CORRELATION OF THE INFORMATIC SYSTEM ON AGRICULTURAL CADASTRE WITH THE SOIL RESOURCES FROM THE TERRITORIAL ADMINISTRATIVE UNITS WITH UNDERGROUND DRAINAGE SYSTEMS

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Abstract: The National Cadastre and Land Registration Program that started in 2015 and is scheduled to be finished in 2023 is meant to ensure the systematic registration of all real estates in Romania, for the cadastral sectors of 3181 administrative territorial units. Some of the basic elements in favour of these changes are: the development of irrigation systems, rehabilitation of land developments works, the development of infrastructure projects for transport routes, unprivileged areas, etc. In this context, there are included all the administrative territorial areas where, at various moments in time, there have been conducted different hydro-ameliorative works and underground drainage systems have been implemented. In Suceava County, these works covered 55,100 ha and included 20 large systems and numerous local systems. The case study consists in the correlation of the graphic and alphanumeric database with the soil-land cartographic units that were identified in the Baia – Sasca hydro-ameliorative system. The mapping activity was conducted between 1976-1977 on a surface of 6,500 ha, and the hydrotechnical schemes were created in 1978-1980 on a total surface of 5,527 ha; from the total surface mentioned before, 1,806 ha also included a systematic underground drainage system with ceramic pipes. The cadastre and land registration activity from the six territorial administrative units of the Baia – Sasca system permited the correlation of the database into an integrated system. The present spatial distribution of the six territorial administrative units: Horodniceni, Cornu Luncii, Rădăşeni, Baia, Fântana Mare and Vadu Moldovei, includes 30,167 ha of the total surface of the agricultural and non-agricultural land.

Key words: agricultural cadastre, soil taxonomic and cartographic units, draining system, underground drainage system

In the case of agricultural lands, based on the technical cadastral data, various information systems are developed for the main categories of agricultural destinations as well as for all the land improvement activities. The implementation of the **National Cadastre and Land Registration Program** that started in 2015 and which is estimated to end in 2023, consists in the systematic registration of real estates on cadastral sectors and administrative territorial units. This program is to be financed by the National Agency for Cadastre and Real Estate Publicity (900 mil. euro), external non-refundable funds (European Union, 312 mil. euro) and funds from the budgets of the administrative territorial units (http://www.ancpi.ro/pnccf/).

The integrated cadastre and real estate system is estimated to be conducted over the nine years of the National Cadastre and Land Registration Program, respecting the present administrative territorial organisation of Romania, which includes **3181 territorial administrative units** with the following structure: **103 municipalities, 217 cities and 2861 communes**, the latter ones including also **12957 villages** (Annual Statistics of Romania, 2015).

The present data indicate the existence of **40 mil real estates** that need to be registered by the National Agency for Cadastre and Real Estate Publicity, of which: **8 mil real estates** (20%) in urban administrative territorial areas and **32 mil real estates** (80%) in rural administrative territorial areas. The present structure and usage of Romania's real estate represents the result of the modifications that occurred in time. In this context there are mentioned various types of cropping and hydro-ameliorative works. The types of works for agricultural and non-agricultural lands include, among others: irrigation systems, surface and underground drainage systems and impounding and regulating water courses, preventing and counteracting soil erosion and landslides, respectively.

In the natural area of Suceava County, that is, on the **total surface of 8,553 km^2**, the works conducted consisted mainly in drainage and underground tile draining systems. The present territorial administrative organization of Suceava County includes **114 administrative territorial units**, structured as follows: **5 municipalities, 11 cities and 98 communes**, the latter ones including also **379 villages.**

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MATERIAL AND METHOD

The distribution of agricultural lands in the extra-Carpathian area of Suceava County was influenced in time by excessive humidity (pluvial and phreatic) which pointed out their existence in a certain climatic area.

The most well-known areas affected by excessive humidity are the following: the **wet meadow and the terraces of Siret, Suceava and Moldova rivers; Falticeni Plateau, Dragomirnei Plateau, Radauti Depression and others.**

In Suceava County it has been indicated a total surface of 88,269 ha of agricultural land with excessive humidity and 60,138 ha floodable land due to river overflow (Moca, V., Bucur, D., 2014).

Considering the natural conditions from the meadows and the terraces near the Moldova river, the hydrographic sector of **Cornu Luncii – Fântâna Mare** has frequently been characterized by periodic excess of humidity in the soil – subjacent rock system. In order to eliminate the excess of water from the soil various systematic surface and underground drainage work have been conducted.

