DIGITALIZATION OF OŢELU ROȘU HYDROGRAPHIC BASINS BY USING TOPOGRAPHIC MAPS IN ANALOGIC FORMAT

Luminița Livia BÂRLIBA[1], Gabriel ELEȘ[2], Costel BÂRLIBA[1], Florin Cristian BÂRLIBA[1]

Abstract. The paper aims to address a current issue of transforming analog maps into digital format for various topics. From this perspective, the map is a horizontal graphical representation of the earth's surface (total or partial), generalized and reduced according to a certain scale of proportion and prepared on the basis of a cartographic projection.

Thus, the purpose of the paper is to transform a printed topographic map on paper into a digital map to be used later in a GIS application. For this purpose, military maps at a scale of 1: 25000 were used. The maps used have the nomenclature L-34-93-B-a, b, c, d and represent the localities: Rusca Montană, Oțelu Roșu, Zăvoi, Glimboca, Obreja, Var, Măru with the related areas.

Keywords: topographic map, georeferencing, digitization.

1. INTRODUCTION

The main objectives for this work were: identifying the problems that exist in the field, proposing technical solutions regarding the use of specialized software to transform analog maps into digital maps, objectives in order to solve existing malfunctions from a technical point of view [4].

The following methods were used in the study:

- **Documentation,** this method consisted in consulting the specialized literature that deals with this topic.

- The method of observation, whether direct or indirect, is a method also used by the related sciences. The terrain, the main laboratory of the surveyor, the physical support on which any study, both theoretical and applied, has been applied and has been described since ancient times. What is essential is that all the elements studied should not only be analyzed but also interpreted. The method allowed the identification of the researched elements, the decipherment and registration of the components and their registration in an ensemble, being indispensable in the research process of the studied area [5].

- **Analyze**, this method explained the causality and outlined the overall picture of the functional system.

- **Synthesis**, it is based on the results obtained from the analysis of the map (natural environment, socio-economic component) being the support for the elaboration of hypotheses and legalities. In this stage it was possible to prefigure the real image of the studied area and the representation of the scale elements at the level of the map.

- **Description,** provides a sufficiently detailed image with explanatory elements and correlative conclusions that configure the physiognomy of the territorial system analyzed and provides sufficient elements in understanding its functionality and dynamics.

The working technique approached in the study was to scan the map with the help of a scanner, being the method by which a digital file L-34-93 was obtained with the extension .tiff (Tagged Image File Format - is a common format used for various image applications, including those for scanning and faxing) being a raster image that will be digitized.

The software used in the study to transform the map from analog to digital and digitize the elements represented on the map was **AutoCAD 2020**, **Raster Design 2020** [2].

2. MATERIAL AND METHOD

The programs used to carry out the work were **TransDatRO**, **AutoCAD 2020** and **Raster Design 2020**.

TransDatRO is used to perform transformations from the ETRS89 system to the reference systems in Romania, the geodetic networks determined with GNSS technology must be connected to the class RGN A, B, C and D (permanent GPS stations and / or bounded points with GNSS determinations) [11], whose contact details are available at the National Geodetic Fund and the Offices of Cadaster and Real Estate Advertising (Fig 1.).

AutoCad is a CAD program used in the design of construction plans in two dimensions (2D), less in three dimensions (3D), developed and marketed by the American company Autodesk. [3]

_____

[1] Banat University of Agricultural Sciences and Veterinary Medicine, "Regele Mihai I al României", Timisoara, Calea Aradului 119, 300645, Romania, barlibacostel@yahoo.com

[2] Politehnica University of Timisoara, Spiru Haret Street, no. 1/A, 300022, Romania, eles.gabriel@yahoo.com
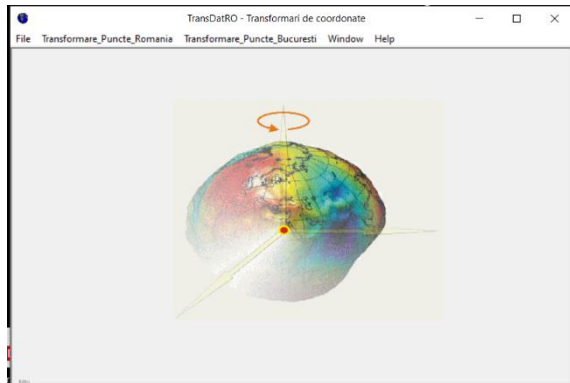
Figure 1. TransDatRO software

The system-specific ("native") files are those of the dwg type, as well as the dxf Drawing eXchange Format), which are extremely widespread.

