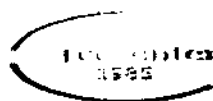


NNLE Ecocenter of Environment Protection



**Hydrological report of the territory owned by LTD “Apolo G.S”
located in Mirza Shafi Street, Tbilisi**



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1. Introduction

On 26-27 January 2015, by the specialists of NNLE Ecocenter of Environment Protection the scientific field work was carried out in Mtatsminda-Krtsanisi administrative district, Abanotubani, in the surrounding area of Mirza Shafi Street, which is the private property of LTD "Apolo G.S." and there is planned to build multifunctional construction.

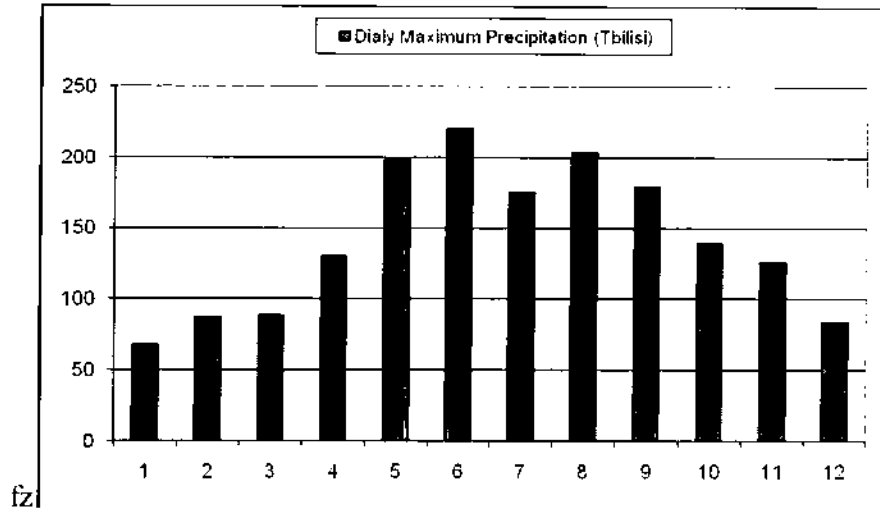
The study area is located on the northern side of Tabori (Seidabadi) hollow. Mountain ridge is sub latitudinal, it begins from Sayaraulo mountain ridge and ends in Tbilisi, near the right bank of river Mtkvari. Study area is processed now and the main part of this territory has a small inclination to the east.

Behind the research territory there is the main part of the ridge slope, which dips north to the river Tsavkisi water and south to the river Dukniskhevi.

According to the research, ground staff of Building plot consist of middle Eocene aged rocks called as "dabakhana row". The rocks are mainly of sandstone, yellow and gray mergel and black argelit serum interchange. On the building area 2650 m² slope of the rock is removed, precipice height is 40-60 meter.

2. Hydrological estimation of Mirza Shafi street territory

According to the data of Tbilisi weather station, rain calculation maximum intensity (1% maintenance) equals 4.58 mm/min, duration of heavy rain – 30 -50 min., rain water layer height 220 mm (draught 1, schedule1)