The purpose was to improve soil aeration and provide relatively good conditions for the agricultural lands.

For the correlation of the present cadastre and land registration system with the resources of the soil and the existent infrastructure works – surface and underground pipe drainage works - the **Baia-Sasca hydro-ameliorative system** from the hydrographic basin of Moldova river was taken into consideration.

The hydro-ameliorative works conducted between 1978 - 1980 covered the cadastral sectors of five administrative units. They included surface and underground pipe drainage systems.

Nowadays, given the reorganization of administrative – territorial units, the area of the Baia – Sasca hydro-ameliorative system covers the following six territories: **Horodniceni, Cornu Luncii, Rădăşeni, Baia, Fântana Mare and Vadu Moldovei**. The total surface of the land from the six administrative territorial units equals **30,167 ha**.

The technical cadastral and real estate works are to be implemented on cadastral sectors, respecting the documents and the property right of each real estate, both on field and on the basic topographic plan.

The graphic spatial distribution fund for the hydrotechnical scheme of the Baia – Sasca hydro-ameliorative system, included, according to the official cartographic framing, **28 geodetic trapeziums**, scale 1:5 000 (Figure 1).

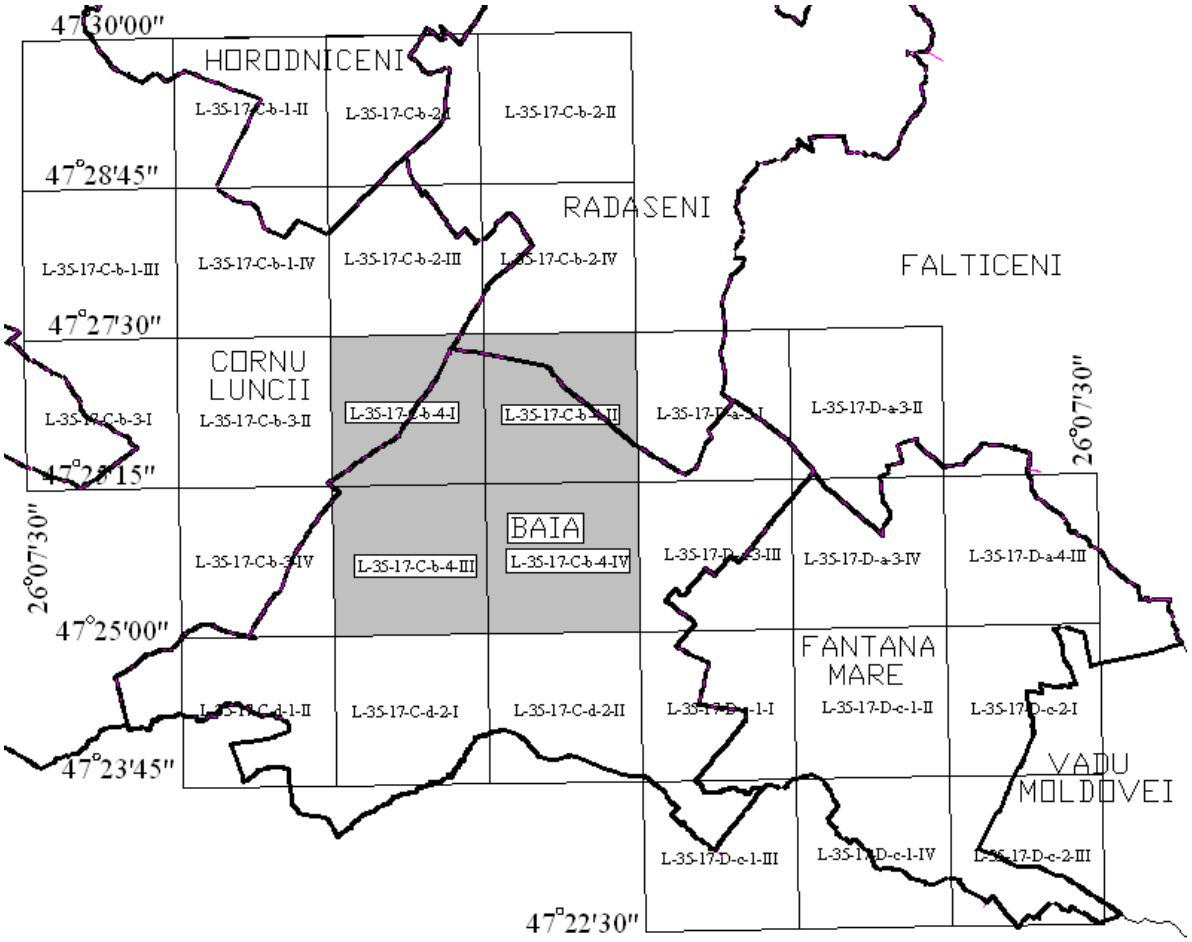


Figure 1 **Cartographic framing of administrative territorial units on geodetic trapeziums, scale 1:5 000**