Although it was originally created to run on platforms such as Unix and Macintosh, its development was abandoned in favor of the Windows operating system.

One of the features that made this application famous, in addition to the lower launch price than other similar software, was the ability to set and automate processes. This includes AutoLISP, Visual LISP, VBA, .Net, ObjectARX.

AutoCAD - computer aided design - is the most common environment for computer aided graphics and design, successfully used in fields such as architecture, geography, medicine, astronomy, technology, etc. (Fig 2.). The first version, called MicroCAD, appeared in 1982, reaching the AutoCAD 2020 version. Autodesk has also developed a multitude of AutoCAD software programs customized in certain areas: AutoCAD Architecture, AutoCAD Electrical, AutoCAD Mechanical, AutoCAD Overlay, AutoCAD Land Desktop, AutoCAD Map, AutoCAD Civil 3D. AutoCAD LT is a version of AutoCAD with reduced capabilities and lower cost, the first being launched in November 1993. AutoCAD LT, priced at $ 495, became the first product with the name "AutoCAD" in the history of the company priced under $ 1000. Currently the price is about 2000 lei for the AutoCAD version. The AutoCAD platform [7] is the basis for the development of specialized Autodesk programs for advanced design in various fields: mechanics (AutoCAD Mechanical), electrical (AutoCAD Electrical), architecture (AutoCAD Architecture), civil engineering (AutoCAD Civil 3D), cartography (AutoCAD Map 3D), factory design (AutoCAD Plant 3D, AutoCAD P&ID). [8]

Drawing in AutoCAD completely replaces the use of the designer's traditional drawing tools (pencil, ruler, eraser, compass, square, etc.).

Compared to technical drawings and graphic representations executed manually, drawing using computer programs such as AutoCAD has the following advantages:
-projects can be made on a natural scale (1: 1 scale);
-drawing accuracy is very high (16 decimal places);
-execution time is reduced because there are libraries with standardized objects that can be inserted;
-the quality of the drawing is very good;
-execution costs are low;

-drawings can be exported to other applications and then processed;
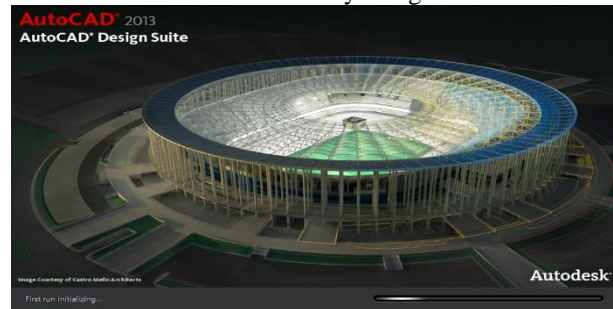- remote file transfer is easy using the internet.

Figure 2. AutoCAD initialization

The AutoCAD Raster Design toolkit adds raster-vector tools to help convert raster images to DWG objects (Figure 3)
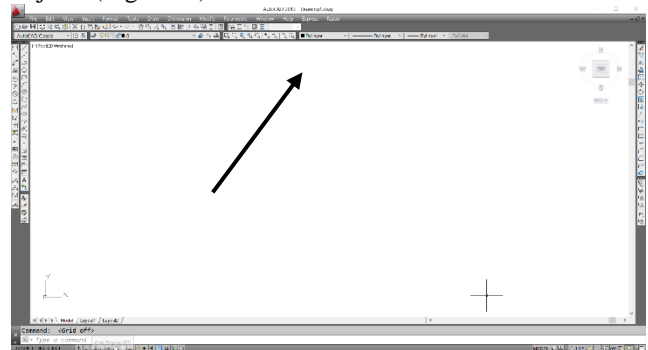