Draught N1 The maximum values for rainfall distribution chart in Tbilisi

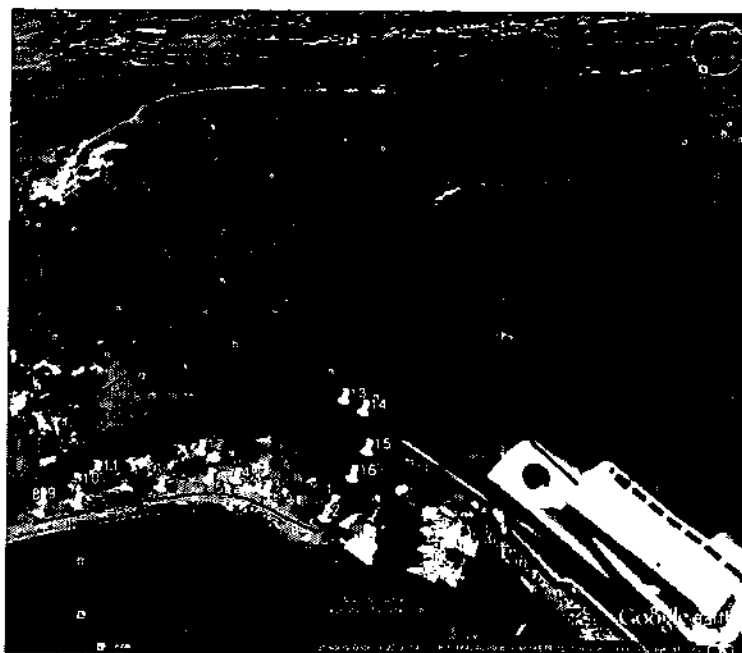
Schedule N1

The maximum intensity of rain $K=0.153$ (mm/min)

The maximum rate of rainfall (mm)

Station	1	2	3	4	5	6	7	8	9	10	11	12
Tbilisi	68	87	88	130	198	220	175	203	179	139	126	83

As a result of ground reconnaissance, orthophotographs and topographic study analyzes was determined catchment pond of rain inflow on plot. It includes surrounding mountain slopes inclined to the plot, total area 8370 m², small part of the catchment pond, = 1100 m² is covered with thin forest (draught N2 and enclosure – picture 1-8). The length of the pond is 211 m; maximal width is 65m; the maximum drop of height – 88m; the average slope – 0.417.



Draught N2, catchment pond of Mirza Shafi Street surrounding area

On the research territory was carried out reconnaissance field works and determined the building area outline coordinates, also the characteristic boundaries of catchment pond. (Schedule N2)

**Schedule N2
Building area outline coordinates**

N	GPS Number	X	Y	H	Remark
1	218	0484217	4614945	440	Sewage well 1
2	219	0484217	4614949	440	
3	220	0484240	4614952	440	
4	221	0484252	4614954	440	
5	222	0484260	4614959	440	Sewage well 1
6	223	0484272	4614970	440	
7	224	0484299	4614990	437	Sewage well 1
8	225	0484299	4614999	437	
9	226	0484302	4614996	436	
10	227	0484297	4614986	441	
11	228	0484295	4614979	442	
12	229	0484270	4614953	447	
13	230	0484237	4614912	449	
14	231	0484228	4614912	448	
15	232	0484218	4614924	447	
16	233	0484217	4614934	445	

In order to determine the maximum discharge of surface water runoff on the research area, it was used the empirical attitude of Professor G. Rostomov, which is recommended for Caucasus Region.

The maximal water flow was calculated according to the attitude:

$$Q = R \frac{\Omega^{\frac{2}{3}} \cdot K^{1.35} \cdot I^{0.38} \cdot \bar{I}^{0.125}}{(L + 10)^{0.44}} \cdot \pi \cdot \sigma \cdot \delta \quad \text{m/cm}^3 \quad (1)$$

Q – The maximum discharge of water flow;

R – The coefficient of research (projection) territory;

Ω - catchment area km^2 (calculated from the large-scale topographic map);

K - Climate coefficient (calculated from the normative map);

π - Recurrence period (%);

I - Average inclination of catchment pond (calculated from the large-scale topographic map);

L – Length of the catchment pond in Km (calculated from the large-scale topographic map);

δ - The shape coefficient of catchment pond, calculated with attitude:

$$\delta = 0.25 \frac{B_{\text{Max}}}{B_{\text{aver}}} + 0.75, \quad (2)$$

B aver.

