Hydrographic Survey of the River Bed Bosut with Subbottom Profiler to Determine the Thickness of Sedimentary Deposits

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Key words: hidrographic measurement, subbottom profiler, sedimentary deposits, river Bosut

SUMMARY

Watercourse Bosut has total length of 132 km. The mouth of Bosut is located in Serbia at the place Bosut and the source is at Županja, along the Sava embankment. Specificity of Bosut is a very small drop the bottom bed, and the floodgates and barriers which attempted regulation of the water level. All this led to more unfavorable water flow, which during the summer almost stops completely. As a consequence, there is a rapid growth of aquatic plants and a large muddy sediment as a result of decomposition of plant mass in the stream.

These reasons lead to the gradual reduction in the volumetric capacity of the riverbed, the total volume of water, and also reduce the amount of water that can be stored in the stream, and thus reduced ability to use water for irrigation but also for other purposes.

Therefore, hydrographic survey of the river bed Bosut by using subbottom profilers was conducted through the entire length of 96 km of the watercourse Bosut to determine the thickness of sedimentary deposits and based on that to develop adequate rehabilitation measures. This paper presents a survey of the river bed Bosut by subbottom profiler and the results obtained.

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1. INTRODUCTION

Watercourse Bosut has total length of 132 km. The mouth of Bosut is located in Serbia at the place Bosut and the source is at Županja, along the Sava embankment. Specificity of Bosut is a very small drop the bottom bed, and the floodgates and barriers which attempted regulation of the water level. All this led to more unfavorable water flow, which during the summer almost stops completely. As a consequence, there is a rapid growth of aquatic plants and a large muddy sediment as a result of decomposition of plant mass in the stream.

Figure 1. Watercourse Bosut streches for 96 km trough Croatia and continues in Serbia

These reasons lead to the gradual reduction in the volumetric capacity of the riverbed, the total volume of water, and also reduce the amount of water that can be stored in the stream, and thus reduced ability to use water for irrigation but also for other purposes.

Figure 1. River Bosut and a rapid growth of aquatic plants and a large muddy sediment as a result of decomposition of plant mass in the stream

Therefore, hydrographic survey of the river bed Bosut by using subbottom profiler was conducted through the entire length of 96 km of the watercourse Bosut to determine the thickness of sedimentary deposits and based on that to develop adequate rehabilitation measures. Also, paralel to the subbottom profiler survey, geotechnical boreholes were sampled along the watercourse to confirm the subbottom profiler surveys.

2. SUBBOTTOM PROFILER MEASUREMENT ON RIVER BOSUT

For the purpose of conducting the survey of the thickness of the sedimentary deposits, subbottom profiler Syquest StrataBox running on 10 kHz was used (URL 1).

Sub-bottom profiling systems identify and measure various marine sediment layers that exist below the sediment/water interface. These acoustic systems use a technique that is similar to single beam echo sounders. A sound source emits an acoustic signal vertically downwards into the water and a receiver monitors the return signal that has been reflected off the seafloor. Some of the acoustic signal will penetrate the seabed and be reflected when it encounters a boundary between two layers that have different acoustic impedance. The system uses this reflected energy to provide information on sediment layers beneath the sediment-water interface(Pribicevic et al 2007), (URL 2).

Acoustic impedance is related to the density of the material and the rate at which sound travels through the material. When there is a change in acoustic impedance, such as the water-sediment interface, part of the transmitted sound is reflected. However, some of the sound energy penetrates

through the boundary and into the sediments. This energy is reflected when it encounters boundaries between deeper sediment layers having different acoustic impedance. The system uses the energy reflected by these layers to create a profile of the marine sediments (URL 2).
Sub-bottom profiling systems can be useful for characterizing benthic habitats, since they provide information about sub-surface sediment structure. No other acoustic techniques provide this type of information, and only physical sampling via cores will allow for characterization of subsurface structures. From this reason sub-bottom profiler was used on river Bosut in combinatiion with geotechnical core sampling (Jones 1999).

2.1 SyQuest StrataBox sub-bottom Profiler

The StrataBox TM is a portable high resolution marine sediment imaging instrument capable of delivering 6cm of marine sediment strata resolution with bottom penetration of up to 40 meters. It is designed exclusively for inshore and coastal geophysical marine survey up to 150 meters of water depth. It has a frequency output of 10 kHz which was used in this case.

