



OFFICE FOR PEDOLOGICAL AND AGROCHEMICAL STUDIES CLUJ
Fax code 4736469, IBAN account RO43TREZ21620F330800XXXX,
Cluj Treasury Bank, Code 400483 Cluj-Napoca, no. 1 Fagului Street
Cluj county, Tel. 0264-443471, tel./fax 0264-443467,
e-mail: CLUJ.OSPA@YAHOO.COM, web: www.ospacluj.ro

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PEDOLOGICAL STUDY

FOR

Drafting of the

Documentation for the *Design competition*

with the purpose of developing the “*Parcul Est*” area

Beneficiary: The Order of Architects of Romania (OAR)

DIRECTOR
Prof. Dr. Eng. Teodor Rusu

DRAFTED
Dr. Eng. Horatio Fodor

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Presentation note

Paper title: Pedological study necessary for:

Drafting the Documentation for the *Design competition* with the purpose of developing the “Parcul Est” area

Contractor- *OSPA Cluj, no. Fagului Str., CLUJ-NAPOCA*

Paper beneficiary: *The Order of Architects of Romania (OAR)*

Land location: On the placement of the RADP Gheorgheni nursery, delimited by Dunarii Str. to the north-west, Lake 3 and the Gheorgheni Sports Base to the south-west, the Becas creek to the south-east, and the Sellgros supermarket to the north-east.

Studied surface area: **39.95 ha**

The fruit-bearing species that shall be planted: forest species and dendrological - flowery cultures

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General considerations

I. Introduction

1. The object and purpose of the pedological study

The pedological and agrochemical study for establishing the land's suitability for dendrological - flowery cultures was executed as to ensure the designer's access to the data necessary for the creation of the plantation, that is:

The soil units on the studied territory, the fact that they favor these dendrological-flowery plantations, as well as their sustainability for forest species.

II. Physics-chemical conditions

The studied land within the Cluj municipality is geographically located within the Somesul Mic Corridor, however, also at the intersection of the largest two morphological regions of the Transylvanian Plateau, respectively the Somesan plateau and Transylvanian Plain.

The studied area is located on the first terrace of Somesul Mic, on the bekas creek's everglade.

Geomorphology

The studied area is plane, (3% slope) and is characterized by alluvial soils and histosols.

2. Geology and parental materials

The geological formations that stand at the basis of the pedogenesis process within the Cluj municipality territory are Paleogene, Neogene, and Quaternary. These formations stand out due to the appearance of some of the most varied rocks: marl, marl sandstone, clay, saliferous marl, volcanic tephra, clay marls, sands, gravel etc.

The studied area is located in the Quaternary system, the Holocene series, the superior floor, represented through gravel and sands.

3. Hydrography and hydrogeology

The land pertaining to the Cluj municipality is completely part of the Somes' hydrographic reservoir.

- The primary water course is represented by Somesul Mic, that passes this territory from west to east.

Becas creek is located in the southern side of the land, and flows into the Somesul Mic. It has a variable flow depending on the season. As such, in spring the flow is greater and towards the end of summer and in autumn, the flow is lighter.

The groundwater depth is of 1.5 - 2 m in the forest vegetation area and under 50 cm around lakes and rush-beds.

4. Climate regimen

The characterization of zonal climate was carried out in accordance with the data registered at the Cluj-Napoca meteorological station.

The mean average temperature in the Cluj-Napoca municipality area is 8.2°C, and the annual amplitude, resulted from the mean differences of the coldest month with those of the warmest month, is of 23.3°C.

Annual mean precipitations present 613 mm values: where the largest quantity of precipitations falls in June (most often torrential precipitation), and the minimum quantity of precipitations is registered in January-February and August-September.

The annual Martonne aridity index is between 25-35, with the highest values in January, and lower ones in September and March. This aridity index emphasizes a certain humidity deficit for the entire municipality's territory.

