAV
10/19/2018	18:26	047-03	3427	10.42	18.75	70.83	0.00	
10/19/2018	18:12	047-04	3424	6.25	12.50	81.25	0.00	
10/21/2018	22:50	047-05	3581	100.00	0.00	0.00	0.00	
10/19/2018	17:50	048-01	3422	75.00	4.17	20.83	0.00	SAV
10/19/2018	17:38	048-02	3420	35.42	31.25	33.33	0.00	
10/19/2018	17:30	048-03	3418	56.25	4.17	39.58	0.00	
10/19/2018	17:21	048-04	3416	47.92	6.25	45.83	0.00	
10/19/2018	17:12	048-05	3414	33.33	2.08	64.58	0.00	
10/19/2018	16:55	048-06	3412	34.04	6.38	59.57	0.00	
10/21/2018	22:26	048-07	3578	29.17	8.33	62.50	0.00	
10/19/2018	16:45	048-08	3410	33.33	6.25	60.42	0.00	
10/19/2018	16:35	048-09	3408	41.67	10.42	47.92	0.00	
10/19/2018	16:26	048-10	3406	0.00	0.00	0.00	0.00	SAV
10/18/2018	22:31	049-01	3385	89.58	0.00	10.42	0.00	SAV
10/18/2018	22:43	049-02	3386	25.00	56.25	18.75	0.00	
10/18/2018	22:51	049-03	3389	25.00	31.25	43.75	0.00	
10/18/2018	23:00	049-04	3391	14.58	16.67	68.75	0.00	
10/18/2018	23:09	049-05	3393	10.42	12.50	77.08	0.00	
10/18/2018	23:17	049-06	3396	31.25	18.75	50.00	0.00	
10/18/2018	23:25	049-07	3398	18.75	4.17	77.08	0.00	
10/18/2018	23:34	049-08	3400	22.92	10.42	66.67	0.00	
10/21/2018	22:07	049-09	3576	22.92	12.50	64.58	0.00	
10/19/2018	16:11	049-10	3404	95.83	2.08	2.08	0.00	
10/18/2018	22:18	050-01	3383	0.00	0.00	0.00	0.00	SAV
10/18/2018	22:06	050-02	3381	66.67	16.67	16.67	0.00	
10/18/2018	21:58	050-03	3379	18.75	45.83	35.42	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/18/2018	21:49	050-04	3377	14.58	18.75	66.67	0.00	
10/18/2018	21:34	050-05	3374	10.42	14.58	75.00	0.00	
10/18/2018	21:21	050-06	3372	10.64	34.04	55.32	0.00	
10/18/2018	21:11	050-07	3370	6.67	26.67	62.22	4.44	
10/21/2018	21:38	050-08	3572	2.08	16.67	81.25	0.00	
10/21/2018	21:50	050-09	3574	10.42	6.25	83.33	0.00	
10/18/2018	20:59	050-10	3368	18.75	29.17	52.08	0.00	
10/18/2018	18:48	051-02	3353	100.00	0.00	0.00	0.00	SAV
10/18/2018	18:59	051-03	3355	41.67	43.75	14.58	0.00	
10/18/2018	19:09	051-04	3357	27.08	35.42	37.50	0.00	
10/18/2018	19:18	051-05	3359	66.67	4.17	29.17	0.00	
10/18/2018	19:29	051-06	3361	18.75	22.92	58.33	0.00	
10/18/2018	20:36	051-07	3364	0.00	29.17	70.83	0.00	
10/21/2018	21:24	051-08	3570	12.50	6.25	81.25	0.00	
10/21/2018	20:14	051-09	3568	4.17	14.58	81.25	0.00	
10/18/2018	20:47	051-10	3366	39.58	41.67	18.75	0.00	
10/18/2018	18:26	052-02	3350	0.00	0.00	0.00	0.00	SAV
10/18/2018	18:00	052-03	3348	0.00	0.00	0.00	0.00	SAV
10/18/2018	17:40	052-04	3346	0.00	0.00	0.00	0.00	SAV
10/18/2018	17:27	052-05	3344	100.00	0.00	0.00	0.00	SAV
10/18/2018	17:15	052-06	3342	39.58	56.25	4.17	0.00	
10/18/2018	17:04	052-07	3340	31.25	20.83	47.92	0.00	
10/18/2018	16:54	052-08	3338	14.58	31.25	54.17	0.00	
10/21/2018	20:00	052-09	3566	2.08	6.25	91.67	0.00	