Figure 3. AutoCAD + Raster Design worksheet

3. RESULTS AND DISCUSSION

The work steps will be represented by PrintScreen on the screen:
- Start the application you will work with, in this case: AutoCAD2020;
- Select the necessary template for the job and click on "Open";
- Save the file to the desired location and enable automatic save as soon as possible to ensure the integrity of the .dwg file. From the "Open and Save" tab, check "Automatic save" and enter a time interval of 10 minutes, press OK.
- Worksheet setting, - Units (Length Type Decimal; Angle Type Grads, Precision 0.0000 g work with four decimal places, Units to scale inserted content Meters, Direction Control 11 North).

Figure 4. Entering the Point command in the Command Line

- The entry of points is done using the command "Point" (Figure 4) And enter y and then x;
- To set the point style, use the "Point Style" command. Select the desired stitch style and press "OK".
- To see the properties of a entered point or date, right-click on the entered point or information and select „properties";

10

- A menu will appear on the left in which all the details of the selected point or information will be displayed;
- The coordinates of the corners of the studied map are entered. The frame is created and the map is inserted to be georeferenced. Use the "line" or "l" command in the command tab to insert a line, join the points at the corners of the map.

The next step is to enter the necessary data into the AutoCad 2020 program.

The map with the studied area is added (Figure 5) and using the Align command, select the corners of the map and the corresponding coordinate points.
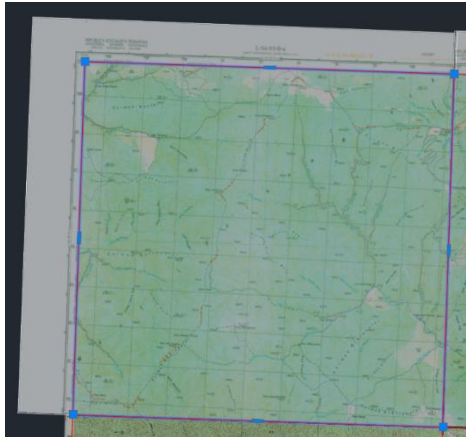
Figure 5. Introduction of a topographic map

This procedure is repeated for each map so as to cover the entire studied area. In the case of this paper we repeat this process 6 times (Figure 6).
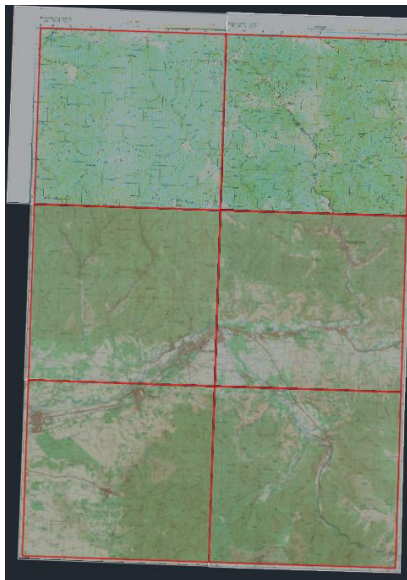
Figure 6. Introduction of the 6 topographic maps

T   he necessary layer is created for the next step, respectively the Oțelul Roșu UAT Limit. To create layers, we go to the tab „Layer Properties" (Figure 7).