The thermal and precipitation regimen is as follows:

- Mean annual temperature: +8.2°C;
- Mean January temperature: -4.0 °C;
- Mean July temperature: +18 °C;
- Annual mean precipitations: 630 mm/year;
- The maximum absolute temperature was recorded on 22.07.1939 - (+36.8°C)

- The minimum temperature was recorded on 11.02.1929 (-32.5°C)
- Average nebulosity is almost 50% of year days, with a maximum during autumn and winter.

According to data within the climatological atlas, the climatological data are as follows:

Means monthly temperature

Table 1

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
-4	-2	3	9	14	16	18	18	14	9	3	-1	8.2

Daily maximum and minimum average

Table 2

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Daily max.	0	2	8	16	20	24	26	26	20	16	8	2
Min. daily	-7	-5	-2	4	8	10	12	12	8	4	0	-4

Absolute maximum and minimum

Table 3

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		.	.	.	y	e		g.	t.			

Absolute minimum	-29.9	-32.5	-22.0	-7.4	-3.1	-0.1	5.4	4.2	-3.0	-5.6	-19.1	-27.9
Max. absolute	14.0	17.3	26.4	30.2	31.5	34.7	36.8	36.1	33.7	32.2	26.0	16.0

The annual sum of daily average temperatures $\geq 0^{\circ}\text{C}$ - 3200

The annual sum of daily average temperatures $\geq 5^{\circ}\text{C}$ - 2800

The annual sum of daily average temperatures $\geq 10^{\circ}\text{C}$ - 2400

The annual sum of daily average temperatures $\geq 15^{\circ}\text{C}$ - 1600

First day with daily average temperatures $\geq 0^{\circ}\text{C}$ - 1 March

First day with daily average temperatures $\geq 5^{\circ}\text{C}$ - 1 April

First day with daily average temperatures $\geq 10^{\circ}\text{C}$ - 11 April

First day with daily average temperatures $\geq 15^{\circ}\text{C}$ - 21 May

Last day with daily average temperatures $\geq 0^{\circ}\text{C}$ - 1 December

Last day with daily average temperatures $\geq 5^{\circ}\text{C}$ - 1 November

Last day with daily average temperatures $\geq 10^{\circ}\text{C}$ - 1 October

Last day with daily average temperatures $\geq 15^{\circ}\text{C}$ - 11 September

First day of frost October 1st

Last day of frost after May 1st

Mean monthly precipitations

Table

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	annual
30	20	30	50	70	100	80	80	50	50	30	30	620

A series of climate anomalies took place over the last years. We can present the air minimum, maximum and annual means between 2007-2011 taken from the Cluj meteorology station.

Table 5

Year	2007			2008			2009			2010			2011		
Station	min	max	mean												
Cluj-Napoca	-10.2	36.0	10.1	-14.0	34.4	9.7	-18.1	33.2	10.0	-18.1	33.8	9.3	-18.6	33.7	8.8

As can be observed, the mean annual temperatures have increased between 2007-2011. It is necessary to take over certain climate data associated to 2012-2018 as well, in order to see the actual trends of the climate elements.

The annual precipitation quantities between 2007-2011 are as follows:

Table 6

Year	2007	2008	2009	2010	2011	Mean
Cluj-Napoca	806.3	675.0	593.8	811.8	509.8	679

As can be observed, the annual mean over 5 years does not differ greatly from the mean over 30 years indicated in the Climatological Atlas; however, there are significant fluctuations from year to year.

In conclusion, we can say that Cluj municipality, according to the Koppen classification system, falls under the following climate formula: D.f.b.k:.

5.1 Soil drainage

The global drainage of the land is moderate on the forest land surface and weak around the lakes in the area.