10/18/2018	16:42	052-10	3336	17.02	6.38	76.60	0.00	
10/17/2018	22:52	053-02	3320	91.67	0.00	8.33	0.00	
10/17/2018	23:01	053-03	3322	100.00	0.00	0.00	0.00	
10/17/2018	23:11	053-04	3324	100.00	0.00	0.00	0.00	
10/17/2018	23:19	053-05	3326	29.79	34.04	36.17	0.00	
10/17/2018	23:29	053-06	3328	81.25	8.33	10.42	0.00	
10/18/2018	16:13	053-07	3332	6.25	14.58	79.17	0.00	
10/21/2018	19:34	053-08	3561	4.17	22.92	72.92	0.00	
10/21/2018	19:45	053-09	3563	0.00	12.50	87.50	0.00	
10/18/2018	16:25	053-10	3334	35.42	35.42	29.17	0.00	
10/17/2018	22:29	054-02	3317	58.33	2.08	39.58	0.00	
10/21/2018	19:19	054-03	3559	8.33	75.00	16.67	0.00	
10/21/2018	19:08	054-04	3557	41.67	12.50	45.83	0.00	
10/21/2018	19:00	054-05	3555	88.89	6.67	4.44	0.00	
10/21/2018	18:49	054-06	3553	14.58	8.33	39.58	37.50	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/17/2018	22:17	054-07	3315	14.58	37.50	47.92	0.00	
10/21/2018	18:37	054-08	3551	0.00	27.08	72.92	0.00	
10/17/2018	22:05	054-09	3313	2.08	14.58	83.33	0.00	
10/17/2018	21:54	054-10	3311	100.00	0.00	0.00	0.00	
10/17/2018	20:57	055-01	3302	6.25	85.42	8.33	0.00	
10/17/2018	21:11	055-02	3304	10.42	6.25	83.33	0.00	
10/21/2018	17:26	055-03	3533	43.75	27.08	29.17	0.00	
10/21/2018	17:39	055-04	3536	31.25	20.83	47.92	0.00	
10/21/2018	17:54	055-05	3539	100.00	0.00	0.00	0.00	
10/21/2018	18:03	055-06	3542	12.50	29.17	58.33	0.00	
10/21/2018	18:13	055-07	3545	0.00	33.33	66.67	0.00	
10/21/2018	18:22	055-08	3548	2.08	16.67	81.25	0.00	
10/17/2018	21:31	055-09	3307	27.08	18.75	54.17	0.00	
10/17/2018	21:43	055-10	3309	72.92	4.17	22.92	0.00	
10/17/2018	20:46	056-01	3300	8.33	35.42	56.25	0.00	
10/16/2018	22:43	056-02	3250	40.43	12.77	46.81	0.00	
10/16/2018	22:54	056-03	3252	2.08	29.17	68.75	0.00	
10/16/2018	23:03	056-04	3254	4.17	43.75	52.08	0.00	
10/16/2018	23:12	056-05	3256	2.08	41.67	56.25	0.00	
10/16/2018	23:23	056-06	3258	0.00	34.09	65.91	0.00	
10/16/2018	23:32	056-07	3260	6.25	6.25	87.50	0.00	
10/17/2018	19:36	056-08	3297	100.00	0.00	0.00	0.00	
10/17/2018	19:29	056-09	3295	100.00	0.00	0.00	0.00	SAV
10/17/2018	19:09	056-10	3293	100.00	0.00	0.00	0.00	SAV
10/17/2018	18:01	057-01	3279	8.33	58.33	33.33	0.00	
10/16/2018	22:30	057-02	3248	0.00	100.00	0.00	0.00	
10/16/2018	22:20	057-03	3246	8.33	58.33	33.33	0.00	
10/16/2018	22:08	057-04	3243	0.00	0.00	0.00	100.00	
10/16/2018	21:58	057-05	3241	2.08	35.42	62.50	0.00	
10/17/2018	18:13	057-06	3281	6.25	16.67	77.08	0.00	
10/17/2018	18:22	057-07	3283	6.25	0.00	93.75	0.00	
10/17/2018	18:35	057-08	3285	20.83	22.92	56.25	0.00	
10/17/2018	18:43	057-09	3287	100.00	0.00	0.00	0.00	
10/17/2018	18:55	057-10	3290	100.00	0.00	0.00	0.00	SAV
10/17/2018	17:50	058-01	3277	22.92	56.25	20.83	0.00	
10/16/2018	20:27	058-02	3228	0.00	100.00	0.00	0.00	