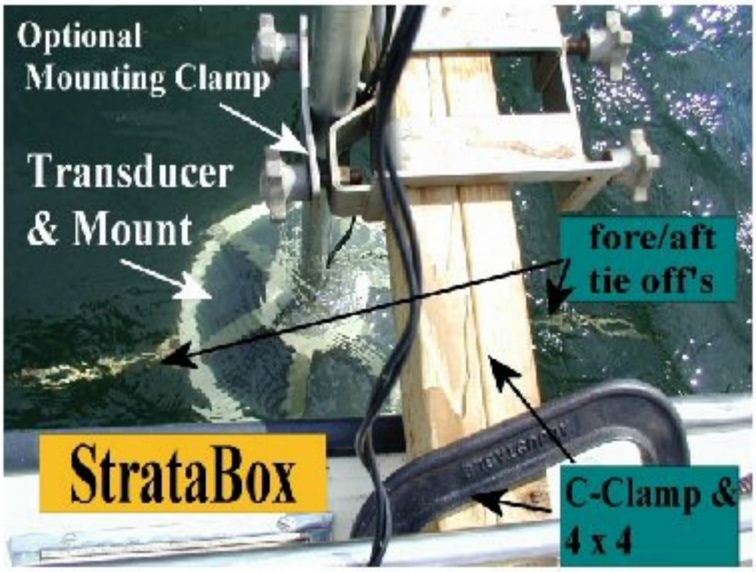

Figure 3. StrataBox overboard installation

2.2. Sub-bottom Measurements on River Bosut

StrataBox was installed overboard the light river boat and on the top of the vertical pole Trimble R8 GNSS was mounted for the purpose of positioning. Positioning of the survey was performed using Croatia CORS network CROPOS thus ensuring positional accuracy better than 5 cm. Data acquisition was done in StrataBox software and later for the processing the combination of SonarWiz and Autodesk Civil 3D.

3. PROCESSING AND THE RESULTS

For the processing of the sub-bottom measurements, the combination of SonarWiz and Autodesk Civil 3D. The acquired data was imported into SonarWiz where they are being analyzed, cleaned, and processed and then vectorized. After vectorization, the data is transfered to Autodesk Civil 3D where the model of the sediment layers is created. The Figure 4. Shows segment of the sub-bottom measurements being vectorized and showing the sediment thickness of 1.8 m.

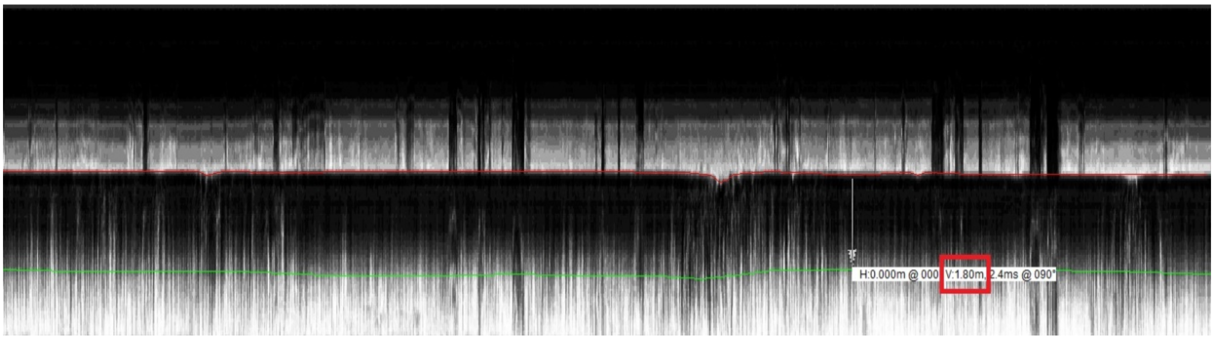

Figure 4. sub-bottom measurements being vectorized and showing the sediment thickness of 1.8 m.

The surface model of the riverbed and sediment layers was created in Civil 3D thus allowing to create longitudinal and cros sections of the river Bosut model. In that way we were able to determine the thickness of the sediment on the riverbed. Figure 5 shows the 3D model of the riverbed of river Bosut in Civil 3D.