Figure 7. The Tab Layer – Properties

A new tab will open where the box checked is „New Layer" (Figure 8).
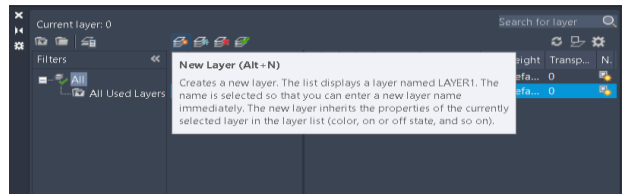

Figure 8. New Layer

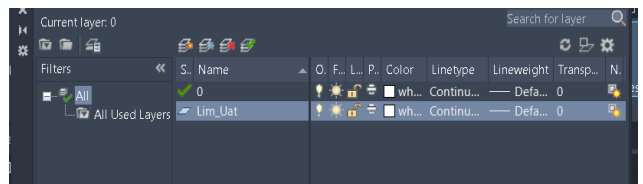The name is set for this Layer „Lim_Uat". (Figure 9).

Figure 9. Layer name setting: lim_uat

- The properties of this layer are change, red color, continuous line type, 2mm line thickness. (Figure 10).
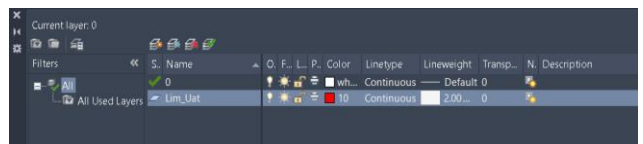

Figure 10. Change the Layer property

Next is the delimitation of the studied area, respectively UAT Oțelu Roșu. The „Spline" command is use and the contour of the UAT-ului is followed, drawing the overlapping lines with the georeferenced image (Figure 11).
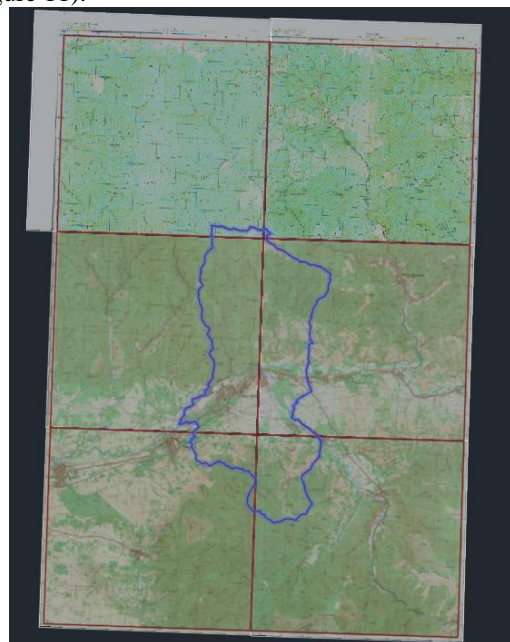

Figure 11. UAT area delimitation

The layer that forms the frame originally is hide, to position the maps. To hide a layer, follow the steps in the following screenshots. It is found in „Layers" tab (Figure 12).
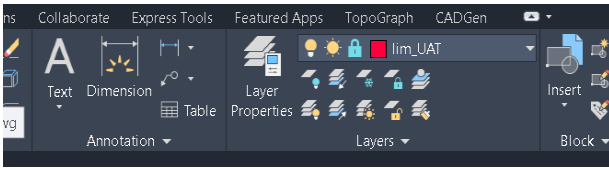

Figure 12. Founding the Layer tab
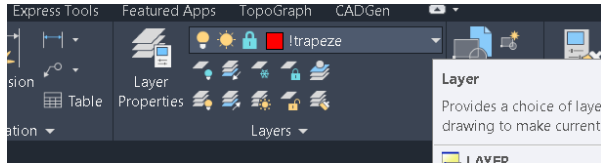
Click on the down arrow (Figure 13)

Figure 13. Clicking the down arrow

Identify the layer to be hidden and click on the "light bulb" (Figure 14), which changes to blue, which means the Layer enters on Off mode. To bring a Layer back, repeat the same procedure and the bulb turns yellow.
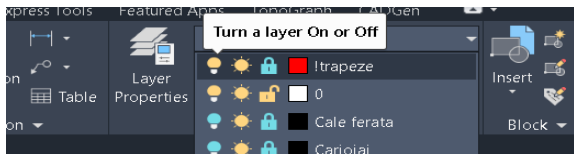

Figure 14. Turning the Layer On or Off

The opening of the layers for each object studied in the field follows. The steps are repeated to create a Layer. Inside the studied area, previously delimited by the lim_uat Layer, we start by digitizing information with information, each object in reality.