6. Soil coating

The soils in the area fall under the Protisoils and Histosoils

The legend of soil units is as follows:

Table 7

No. SU	Soil type	Main profiles	Texture		Depth of underground water
			Ap	Control section	
	protisoils				
1	Moderate gley alluvial-soil	1	Clay-lute	Lute	1-2 m
	Histosoils				
2	Histosoil	2	lute	Organic dep.	< 0.50 m

7. Characterization of soils within the studied perimeter (pedologic profile sheets)

In the following, we shall present the morphological, physical, and chemical description of the aforementioned soils

SOIL TERRITORIAL UNIT (SU) no. 1

Denomination: Moderate gley alluvial-soil on the alluvial deposits, clay/lute

Formula: SAgo-K1-d6-FPm—G3- 61/42-

County: CLUJ

Administrative territory: Cluj-Napoca municipality

Geographical coordinating: 46.777532 N 23.64293 E altitude 333 m

Terrain aspect: normal

Natural conditions in which it occurs: meadow terraces

Main soils with which it associates: typical gley soil, gley alluvial soil

SOIL CHARACTERISTICS

Morphological

Ao 0-25 cm clay-lute, 10 YR 4/3 (brown) sub-glandular poliedric

medium, plastic, and adhesive, roots frequent, strong effervescence

A/CGo 25-54 cm clay-lute, 5Y 5/3 (olive), 25% reduction stains, medium sub-angular poliedric, plastic and adhesive, strong effervescence, rare roots.

CGo 54-110 cm lute, 5Y7/3, (weakly yellow) sub-angular poliedric medium, 20% reduction stains, Fe and Mn stains, weakly plastic and adhesive, strong effervescence

Analytic data of SU 1

Profile 1

table

8

Horizons	Ao	A/CGo	CGo	
Depth of sample collection (cm)	5-15	35-45	60-70	
PHYSICAL ANALYSES				
Gravel/grit	9.75	11.28	20.42	
Fine sand	17.99	12.79	36.45	
Dust I	604	7.68	8.07	
Dust II	18.46	20.17	10.85	
Clay	47.76	48.08	24.41	
Texture interpretation	AL/61	AL/61	LL/42	
<i>Chemical analyses</i>				
pH	8.08	8.05	8.25	
<i>Interpretation</i>	<i>Weakly alkaline</i>	<i>Weakly alkaline</i>	<i>Weakly alkaline</i>	
Carbonate %	12.40	13.50	12.10	
<i>Interpretation</i>	<i>medium</i>	<i>High</i>	<i>medium</i>	
Humus %	3.33			
<i>Interpretation</i>	<i>low</i>			
Nitrogen index				
<i>Interpretation</i>				
Mobile P (ppm)	33			
<i>Interpretation</i>	<i>medium</i>			
Mobile K (ppm)	876			
<i>Interpretation</i>	<i>Very high</i>			
V %	100			
	Saturated in the bases			

Denomination: Eutric histosoil

County: CLUJ

Administrative territory: Cluj-Napoca municipality

Geographical coordinating: 46.77461 N 23.63023 E 329 m

Terrain aspect: normal

Natural conditions in which it occurs: meadow terraces, around the lakes 1 and 2 Gheorgheni

Main soils with which it associates: typical gley soil

SOIL CHARACTERISTICS

Morphological

Ao Gr/T 0-26 cm lute, 5 Y 3/1 (very dark gray) weak, small grainy
plastic and adhesive, frequent roots, gradual passing

T 26-120 cm organic deposits 2,5Y 3/3 (very dark gray) non-structured

Analytic data of SU 2

Profile 2

table

9

Horizons	Ao Gr/T	T		
Depth of sample collection (cm)	5-15	30-60		
PHYSICAL ANALYSES				
Gravel/grit	0.29			
Fine sand	41.47			
Dust I	8.57			
Dust II	17.72			
Clay	31.95			
Texture interpretation	<i>LL/42</i>			
<i>Chemical analyses</i>				
pH	7.55	7.87		
<i>Interpretation</i>	<i>Weakly alkaline</i>	<i>weakly alkaline</i>		
Carbonate %				
<i>Interpretation</i>				
Humus %	25.33			
<i>Interpretation</i>	<i>Organic matter</i>			
Nitrogen index				
<i>Interpretation</i>				
Mobile P (ppm)	36			
<i>Interpretation</i>	<i>Medium</i>			
Mobile K (ppm)	810			
<i>Interpretation</i>	<i>Very high</i>			
V %				