RESULTS AND DISCUSSIONS

The implementation of the cadastre and land registration system in the territorial administrative units ensures, from a practical point of view, the answer to both economic and legal demands of local communities.

a. Mapping and classification of soil units from the Baia- Sasca hydro-ameliorative system

The pedological studies conducted during the design phase of the Baia-Sasca hydro-ameliorative system from 1976-1978 included a total surface of **6,500 ha**, from six territorial units, namely: Horodniceni, Cornu Luncii, Radaseni, Baia, Fantana Mare and Vadul Moldovei. The identification and the areas where the soil units could be found was possible at the time of the pedological mapping process using the criteria mentioned in the Romanian Soil Classification System (**SRCS – 1976, 1980**).

Considering the pedegenetic conditions of the Baia-Sasca Depression, four soil classes have been identified: **mollisols, argiluvisols, hydrogenic soils** and **imature soils**, that included, at higher and lower level, **11 types, 21 subtypes and 47 soil varieties** (Table 1).

Table 1

Classification of soil types and subtypes from Baia Depression, according to the Romanian Soil Classification System (SRCS – 1976, 1980)

Crt. no.	Soil class, type and subtype	Area	
		ha	%
	MOLLISOLS	**2,729**	**42.0**
1	Argilic cambic pratoziom	134	2.1
2	Grey cambic soil	431	6.6
3	Grey pseudogleyied soils	2164	33.3
	ARGILUVISOLS	**522**	**8.0**
4	Argilic brown soil	87	1.3
5	Pseudogleyied podzolied brown soil	213	3.3
6	Podzolic pseudogleyied soil	146	2.2
7	Podzolic pseudogleyied soil	76	1.2
	HYDROGENIC SOIL	**1482**	**22.8**
8	Tipic pseudogley	65	1.0
9	Mollic pseudogley	405	6.2
10	Podzolic pseudogey	210	3.3
11	Mollic amphigley	500	7.7
12	Cambic amphigley	152	2.3
13	Histic gley	150	2.3
	IMATURE SOIL	**1767**	**27.2**
14	Mollic alluvial soil	465	7.2
15	Lithic alluvial soil	41	0.6
16	Gleyic alluvial soil	177	2.7
17	Mollic lithic alluvial soil	653	10.0
18	Mollic gleyied alluvial soil	138	2.1
19	Lithic alluvial soil	267	4.1
20	Gleyied colluvial soil	16	0.3
21	Pseudogleyied eroded soil	10	0.2
TOTAL SURFACE MAPPED		**6,500**	**100.0**

By adopting the Romanian Soil Taxonomy System, which based on the passing of time and experience, developed four editions, **SRTS – 2000, 2003, 2012, 2012**$^{+}$, resulted an improvement of the practical usage of soil units and also their correlation to the world wide existent systems.

The present soil taxonomy system (**SRTS – 2012, 2012**$^{+}$) has defined 12 soil classes compared to the 10 classes of the old system (**SRCS – 1976, 1980**). The updating of soil units at class level was possible depending of the presence of a certain horizon real estate reference point (Vlad, V., Florea, N., et. al., 2014).

Based on the correlation of SRCS and SRTS soil classification systems (Moca, V., Filipov, F., et. al., 2015) resulted **six soil classes**, keeping the **21 soil types/subtypes**, but including them in different classes (Table2).