10/16/2018	20:44	058-03	3230	2.08	35.42	62.50	0.00	
10/16/2018	21:02	058-04	3233	10.42	47.92	41.67	0.00	
10/16/2018	21:13	058-05	3235	4.17	68.75	27.08	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/16/2018	21:25	058-06	3237	8.33	0.00	60.42	31.25	
10/16/2018	21:37	058-07	3239	6.25	8.33	81.25	4.17	
10/17/2018	17:39	058-08	3275	14.58	4.17	81.25	0.00	
10/17/2018	17:28	058-09	3273	50.00	0.00	50.00	0.00	
10/17/2018	17:17	058-10	3271	0.00	0.00	0.00	0.00	SAV
10/17/2018	16:50	059-01	3267	100.00	0.00	0.00	0.00	
10/16/2018	19:16	059-02	3225	18.75	12.50	29.17	39.58	
10/16/2018	19:06	059-03	3223	100.00	0.00	0.00	0.00	
10/16/2018	18:54	059-04	3221	100.00	0.00	0.00	0.00	
10/16/2018	18:40	059-05	3218	76.60	6.38	17.02	0.00	
10/21/2018	17:09	059-06	3530	97.92	2.08	0.00	0.00	
10/21/2018	17:00	059-07	3527	0.00	52.08	47.92	0.00	
10/16/2018	18:14	059-08	3216	4.26	4.26	91.49	0.00	
10/16/2018	18:04	059-09	3214	0.00	0.00	0.00	100.00	
10/17/2018	17:02	059-10	3269	31.25	2.08	66.67	0.00	
10/17/2018	16:30	060-01	3263	83.33	14.58	2.08	0.00	
10/17/2018	16:38	060-02	3265	100.00	0.00	0.00	0.00	
10/16/2018	16:24	060-03	3202	100.00	0.00	0.00	0.00	
10/16/2018	16:36	060-04	3204	100.00	0.00	0.00	0.00	
10/16/2018	16:47	060-05	3206	83.33	0.00	16.67	0.00	
10/16/2018	17:01	060-06	3208	100.00	0.00	0.00	0.00	
10/21/2018	16:34	060-07	3520	0.00	93.75	6.25	0.00	
10/21/2018	16:51	060-08	3524	0.00	0.00	100.00	0.00	
10/16/2018	17:36	060-09	3210	6.67	2.22	91.11	0.00	
10/16/2018	17:50	060-10	3212	60.42	2.08	37.50	0.00	
10/23/2018	16:19	061-01	3646	56.25	4.17	39.58	0.00	
10/23/2018	16:28	061-02	3647	29.17	0.00	70.83	0.00	
10/22/2018	22:19	061-03	3628	22.92	6.25	70.83	0.00	
10/22/2018	22:09	061-04	3626	0.00	14.58	85.42	0.00	
10/23/2018	16:41	061-05	3650	0.00	16.67	83.33	0.00	
10/23/2018	17:06	062-01	3654	27.08	6.25	66.67	0.00	
10/23/2018	16:56	062-02	3652	64.58	2.08	33.33	0.00	
10/22/2018	23:03	062-03	3634	89.58	10.42	0.00	0.00	
10/22/2018	22:50	062-04	3632	85.42	14.58	0.00	0.00	
10/22/2018	22:38	062-05	3630	100.00	0.00	0.00	0.00	
10/23/2018	17:20	063-01	3656	4.17	81.25	14.58	0.00	
10/22/2018	23:20	063-02	3636	12.50	4.17	83.33	0.00	
10/22/2018	23:30	063-03	3638	41.67	4.17	54.17	0.00	
10/22/2018	23:39	063-04	3640	16.67	12.50	70.83	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/22/2018	23:47	063-05	3642	31.91	0.00	68.09	0.00	
10/23/2018	17:33	064-01	3658	12.50	4.17	83.33	0.00	
10/23/2018	17:42	064-02	3660	8.33	6.25	85.42	0.00	
10/24/2018	22:59	064-03	3750	4.17	0.00	95.83	0.00	
10/24/2018	23:09	064-04	3752	93.75	0.00	6.25	0.00	
10/24/2018	23:22	064-05	3754	22.92	8.33	68.75	0.00	
10/23/2018	18:09	065-01	3664	100.00	0.00	0.00	0.00	
10/23/2018	18:00	065-02	3662	0.00	0.00	100.00	0.00	