From the studied soils, SU 1 (gley alluvial soil) appears on most land portions in the future park. As we have observed, there are portions lacking in forests, with different wastes covered in soil. After deforestation, there must be identified and, eventually, dislocated from the area depending on the found waste.

Given the fact that dendrological and flowery plant species shall be planted on the studied land, we shall execute the suitability for sylvan developments.

III. Establishing the suitability class of the land for sylvan developments

In order to obtain a greater accuracy regarding the creation of a sylvan plantation, we shall approach this subject in accordance with Chapter 8 under the second volume of the Methodology for pedological studies with the title (ELABORATION METHODOLOGY FOR PEDOLOGICAL STUDIES CARRIED OUT PRIOR TO SYLVAN DEVELOPMENTS)

ADDENDUM 8-12. Classification criteria of lands depending on the sylvan suitability

SU 1 - Moderate gley alluvial-soil		
	values	Suitability class
Thickness of soil until compact rock limitations	088	II - reduced
Useful edaphic volume limitations	088-high	II - reduced
Skeleton content	15-weak	II - reduced limitations
Soil texture	61-AL	III - moderate limitations
Soil compactness limitations	sc - weakly compact	II - reduced
Salinity	no salinity	I - no limitations
Organic matter content	03 - low	III - moderate limitations
Slope	horizontal	I - no limitations
Affectation - erosion	not eroded	I - no limitations
Land slide categories	absent	I - no limitations
Underground water depth limitations	02.0 - low	III - moderate
Gleization	3-moderate gley	III - moderate limitations
Surface humidity excess	1 - practically null	I - no limitations
Stagnogleization degree	1 no stagnogleization	I - no limitations
Flooding character limitations	2 rarely flooded	II - reduced

We can conclude that, from the point of view of the suitability for sylvan plantations, this soil has a medium sylvan suitability with moderate limitations due to the clay-lute

texture content of organic matter, the depth of the underground water and the gleization degree.

SU 2 - Eutric histosoil		
	values	Suitability class
Thickness of soil up to the compact rock	113	I - no limitations
Useful edaphic volume	113 - very high	I - no limitations
Skeleton content	without	I - no limitations
Soil texture	42-clay	I - no limitations
Soil compactness	fn-very soft	I - no limitations
Salinity	no salinity	I - no limitations
Organic matter content	06-very high	I - no limitations
Slope	horizontal	I - no limitations
Affectation - erosion	not eroded	I - no limitations
Land slide categories	absent	I - no limitations
Underground water depth very low	0.02-low	V-lands with sylvan suitability
Gleization degree sylvan suitability	5-very strong gleization	V-lands with very low
Surface humidity excess suitability	extremely high	V-lands with very low sylvan
Stagnogleization degree	1 no stagnogleization	I - no limitations
Flood character limitations	3 very frequently flooded	IV - severe

As can be observed, the studied land located around the lakes is inadequate for sylvan plantations. These areas must be kept with grass and reed plantations. These have the role of filtrating the water in the lake. Water loving species, wicker, willow etc. can be planted at a distance greater than 10-15 m from the water surface.

The data in the tables above are synthetically presented under the following table

Table 10

No. SU	Denomination	Suitability to silviculture
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1	SU 1 - Moderate gley alluvial-soil	Moderate limitations III
2	SU 2 - Eutric histosol	Severe limitations V

IV Classes of favorability for the species suitable for the analyzed land

According to Chapter 8 under the second volume of the Methodology for pedological studies with the title (ELABORATION METHODOLOGY FOR PEDOLOGICAL STUDIES CARRIED OUT PRIOR TO SYLVAN DEVELOPMENTS)

We shall classify under favorability classes the sylvan species that will probably be planted in the future Parcul Est on the surface area with the moderate gley SU1-Alluvial-soil, that is suitable for these species.