Table 2

Classification of soil types and subtypes from Baia Depression, according to the Romanian Soil Taxonomy System (SRTS-2012, 2012^{+})

Crt. no.	Soil class, type and subtype	Area	
		ha	%
CERNISOLURI		**3,229**	**49.7**
1	Faeoziom cernoziomid cambic (FZ cm.cb)	134	2.1
2	Faeoziom cambic greic cernic (FZ cb.gr.ce)	431	6.6
3	Faeoziom argic greic stagnic cernic (FZ ar.gr.st.ce)	2,164	33.3
4	Faeoziom gleic cernic (FZ gl.ce)	500	7.7
CAMBISOLURI		**152**	**2.3**
5	Eutricambosol molic amfigleic (EC mo.dg.st)	152	2.3
LUVISOLURI		**446**	**6.8**
6	Preluvosol tipic (EL ti)	87	1.3
7	Luvosol stagnic (LV st)	213	3.3
8	Luvosol albeglosic stagnic (LV gl.st)	146	2.2
HIDRISOLURI		**906**	**14.0**
9	Stagnosol tipic (SG ti)	65	1.0
10	Stagnosol molic (SG mo)	405	6.2
11	Stagnosol luvic (SG lv)	210	3.3
12	Albeglosic Stagnosols (SG ab.gl.dg)	76	1.2
13	Gleiosol histic (GS tb)	150	2.3
PROTISOLURI		**1,757**	**27.0**
14	Aluviosol molic (AS mo)	465	7.2
15	Aluviosol prundic (AS pr)	41	0.6
16	Aluviosol gleic (As gk)	177	2.7
17	Aluviosol molic prundic (AS mo.pr)	653	10
18	Aluviosol molic batigleic (AS mo.dg)	138	2.1
19	Aluviosol entic eutric (AS en.eu)	267	4.1
20	Aluviosol coluvic batigleic (AS co.eu)	16	0.3
ANTRISOLURI		**10**	**0.2**
21	Antrosol erodic (AS er)	10	0.2
TOTAL SURFACE MAPPED		**6,500**	**100.0**

The basic cadastral entities of the technical and qualitative cadastre are to be represented graphically on the basic topographic plan, scale 1:5000. In this context, four trapeziums with the following nomenclature have been selected **L-35-17-C-b-4-I; L-35-17-C-b-4-II; L-35-17-C-b-4-III and L-35-17-C-b-4-IV**, respectively, that mainly, cover the administrative territory of the Baia commune, Suceava County.

The graphic representation of the four trapeziums, scale 1:5000, includes a total surface of 2183.9068 ha, that is the equivalent of 33.6% of the total soil map surface, and indicates the spatial distribution of soil units (1, 2, 3, …, 47).

The equivalation of old soil names with new ones from the new system conducted to the following framing of the soil units from the four trapeziuns considered in this study: **five soil classes: 14 types/subtypes and 30 soil varieties** (Figure 2).

b. Elements of surface and underground drainage in the Baia-Sasca system

In the "**Baia Depression**" which includes the meadow and the terraces on the left side of Moldova river from the sector of **Cornu Luncii – Baia – Fantana Mare hydrographic basin**, have been conducted between 1978-1980 extended works for removing the surface and underground water excess.

The Baia-Sasca hydro-ameliorative system included a total surface of 5,527 ha from six territorial administrative units.

On 1,806 ha there was also a systematic underground clay drainage system (Moca, V., Bucur, D., 2014).

The scheme of the surface and underground pipe drainage network from the Baia commune is presented below (Figure 3).