B Max – Maximal width of catchment pond in Km;

B aver. – Average width of catchment pond in Km, (calculated from the large-scale topographic map)

For calculating B average, there is used a attitude:

$$B = \frac{F}{L} \quad (3)$$

L

Where,

F - is the Catchment Area in km^2 ;

- forested characteristic no dimensional value, calculated with the attitude:

$$K = \frac{1}{1 + 0.2 \frac{\Omega_{\text{forest}}}{\Omega}}$$

Where,

Ω_{forest} – is the area of catchment pond which is covered with forest, km²;

Π – Soil parameter, which is calculated from the map and the schedules;

For calculation all the characteristics mentioned above, it is used large-scale topographic maps and technical instructions published by Professor G. Rostomov ‘The maximum flow of the rivers in Caucasus conditions’, Tbilisi 1980,(In Russian).

At the end, in order to determine maximum discharge of water flow 1% ensures it was calculated every value included formula (N1).

The Meaning of R is given in the technical instruction an equals 1.15; $\Omega = 0.00837$ km²; K=7; $\pi = 100$ sec. (1 % ensure); I = 0.417; L = 0.211km; $\Pi = 0.7$; $\delta = 1.16$; $\beta = 0.97$; $B_{\text{max}} = 0.065$ km; $B_{\text{aver}} = 0.039$ km;

According to the calculations (1), It has been determined the maximum discharge of water flow (1% ensure), which equals $Q = 0.961$ m³/sec in the catchment pond.

3. Conclusions and recommendations

On 26-27 January 2015, by the specialists of NNLE Ecocenter of Environment Protection the scientific field work was carried out in Mtatsminda-Krtsanisi administrative district, Abanotubani, in the surrounding area of Mirza Shafi Street, according to the scientific field works, it can be given general recommendations and conclusions:

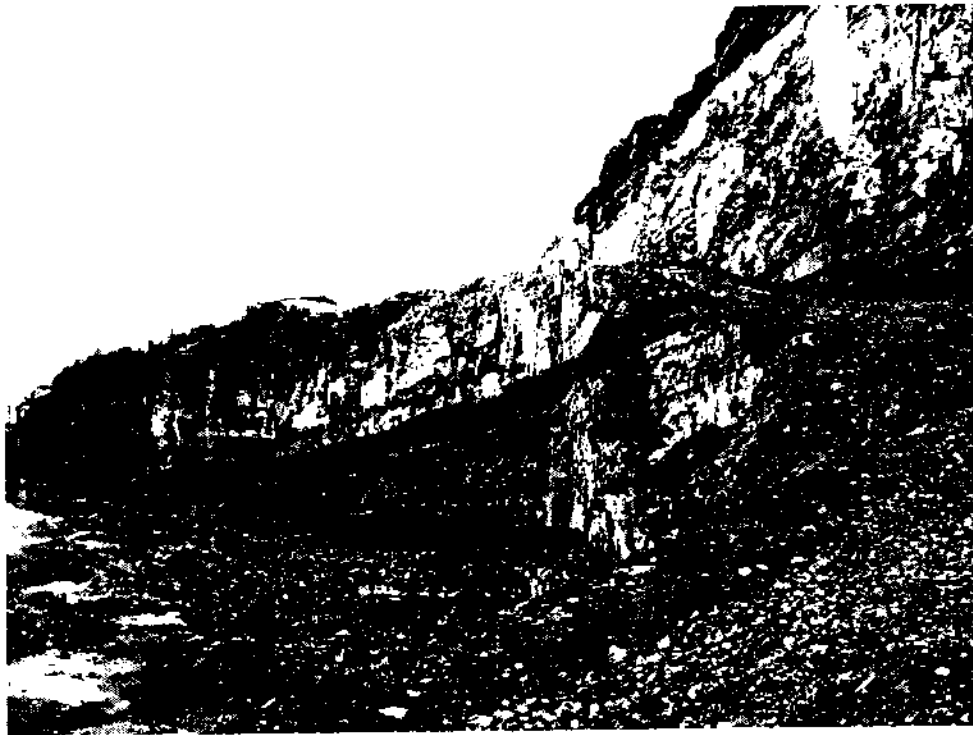
- Stream waters of the territory must be collected with the wells arranged on the outline of the building square and must be connected to the city's sewer system, located in Mirza Shafi Street.
- It is calculated the maximal 1 % ensure discharge of water flow, which is equal $Q = 0.961 \text{ m}^3/\text{sec}$ in the catchment.
- According to the geomorphologic and Hydrologic conditions of the territory, despite of the existence of horizontal Building Square at the foot of the rock, in case of arranging draining building, Surface waters (formed by the intensive rains) will not percolate in soil and will not have any influence on the sulfur springs, which are located in deep layers of the earth.
- Because of big inclinations and existence of high almost vertical rocky wall, there are additional Foreseeable circumstances:
 1. Superficial flow high speed will cause the transportation of great deal of sediment rock material. It is recommended to provide a construction which will block the sediment materials.
 2. According to the geological sections, forming rocks are inclined to the construction site, which, in case of permanent rains may cause the concentrate outcome of water percolated in soil from the rocky vertical wall and Calculating discharge increase. This issue can be clarified after further hydrologic research and upcoming spring rains.
 3. The vertical surface of Exposed rock built with sandstone, yellow and gray mergel and black argelit serum interchange can be Collapse under the influence of atmospheric phenomena. Accordingly there is recommended