These favorability classes are:

I - very high favorability FR

II - high favorability R

III - medium favorability M

IV - low favorability S

V - very low favorability FS

The favorability classes of ecological factors and determinants for the species:

Item no.	Ecological factor or determinant	Value s.	Favorability classes for the species							
			Holm	Beech	hornbeam	linde	maple	ash	Oak pedunculate and common	locust tree
1	Annual mean temp.	8.2oC	I	III	IV	III	III	I	III	III
2	Thermal sum over 10o C	2400	I	I	IV	V	IV	II	IV	-
3	Annual mean precipitations	633 mm	II	II	IV	III	III	I	III	I
3	pH value in the Ao horizon	8.08						I	-	
4	Sum of changeable bases	100	I	I		-		II	-	-
5	Edaphic volume	088	II	II	IV	IV	III	II	III	II
6	Humus reserve	140 t	II	II	-	-	-		III	III

7	Soluble phosphorus reserve	22	III	III	-	-	-		-	-
8	Soluble potassium reserve	350	II	II	-	-	-		-	-
9	Clay content	47	-		-		-	I	IV	EXCES S III
10	Apparent density	1.30	-					II	II	
11	Depth of underground water	1.5 - 2 m	-	-						II
Sylvan favorability class			III- M	III- M	IV- S	V- FS	IV- S	II- R	IV- S	III- M

As can be observed from the aforementioned species, the ash has a high favorability, the holm, locust tree, and the beech have a medium favorability, and the hornbeam, maple, oak have low favorability. The linden has a very low favorability due to climate factors.

We do not have other data regarding dendrological-flowery species. *In the Elaboration methodology for pedological studies - part II*, chapter 8, we find data only for these species. The data in our instructions are incomplete for the locust tree; data on pH must be consulted, and the carbonates content held by sylvan specialists.

The aforementioned data have a purely guide role, as new dendrological species have appeared, as well as various varieties of the studied species, that have other conditions of ecologic-conditioning.

The favorability classes have been defined with the aid of the relationship between the species' productivity and the values of each factor, there being a strong correspondence between the favorability classes and the productivity classes. In the case in which certain factors occur, which have a much lower favorability compared to the rest of the factors, these shall also determine productivity decreases.

VI Pedological study conclusions

As to conclude with regards to the studied lands' favorability for sylvan species, we shall present the following table:

Table 11

No. SU	Denomination	Suitability to silviculture
1	SU 1 - Moderate gley alluvial-soil	Moderate limitations III
2	SU 2 - Eutric histosol	Severe limitations V

The area around the lakes and reed areas are inadequate for sylvan or dendrological species.

The area around the lake next to Iulius Mall is highly anthropic and cannot be pedologically mapped. The southern part is developed, and the western and northern sides present paved roads, and the eastern part there is a reed portion.

On the area occupied with forest vegetation (SU 1), the studied sylvan species have the following favorability

Table 12

Item no.	Sylvan species	Favorability-productivity
1	Holm	III
2	Beech	III
3	Hornbeam	IV
4	Linden	V
5	Maple	IV
6	Ash	II
7	Pendunculate and common oak	IV
8	locust tree	III

As can be observed from the studied species, the ash has the highest favorability, followed by holm, beech, and locust tree. The hornbeam, maple, and oak have low favorability, and the linden has a very low favorability. We do not have other data regarding dendrological-flowery species. *In the Elaboration methodology for pedological studies - part II*, chapter 8, we find data only for these species.

The aforementioned data have a guide role, as new dendrological species have appeared, as well as various varieties of the studied species, that have other conditions of ecologic-conditioning.

Dr. Eng. Horatio Fodor

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