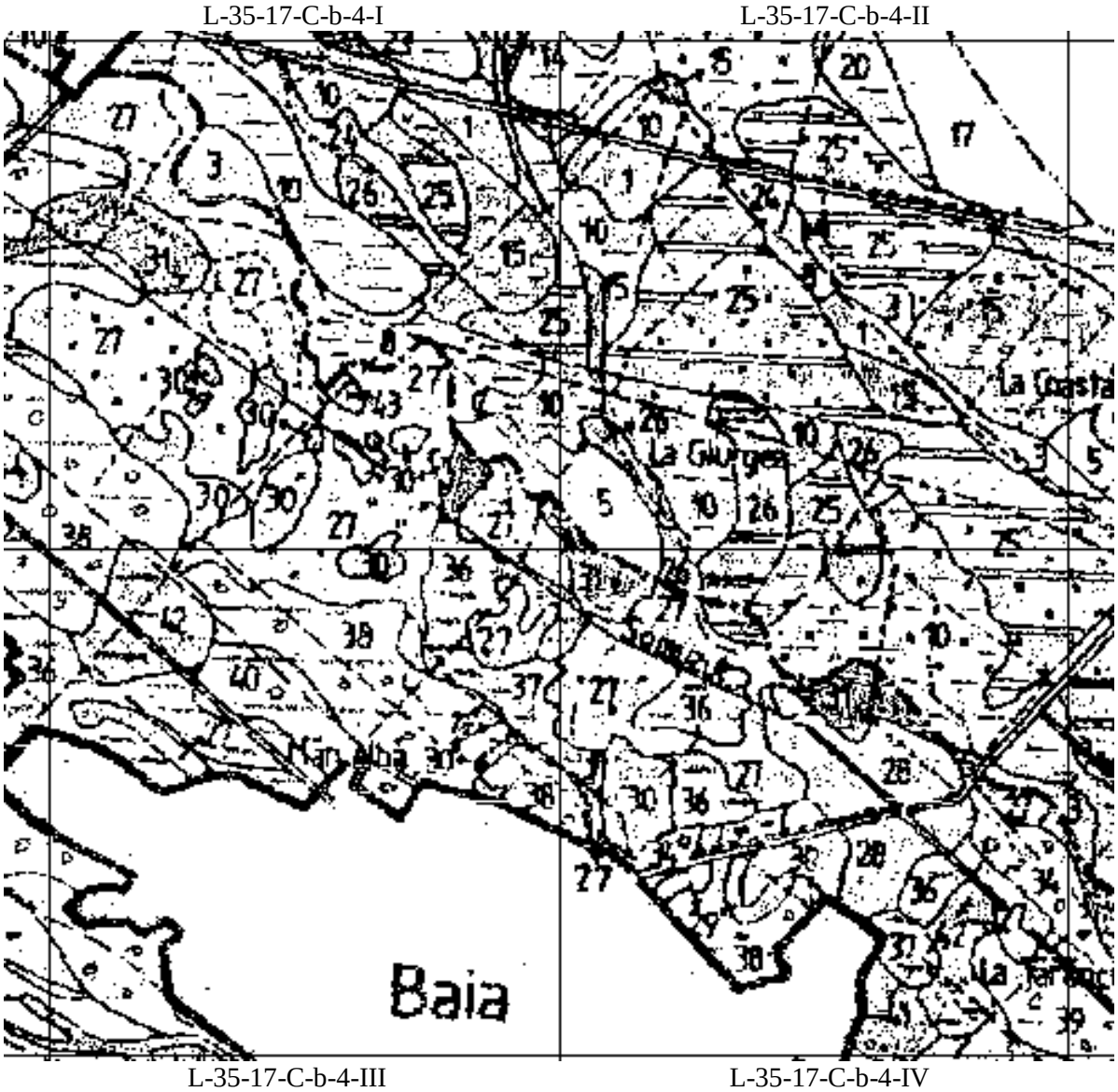
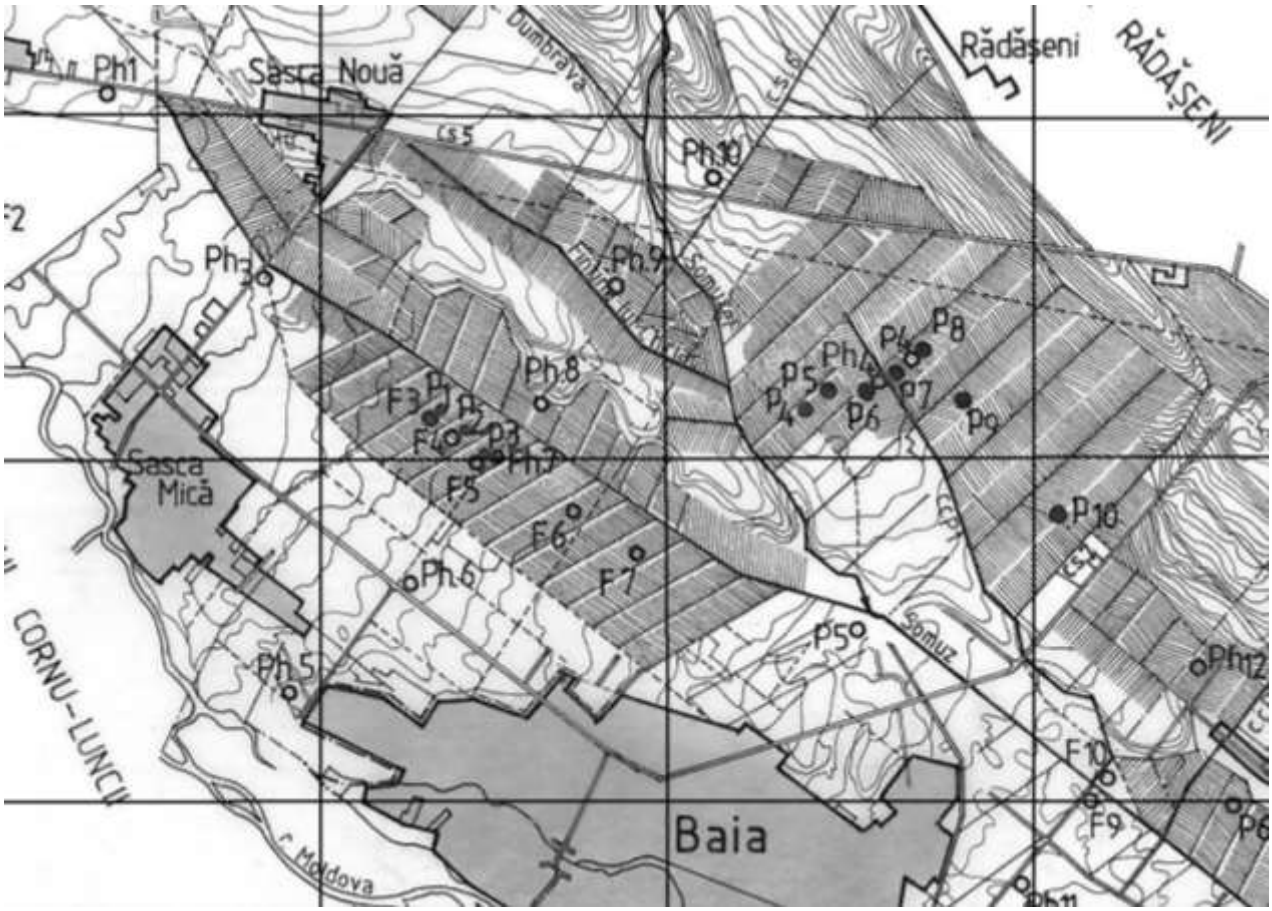