10/24/2018	22:39	065-03	3747	6.25	4.17	81.25	8.33	
10/24/2018	22:20	065-04	3745	14.58	10.42	75.00	0.00	
10/24/2018	22:11	065-05	3743	100.00	0.00	0.00	0.00	
10/24/2018	21:20	066-01	3735	31.25	6.25	62.50	0.00	
10/24/2018	21:32	066-02	3737	18.75	6.25	75.00	0.00	
10/24/2018	21:42	066-03	3739	14.58	0.00	85.42	0.00	
10/24/2018	21:53	066-04	3741	31.25	12.50	56.25	0.00	
10/23/2018	18:28	066-05	3666	100.00	0.00	0.00	0.00	
10/23/2018	22:44	067-01	3686	39.58	29.17	31.25	0.00	
10/24/2018	20:52	067-02	3732	2.08	2.08	95.83	0.00	
10/23/2018	23:04	067-03	3689	2.08	4.17	93.75	0.00	
10/23/2018	23:19	067-04	3692	35.42	8.33	56.25	0.00	
10/23/2018	23:29	067-05	3695	31.25	2.08	66.67	0.00	
10/24/2018	19:22	068-01	3727	22.92	12.50	64.58	0.00	
10/24/2018	19:33	068-02	3729	95.83	0.00	4.17	0.00	
10/23/2018	21:42	068-03	3680	0.00	0.00	0.00	100.00	
10/23/2018	22:02	068-04	3682	0.00	0.00	0.00	0.00	SAV
10/23/2018	22:14	068-05	3684	0.00	0.00	0.00	0.00	SAV
10/24/2018	18:59	069-01	3723	14.58	10.42	75.00	0.00	
10/24/2018	19:08	069-02	3725	33.33	6.25	60.42	0.00	
10/23/2018	21:06	069-03	3676	72.92	0.00	27.08	0.00	
10/23/2018	21:18	069-04	3678	0.00	0.00	0.00	0.00	SAV
10/24/2018	18:15	070-01	3715	25.00	6.25	68.75	0.00	
10/24/2018	18:24	070-02	3717	2.08	16.67	81.25	0.00	
10/24/2018	18:33	070-03	3719	4.17	45.83	50.00	0.00	
10/24/2018	18:42	070-04	3721	18.75	0.00	81.25	0.00	
10/23/2018	20:49	070-05	3674	10.42	2.08	87.50	0.00	
10/23/2018	20:23	071-01	3670	100.00	0.00	0.00	0.00	
10/24/2018	18:01	071-02	3713	100.00	0.00	0.00	0.00	
10/24/2018	17:49	071-03	3711	31.25	62.50	6.25	0.00	
10/24/2018	17:40	071-04	3709	0.00	0.00	0.00	100.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/23/2018	20:34	071-05	3672	0.00	0.00	0.00	100.00	
10/24/2018	16:47	072-01	3699	62.50	0.00	37.50	0.00	
10/24/2018	16:57	072-02	3701	14.58	0.00	0.00	85.42	
10/24/2018	17:06	072-03	3703	0.00	0.00	0.00	100.00	
10/24/2018	17:17	072-04	3705	14.58	8.33	68.75	8.33	
10/24/2018	17:26	072-05	3707	41.67	4.17	54.17	0.00	
10/11/2018	22:32	073-01	3014	41.67	12.50	45.83	0.00	
10/11/2018	21:56	073-02	3011	60.42	0.00	10.42	29.17	
10/11/2018	21:39	073-03	3009	100.00	0.00	0.00	0.00	
10/11/2018	21:27	073-04	3007	72.92	2.08	25.00	0.00	
10/11/2018	22:56	073-05	3016	87.50	0.00	12.50	0.00	SAV
10/11/2018	20:13	074-01	3000	0.00	0.00	0.00	100.00	
10/11/2018	20:30	074-02	3003	14.58	0.00	27.08	58.33	
10/11/2018	20:41	074-03	3005	93.75	0.00	6.25	0.00	
10/11/2018	23:12	074-04	3018	54.17	16.67	29.17	0.00	
10/11/2018	23:29	075-01	3020	22.92	8.33	68.75	0.00	
10/11/2018	19:18	075-02	2990	12.50	37.50	50.00	0.00	
10/11/2018	19:31	075-03	2992	4.17	58.33	37.50	0.00	
10/11/2018	19:40	075-04	2994	18.75	18.75	62.50	0.00	
10/11/2018	19:50	075-05	2996	100.00	0.00	0.00	0.00	