Following the observation of the studied area, Layers will be needed for: waters, buildings, asphalt roads, paved roads, agricultural roads, for areas delimited by hay, hayfields, forest areas, birch areas, areas with fruit trees, areas with railways, beech forests, for cadastral points, for text and for grid. Layer will be entered and created for each goal listed above.

From the "Layer" menu, select "Layer Properties", then a menu will open in which you can create each Layer separately. Press the New Layer button.

Next is the addition of each Layer needed to cover the areas listed above.

For each Layer, the line style, color, transparency and line thickness are set, so that after setting these values, the respective Layer is almost identical to the type of line found in the Topographic Map to be digitized.

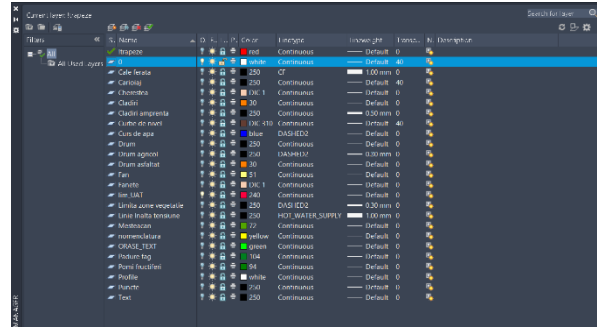After creating all the necessary Layers, each Layer will be worked on separately. (Figure 15).

Figure 15. All necessary Layers are created

4. STUDY OF THE HYDROGRAPHIC BASINS OF THE OȚELUL ROȘU AREA

Oțelu Roșu is located on an alluvial terrace, at 268 m altitude, along the tectonic fault, through which the river Bistra, after the confluence with Bistra Mărului, goes to Timiș [9].

After studying the area and introducing the necessary layers, we actually move on to the digitization stage of the Oțelu Roșu UAT area.

The digitization of the designated lines of rivers and streams begins. Therefore, select the "Cursuri de ape" Layer and use the "pline" command and follow the streams. In order to ensure the integrity of the coverage of the areas and watercourses, it is recommended to start with the discharge area of all streams and tributaries, their discharge taking place in the Bistra River.

The main watercourses on each tributary are followed [1], from the place of discharge into the Bistra River and to each spring. (Figures 16 - 19).
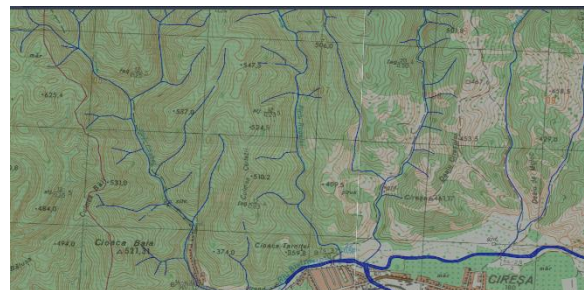

Figure 16. Watercourses (1)
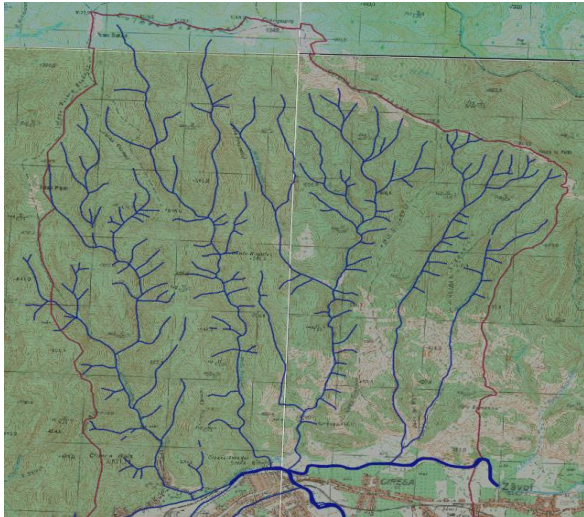

Figure 17. Watercourses (2)

Figure 18. Watercourses to Poiana Bradului

Figure 19. Watercourses to Blidarului Peak

Figure 20. The entire water network

Given that there are many tributaries in the studied area, it must be verified that each watercourse and each tributary is correctly highlighted. It is chosen to highlight with different line thicknesses the discharge areas of these watercourses.