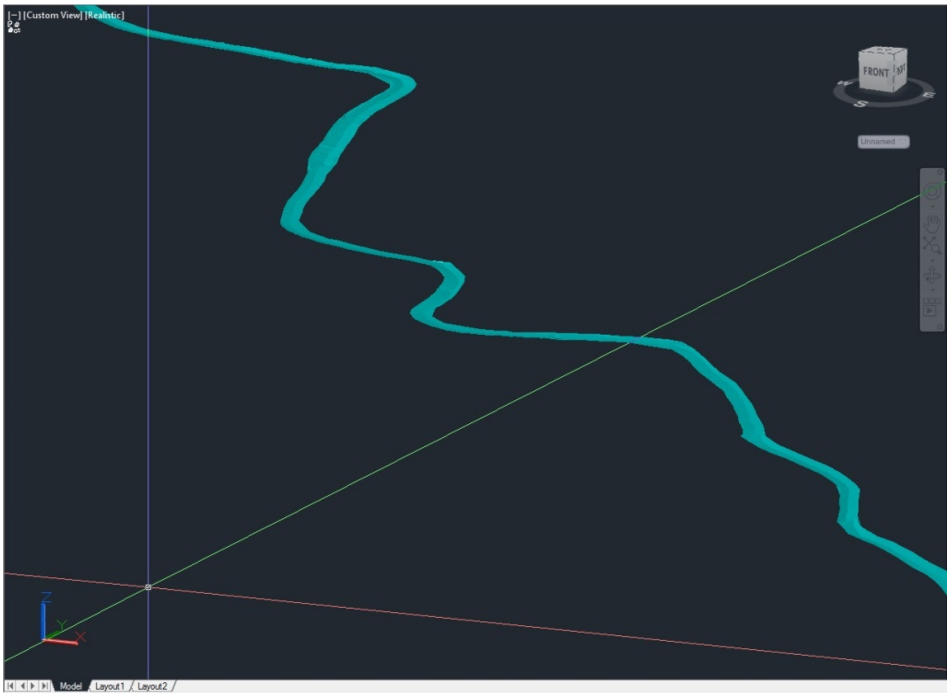

Figure 5. 3D model of the riverbed of river Bosut in Civil 3D

3.1 Correlation with Geomechanical Core Sampling

Parallel to the sub-bottom survey the geotechnical core sampling was conducted on every 2 km of the riverbed. The aim of geotechnical works to determine the thickness, composition and basic strength parameters of sludge in Bosut, as the basis for creation documentation removing silt from the river. Geotechnical investigation works must include field research and laboratory testing of particle size distribution.

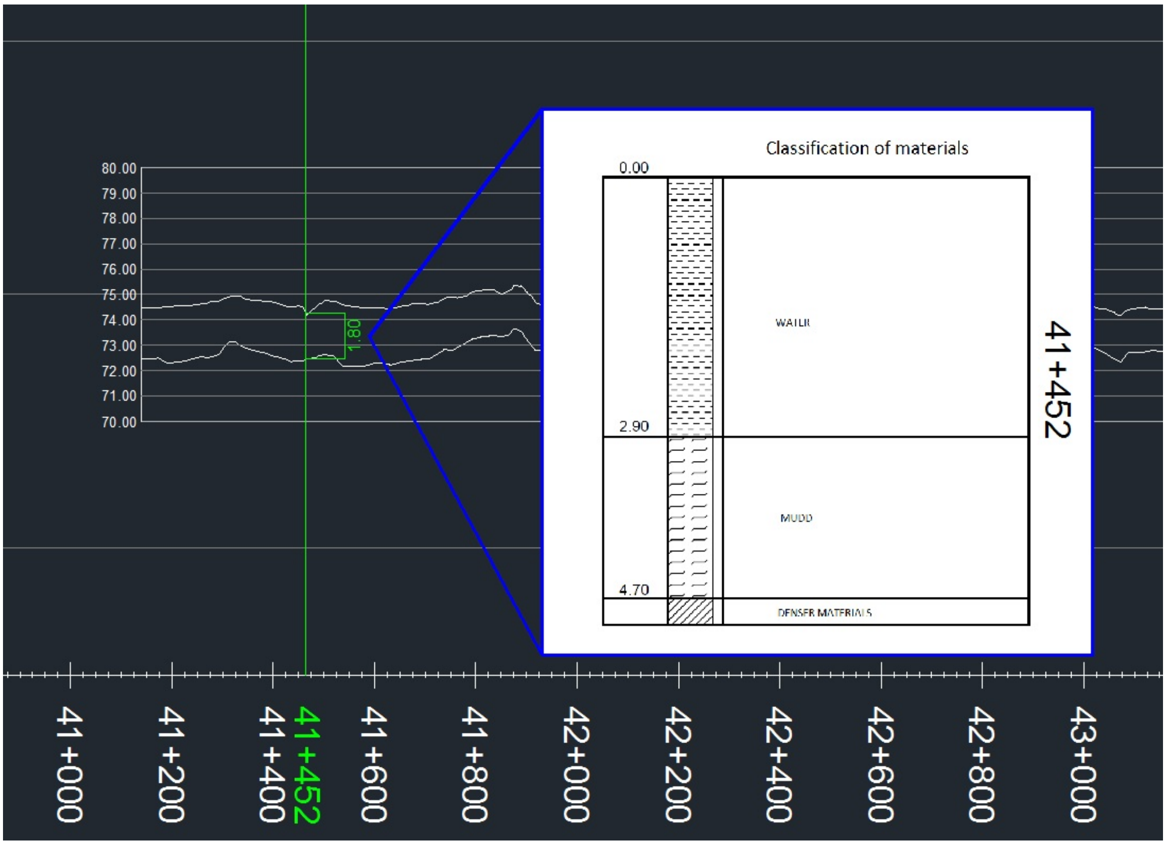

Figure 5. Correlation between the mud thickness determined by sub-bottom profiler and by geotechnical core sampling

4. CONCLUSION

Aim of this study is to obtain reliable surface morphology of Bosut and quality surface with well defined composition of the soil at the bottom of the river Bosut and its propagation in depth, which would give an answer to the question whether it is appropriate for extracting sludge or not. The study should define locations for excavation and provide preliminary amounts for extracting sludge.

Applied methodology of sub-bottom profiling, described in this paper has given excellent results, as confirmed by geotechnical core sampling along the Bosut riverbed.

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BIOGRAPHICAL NOTES

Almin Đapo was born on August 17. 1974 in the town of Dubrovnik in the Republic of Croatia. He works as an Assistant Professor at University of Zagreb, Faculty of Geodesy,Chair of Hidrography. He has 17 years of experience in the field of geodesy and geoinformatics. In that time he worked on large number of projects in different fields of geodesy and geoinformatics.

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