10/11/2018	23:44	076-01	3022	100.00	0.00	0.00	0.00	
10/11/2018	18:52	076-02	2988	10.42	4.17	62.50	22.92	
10/11/2018	18:42	076-03	2986	18.75	0.00	81.25	0.00	
10/11/2018	18:31	076-04	2984	8.33	10.42	81.25	0.00	
10/11/2018	18:20	076-05	2982	100.00	0.00	0.00	0.00	
10/12/2018	0:00	077-01	3024	18.75	2.08	79.17	0.00	
10/11/2018	17:29	077-02	2974	89.58	2.08	8.33	0.00	
10/11/2018	17:42	077-03	2976	41.67	4.17	54.17	0.00	
10/11/2018	17:53	077-04	2978	22.92	0.00	77.08	0.00	
10/11/2018	18:05	077-05	2980	53.85	0.00	46.15	0.00	
10/10/2018	21:29	078-01	2934	54.17	2.08	43.75	0.00	
10/10/2018	21:41	078-02	2936	0.00	2.08	97.92	0.00	
10/10/2018	20:18	078-03	2928	45.83	8.33	37.50	8.33	
10/10/2018	20:31	078-04	2930	20.83	2.08	77.08	0.00	
10/10/2018	20:41	078-05	2932	100.00	0.00	0.00	0.00	
10/10/2018	22:10	079-01	2940	100.00	0.00	0.00	0.00	SAV
10/10/2018	22:00	079-02	2938	16.67	12.50	70.83	0.00	
10/10/2018	19:57	079-03	2925	12.50	2.08	85.42	0.00	
10/10/2018	19:45	079-04	2923	27.08	22.92	50.00	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/10/2018	19:33	079-05	2921	100.00	0.00	0.00	0.00	
10/10/2018	18:22	080-01	2910	12.50	6.25	81.25	0.00	
10/10/2018	18:32	080-02	2912	16.67	6.25	77.08	0.00	
10/10/2018	18:43	080-03	2914	6.25	0.00	93.75	0.00	
10/10/2018	18:54	080-04	2916	100.00	0.00	0.00	0.00	
10/10/2018	19:11	080-05	2918	89.58	0.00	10.42	0.00	
10/10/2018	18:06	081-01	2907	39.58	56.25	4.17	0.00	
10/10/2018	17:53	081-02	2905	20.83	0.00	0.00	79.17	
10/10/2018	17:36	081-03	2903	25.00	8.33	2.08	64.58	
10/10/2018	17:21	081-04	2901	20.00	4.44	75.56	0.00	
10/10/2018	17:09	081-05	2899	20.83	31.25	47.92	0.00	
10/9/2018	23:33	082-01	2885	72.92	14.58	12.50	0.00	
10/9/2018	23:44	082-02	2887	12.50	10.42	77.08	0.00	
10/9/2018	23:54	082-03	2889	100.00	0.00	0.00	0.00	
10/10/2018	0:04	082-04	2891	83.33	16.67	0.00	0.00	
10/10/2018	16:49	082-05	2897	40.43	10.64	48.94	0.00	
10/9/2018	23:04	083-01	2881	18.75	6.25	75.00	0.00	
10/9/2018	23:16	083-02	2883	68.75	0.00	31.25	0.00	
10/11/2018	16:57	083-03	2972	72.92	8.33	18.75	0.00	
10/11/2018	0:02	084-01	2955	100.00	0.00	0.00	0.00	SAV
10/10/2018	23:48	084-02	2953	64.58	4.17	31.25	0.00	
10/9/2018	22:43	084-03	2879	100.00	0.00	0.00	0.00	
10/10/2018	23:34	084-04	2951	100.00	0.00	0.00	0.00	
10/10/2018	23:20	084-05	2949	0.00	0.00	0.00	0.00	SAV
10/11/2018	0:17	085-01	2957	100.00	0.00	0.00	0.00	
10/11/2018	0:26	085-02	2959	100.00	0.00	0.00	0.00	
10/9/2018	22:19	085-03	2877	10.42	4.17	85.42	0.00	
10/9/2018	22:07	085-04	2875	95.83	4.17	0.00	0.00	
10/9/2018	21:48	085-05	2872	100.00	0.00	0.00	0.00	
10/9/2018	21:29	085-06	2870	66.67	2.08	31.25	0.00	
10/11/2018	16:39	085-09	2970	100.00	0.00	0.00	0.00	
10/11/2018	16:23	085-10	2967	100.00	0.00	0.00	0.00	