During the studied area, delimited by the Oțelu Roșu UAT limit, the following watercourses are found, from spring to its discharge: Ohabei Stream with its tributaries, Rugului Stream with its tributaries, Frasinului Stream with its tributaries, Jgheabului Stream with its tributaries, Valea Rea with its tributaries, Cireșului Stream with its tributaries, Vladnicului Stream with its tributaries flowing into Bistra River.

From the Bistra River the following watercourses flow further: Veriga Stream with its tributaries, Strâmba Stream with its tributaries, Scoarței Stream with its tributaries, but also other smaller springs, which flow both back into the Bistra River and into a accumulation lake near Glimboca.

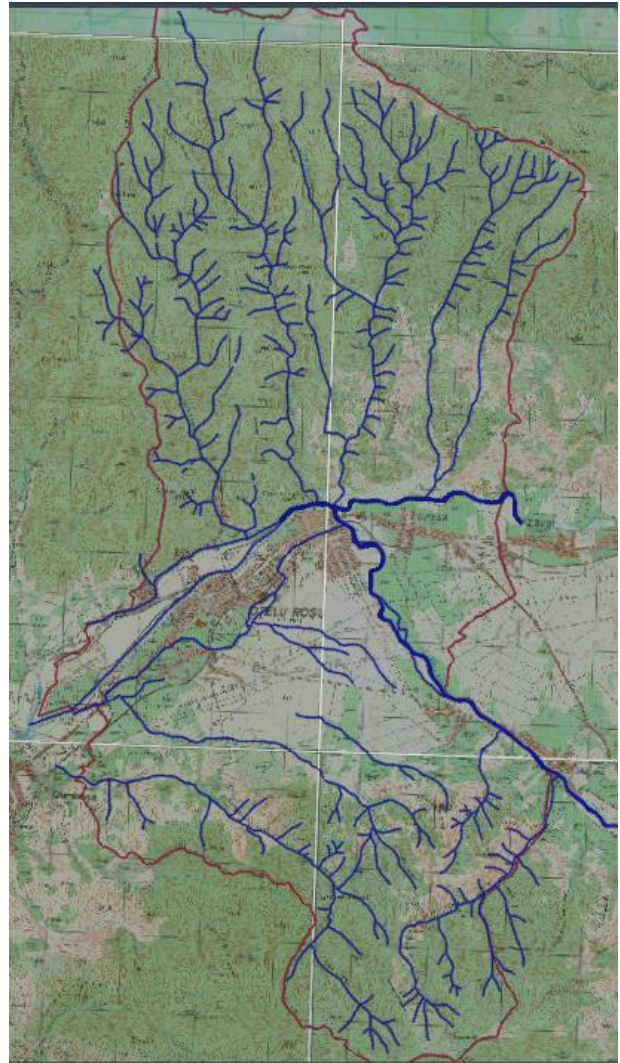This is the entire network of watercourses in the studied area. (Figure 20)

The same procedure was followed for all planimetry and relief elements, which required a very large volume of work with the use of all categories of icons in the "draw" command line.

Thus, all the previously created layers were completed, by destination categories and conventional signs. The paper can be used for many destinations as thematic maps for different fields.