Figure 2 **Soil units mapping on trapeziums in Baia commune, scale 1:5000**

L-35-17-C-b-4-I L-35-17-C-b-4-II



L-35-17-C-b-4-III L-35-17-C-b-4-IV

Figure 3 **The surface and sub-surface drainage network in Baia, on trapeziums, scale 1:5000**

The surface and underground pipe drainage works from the meadow and the low terraces of Moldova river were conducted on the following soil-land units: Aluviosol gleic (As gk); Aluviosol molic batigleic (AS mo.dg); Gleyic Phaeozems (LV ab); Mollic stagnic gleyic Combisols (CM mo-gl-st) and Histic Gleysols (GL hi), (Table 1).

On the platforms from the middle terrace of the Moldova river, the surface underground drainage system was expanded on the following soil units: Haplic Stagnosols (ST ha), and Luvic Stagnosols (ST lv), (Table 1).

At the same time, these works are also mentioned on isolated areas – on the platforms of high terraces with depression like features, on the following soil units: Stagnic Luvisols (LV st); Stagnic Albeluvisols (AB st) and Stagnic Albeluvisols (AB st), (Table 1).

Depending of the presence of a certain diagnosis and/or a key feature of the soil considered, the soil units were equivalated from the Romanian Soil Classification System (SRCS – 1976, 1980) into the Romanian Soil Taxonomy System (SRTS – 2012, 2012^{+}), presented above (Table 1 and Table 2).

The representation of the hydro-ameliorative system on the **control areas** of the four trapeziums scale 1:5000 pointed out the structure the wideness of the works and the hydrotechnical constructions.

The total length on the drainage canals of various orders, at a distance of 300 - 400 m between them, was of 168,10 km.

The underground pipe drainage system included clay and locally, plastic pipes, respected the 15-20 m distance between the absorbent drains and posing depth of 0.80 - 1.10 m (Figure 3).

c. The correlation of a real estate extract with soil units and the hydro-technical scheme

For the correlation of the graphic and alphanumeric cadastral database with soil units and the elements of the surface and underground drainage network, it was considered a real estate extract of **38.5118 ha**, of an agricultural land used as natural pasture. The surface measured was determined using the system of coordinates of the 1970 Stereographic projection. It was also graphically represented on the geodetic trapezium at scale 1:5000 (L-35-17-C-b-4-I) with the control and compensation area of 545,8709 ha (Figure 4).