10/3/2018	22:27	086-01	524	0.00	0.00	0.00	0.00	SAV
10/3/2018	22:18	086-02	519	0.00	0.00	0.00	0.00	SAV
10/9/2018	0:09	086-02	2683	27.08	14.58	58.33	0.00	
10/3/2018	22:03	086-03	516	25.00	4.17	70.83	0.00	
10/3/2018	21:55	086-04	514	100.00	0.00	0.00	0.00	
10/3/2018	21:45	086-05	512	100.00	0.00	0.00	0.00	
10/3/2018	21:36	086-06	509	100.00	0.00	0.00	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/3/2018	21:23	086-07	505	100.00	0.00	0.00	0.00	
10/3/2018	21:12	086-08	502	100.00	0.00	0.00	0.00	
10/3/2018	21:02	086-09	470	100.00	0.00	0.00	0.00	
10/3/2018	20:39	086-10	48	0.00	0.00	0.00	0.00	SAV
10/3/2018	22:51	087-01	526	50.00	4.35	45.65	0.00	
10/3/2018	23:11	087-02	528	16.28	16.28	67.44	0.00	
10/3/2018	23:21	087-03	530	100.00	0.00	0.00	0.00	
10/4/2018	18:13	087-04	536	31.82	4.55	63.64	0.00	
10/4/2018	18:33	087-05	645	40.48	7.14	52.38	0.00	
10/9/2018	20:58	087-06	2866	100.00	0.00	0.00	0.00	
10/9/2018	20:44	087-07	2860	100.00	0.00	0.00	0.00	
10/9/2018	20:49	087-08	2862	100.00	0.00	0.00	0.00	
10/9/2018	20:39	087-09	2858	93.75	0.00	6.25	0.00	
10/9/2018	20:33	087-10	2856	100.00	0.00	0.00	0.00	
10/6/2018	16:39	088-01	2483	100.00	0.00	0.00	0.00	
10/5/2018	16:58	088-02	1934	100.00	0.00	0.00	0.00	
10/4/2018	23:22	088-03	1768	39.13	8.70	52.17	0.00	
10/4/2018	23:13	088-04	1765	100.00	0.00	0.00	0.00	
10/4/2018	23:08	088-05	1762	100.00	0.00	0.00	0.00	
10/4/2018	18:56	088-06	656	100.00	0.00	0.00	0.00	
10/5/2018	20:03	088-07	2302	100.00	0.00	0.00	0.00	
10/5/2018	20:22	088-08	2346	100.00	0.00	0.00	0.00	
10/9/2018	20:19	088-08	2850	100.00	0.00	0.00	0.00	
10/5/2018	19:02	088-09	2227	89.58	10.42	0.00	0.00	
10/9/2018	20:13	088-10	2848	85.42	14.58	0.00	0.00	
10/6/2018	16:53	089-01	2485	100.00	0.00	0.00	0.00	
10/5/2018	17:16	089-02	8902	100.00	0.00	0.00	0.00	
10/4/2018	22:43	089-03	1756	44.68	8.51	46.81	0.00	
10/4/2018	22:51	089-04	1758	100.00	0.00	0.00	0.00	
10/4/2018	22:58	089-05	1760	100.00	0.00	0.00	0.00	
10/4/2018	20:57	089-06	1712	100.00	0.00	0.00	0.00	
10/5/2018	19:31	089-07	2274	100.00	0.00	0.00	0.00	
10/9/2018	20:25	089-08	2854	100.00	0.00	0.00	0.00	
10/5/2018	20:58	089-09	2366	97.92	2.08	0.00	0.00	
10/9/2018	20:08	089-10	2846	100.00	0.00	0.00	0.00	
10/8/2018	23:14	090-01	2670	100.00	0.00	0.00	0.00	SAV
10/4/2018	22:33	090-02	1754	85.42	6.25	8.33	0.00	
10/8/2018	23:20	090-03	2672	100.00	0.00	0.00	0.00	
10/4/2018	22:16	090-04	1732	70.83	4.17	25.00	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/4/2018	22:00	090-05	1730	100.00	0.00	0.00	0.00	
10/4/2018	21:44	090-06	1725	100.00	0.00	0.00	0.00	
10/4/2018	21:24	090-07	1723	43.75	6.25	50.00	0.00	
10/5/2018	23:53	090-08	2477	100.00	0.00	0.00	0.00	
10/9/2018	19:55	090-09	2842	100.00	0.00	0.00	0.00	
10/9/2018	20:01	090-10	2844	100.00	0.00	0.00	0.00	