Below will be the final project, with all Layers open, to see the full result after digitization. Hence the fact that the hydrographic network crosses a fairly dense tree vegetation on gullies and quite steep ravines with a rapid fall of water and a large volume in case of heavy rainfall, representing in this sense a danger in inclement weather. (Figure 21).
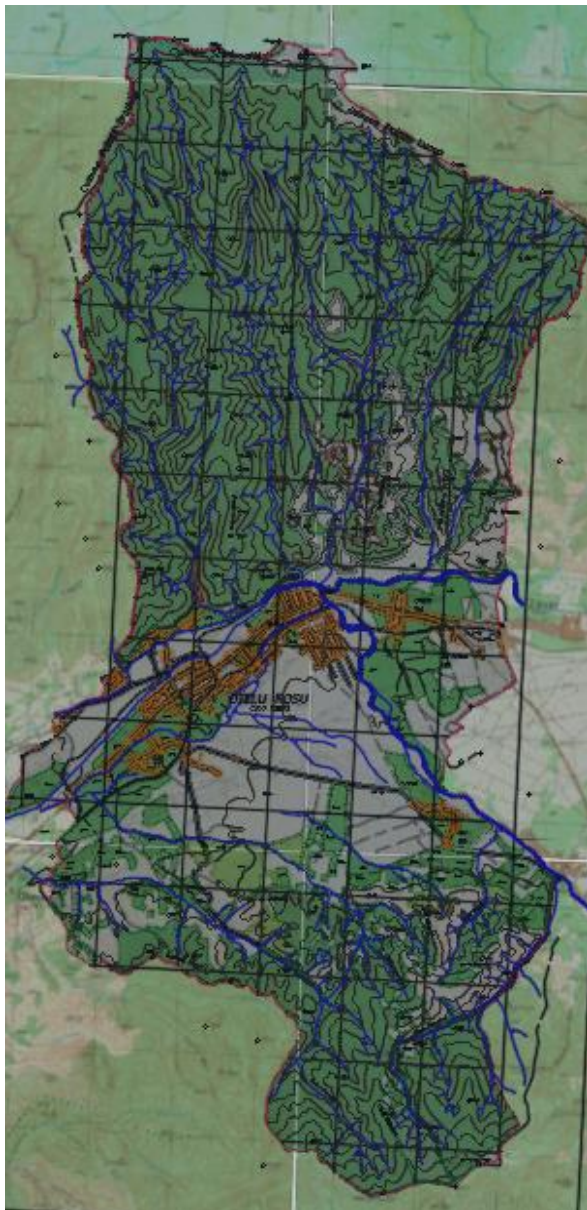
Figure 21. Hydrographic network superimposed with the other details of planimetry and relief

5. CONCLUSIONS

In this paper was presented a method of transformation and digitization of analog maps, to be available in digital format, but also the importance of this procedure for example, maps of the U.A.T. of the Oțelu Roșu.

For the actual digitization, the topographic drawings related to the map to be digitized and the satellite images were used for comparison and verification. The extracted information is then transposed into Geographic Information Systems, for analysis and processing. The formed map is then transformed by translation, rotation, scaling or deformation, taking into account the current coordinates, so that the elements of the map correspond to reality.

By digitizing analog maps in classic format, which are kept in the archives of institutions, maps and other related documents become much easier to use. This change would have a major impact, especially in areas such as agriculture, topography, cartography, photogrammetry, geodesy or astronomy and last but not least in the field of hydrography.

REFERENCES

[1] *Achim F.,* Cartografie geografică, Editura Universitară, București, 2018;

[2] *Bârliba C.,* Desen tehnic și cartografie, Editura Solness, Timișoara, 2006;

[3] *Bârliba C.,* Ridicări topografice speciale, Note de Curs USAMVBT, 2018;

[4] *Herbei M.V., Herbei O.,* Proiecții cartografice, Editura Universitas, Petroșani, 2011;

[5] *Munteanu C. Gh.,* Cartografie matematică, Editura Matrixom, București, 2010;

[6] https://docs.qgis.org/2.14/ro/docs/gentle_ gis_ introduction / raster_data.html

[7] https://ro.wikipedia.org/wiki/AutoCAD

[8] https://www.cadware.ro/magazin/autocad-raster-design/

[9] https://ro.wikipedia.org/wiki/O%C8%9Belu_Ro%C8%99u

[10] www.ancpi.ro;

[11] http://rompos.ro/