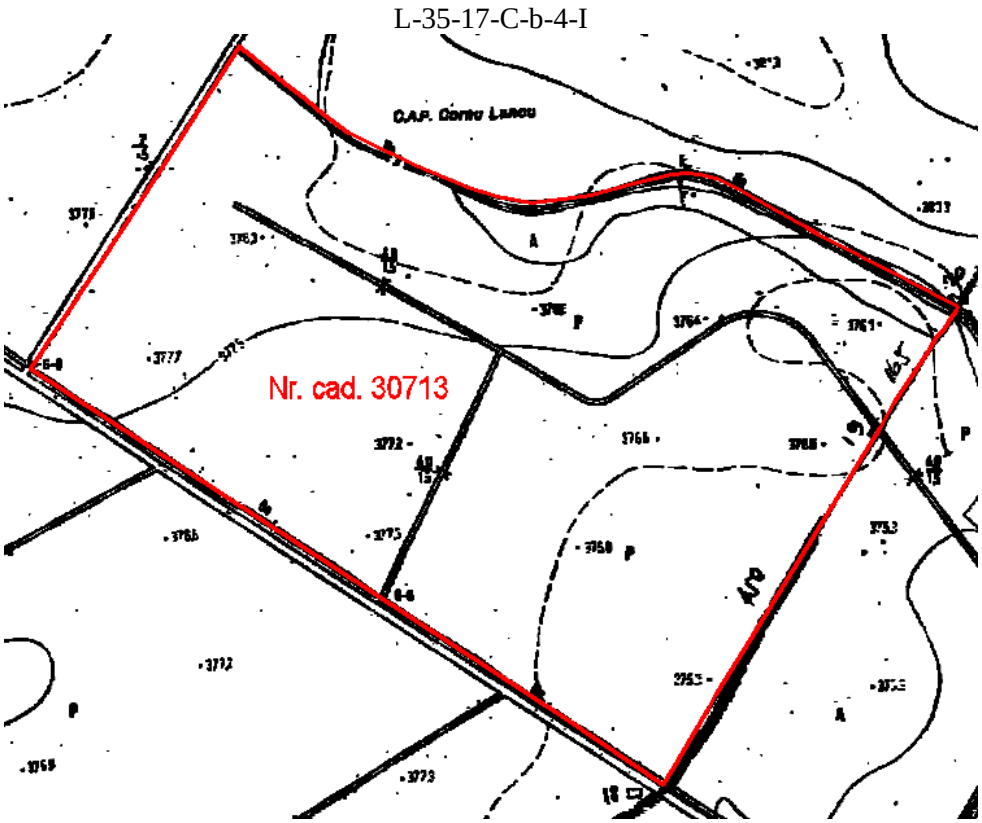


Figure 4 **Representation of the real estate register no. 30713 in the L-35-17-C-b-4-I trapezium, scale 1:5 000**

The incorporated agricultural land as private property was identified on field and represented graphically based on the rectangular coordinates of the 47 points placed on the borders of the field measured. They were obtained using the 1970 – Stereographic projection method.

The length of the partial segments between the points identified on the geometric border ranged between the minimum limit of 3,591 m (points 19-20) and maximum limit of 674,651 m (points 2-3).

On the surface of the cadastral sector with agricultural destination represented in the trapezium **L-35-17-C-b-4-1**, scale 1:5000, the following types of soil were identified: Faeoziom gleic cernic (FZ gl.ce); Eutricambosol molic amfigleic (EC mo.dg.st); Gleiosol histic (GS tb), after the correlation of the two soil classification systems SRCS - 1976, 1980 and SRTS – 2012, 2012^{+}, respectively.

On these soil-land units, scarcely drained, characterized by a depression like relief with the water layer relatively close to the surface it has been implemented a systematic surface and underground pipe drainage network.

Some of the infrastructure elements of the systematic underground drainage network are: the distance between the adsorbent drain lines (20m); the depth of the drain pipes (1,0m), the types of pipes used (pipe are from ceramic).

CONCLUSIONS

The graphic representation of the soil map and the hydrotechnic scheme of the Baia-Sasca system consisted in 28 trapeziums, scale 1:5000.

The spatial distribution of the soil map and the hydro-ameliorative system included the cadastral sectors of six administrative units.

On the cadastral sector represented by agricultural land with the surface of **38,5118 ha** there have been identified three soil units and a systematic underground pipe drainage network.

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