10/8/2018	23:02	091-01	2667	100.00	0.00	0.00	0.00	SAV
10/8/2018	22:45	091-02	2665	83.33	16.67	0.00	0.00	
10/8/2018	22:27	091-03	2661	60.42	22.92	16.67	0.00	
10/8/2018	22:07	091-04	2658	10.42	6.25	66.67	16.67	
10/6/2018	17:15	091-05	2487	100.00	0.00	0.00	0.00	
10/6/2018	17:33	091-06	2489	100.00	0.00	0.00	0.00	
10/6/2018	17:48	091-07	2491	100.00	0.00	0.00	0.00	
10/6/2018	18:03	091-08	2493	39.47	0.00	60.53	0.00	
10/9/2018	19:48	091-09	2840	100.00	0.00	0.00	0.00	
10/9/2018	19:41	091-10	2837	100.00	0.00	0.00	0.00	
10/6/2018	19:13	092-02	2499	0.00	0.00	0.00	100.00	
10/8/2018	21:10	092-03	2649	100.00	0.00	0.00	0.00	
10/8/2018	21:27	092-04	2651	100.00	0.00	0.00	0.00	
10/8/2018	21:40	092-05	2654	100.00	0.00	0.00	0.00	
10/8/2018	21:54	092-06	2656	18.75	25.00	56.25	0.00	
10/6/2018	19:39	092-07	2502	100.00	0.00	0.00	0.00	
10/6/2018	18:58	092-08	2497	97.92	2.08	0.00	0.00	
10/6/2018	18:25	092-09	2495	68.75	2.08	29.17	0.00	
10/9/2018	19:35	092-10	2835	77.08	4.17	18.75	0.00	
10/8/2018	20:44	093-01	2647	100.00	0.00	0.00	0.00	
10/8/2018	20:31	093-02	2645	100.00	0.00	0.00	0.00	
10/8/2018	20:09	093-04	2643	100.00	0.00	0.00	0.00	
10/6/2018	20:10	093-05	2505	83.33	0.00	16.67	0.00	
10/6/2018	20:27	093-06	2507	45.83	35.42	18.75	0.00	
10/6/2018	20:49	093-07	2509	0.00	0.00	0.00	100.00	
10/6/2018	21:09	093-08	2512	41.67	2.08	56.25	0.00	
10/6/2018	21:23	093-09	2514	9.09	4.55	86.36	0.00	
10/6/2018	21:35	093-10	2516	22.92	14.58	62.50	0.00	
10/8/2018	19:36	094-01	2641	100.00	0.00	0.00	0.00	
10/6/2018	23:30	094-02	2532	62.50	10.42	27.08	0.00	
10/6/2018	23:17	094-03	2530	100.00	0.00	0.00	0.00	
10/6/2018	23:04	094-04	2528	100.00	0.00	0.00	0.00	
10/6/2018	22:51	094-05	2526	100.00	0.00	0.00	0.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/6/2018	22:37	094-06	2524	27.08	68.75	4.17	0.00	
10/6/2018	22:21	094-07	2522	0.00	0.00	0.00	100.00	
10/6/2018	22:08	094-08	2520	29.17	2.08	68.75	0.00	
10/6/2018	21:55	094-09	2518	10.42	35.42	54.17	0.00	
10/8/2018	16:26	094-10	2612	39.58	52.08	8.33	0.00	
10/8/2018	19:25	095-01	2638	31.25	8.33	6.25	54.17	
10/6/2018	23:46	095-02	2534	89.58	0.00	10.42	0.00	
10/7/2018	16:26	095-03	2539	100.00	0.00	0.00	0.00	
10/7/2018	16:41	095-04	2541	100.00	0.00	0.00	0.00	
10/7/2018	16:52	095-05	2543	58.33	0.00	41.67	0.00	
10/7/2018	17:13	095-06	2545	0.00	0.00	0.00	100.00	
10/7/2018	17:26	095-07	2547	26.09	36.96	36.96	0.00	
10/7/2018	17:38	095-08	2550	13.04	26.09	60.87	0.00	
10/7/2018	17:51	095-09	2552	21.28	14.89	63.83	0.00	
10/8/2018	16:51	095-10	2616	100.00	0.00	0.00	0.00	
10/8/2018	19:11	096-01	2636	64.58	4.17	31.25	0.00	
10/7/2018	19:29	096-02	2569	16.67	0.00	0.00	83.33	
10/7/2018	19:16	096-03	2567	77.08	0.00	0.00	22.92	
10/7/2018	19:05	096-04	2565	60.42	0.00	0.00	39.58	
10/7/2018	18:54	096-05	2563	37.50	0.00	0.00	62.50	
10/7/2018	18:42	096-06	2561	97.92	0.00	2.08	0.00	
10/7/2018	18:29	096-07	2559	8.33	41.67	50.00	0.00	
10/7/2018	18:14	096-08	2557	0.00	0.00	0.00	100.00	
10/7/2018	18:07	096-09	2555	4.35	23.91	71.74	0.00	
10/8/2018	16:39	096-10	2614	33.33	10.42	56.25	0.00	
10/8/2018	19:00	097-01	2634	100.00	0.00	0.00	0.00	
10/8/2018	18:48	097-02	2632	85.42	10.42	4.17	0.00	
10/7/2018	20:02	097-03	2571	27.08	0.00	16.67	56.25	
10/7/2018	20:13	097-04	2573	0.00	0.00	0.00	100.00	
10/7/2018	20:33	097-05	2577	100.00	0.00	0.00	0.00	
10/7/2018	20:49	097-06	2580	0.00	0.00	0.00	100.00	
10/7/2018	21:02	097-07	2582	50.00	50.00	0.00	0.00	
10/7/2018	21:16	097-08	2584	18.75	29.17	52.08	0.00	
10/7/2018	21:30	097-09	2586	42.55	17.02	40.43	0.00	
10/8/2018	17:08	097-10	2618	72.92	27.08	0.00	0.00	
10/8/2018	18:28	098-01	2630	0.00	0.00	0.00	0.00	SAV
10/8/2018	18:13	098-02	2628	100.00	0.00	0.00	0.00	
10/7/2018	23:08	098-03	2603	100.00	0.00	0.00	0.00	
10/7/2018	22:57	098-04	2600	0.00	0.00	0.00	100.00	

Table 5-2. Underwater Imagery Processing and Analysis Results

Date[1]	Time[1]	Station ID	Image ID	Fine Grained Sediment (< 2 mm) (%)	Gravel (2 to64 mm) (%)	Cobble/ Boulder (> 64 mm) (%)	Bedrock (%)	Flags
10/7/2018	22:47	098-05	2598	100.00	0.00	0.00	0.00	
10/7/2018	22:36	098-06	2596	100.00	0.00	0.00	0.00	
10/7/2018	22:25	098-07	2594	100.00	0.00	0.00	0.00	
10/7/2018	22:12	098-08	2592	43.75	56.25	0.00	0.00	
10/7/2018	21:59	098-09	2590	25.00	33.33	25.00	16.67	
10/7/2018	21:46	098-10	2588	31.25	58.33	10.42	0.00	
10/8/2018	17:52	099-01	2624	100.00	0.00	0.00	0.00	
10/8/2018	18:02	099-02	2626	100.00	0.00	0.00	0.00	
10/7/2018	23:23	099-03	2605	62.50	0.00	37.50	0.00	
10/7/2018	23:33	099-04	2607	72.92	16.67	10.42	0.00	
10/7/2018	23:45	099-05	2609	100.00	0.00	0.00	0.00	
10/9/2018	16:35	099-06	2808	100.00	0.00	0.00	0.00	
10/9/2018	16:47	099-07	2810	89.58	10.42	0.00	0.00	
10/9/2018	16:58	099-08	2812	40.43	59.57	0.00	0.00	
10/9/2018	17:18	099-09	2814	33.33	25.00	41.67	0.00	
10/9/2018	17:28	099-10	2816	100.00	0.00	0.00	0.00	
10/8/2018	17:41	100-01	2622	100.00	0.00	0.00	0.00	
10/8/2018	17:30	100-02	2620	100.00	0.00	0.00	0.00	
10/9/2018	19:00	100-03	2833	72.92	0.00	27.08	0.00	
10/9/2018	18:49	100-04	2831	100.00	0.00	0.00	0.00	
10/9/2018	18:38	100-05	2829	100.00	0.00	0.00	0.00	
10/9/2018	18:28	100-06	2827	100.00	0.00	0.00	0.00	
10/9/2018	18:17	100-07	2825	89.58	0.00	10.42	0.00	
10/9/2018	18:05	100-08	2823	100.00	0.00	0.00	0.00	
10/9/2018	17:54	100-09	2821	52.08	10.42	37.50	0.00	
10/9/2018	17:44	100-10	2819	29.17	16.67	54.17	0.00	

Notes:

[1]Dates and times are listed in Universal Coordinated Time (UTC)

SAV – submerged aquatic vegetation