to Set the appropriate measures (vertical garden, cementation, metal constructions and etc.)

4. Enclosure



Pic. 1



Pic. 2



Pic. 3



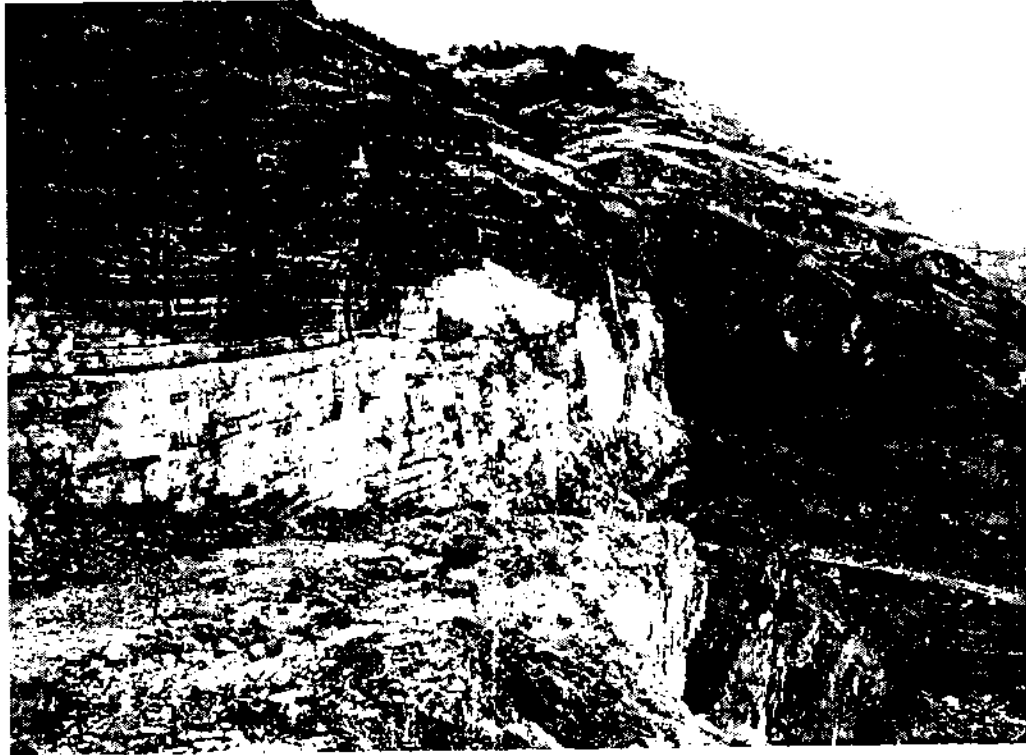
Pic. 4



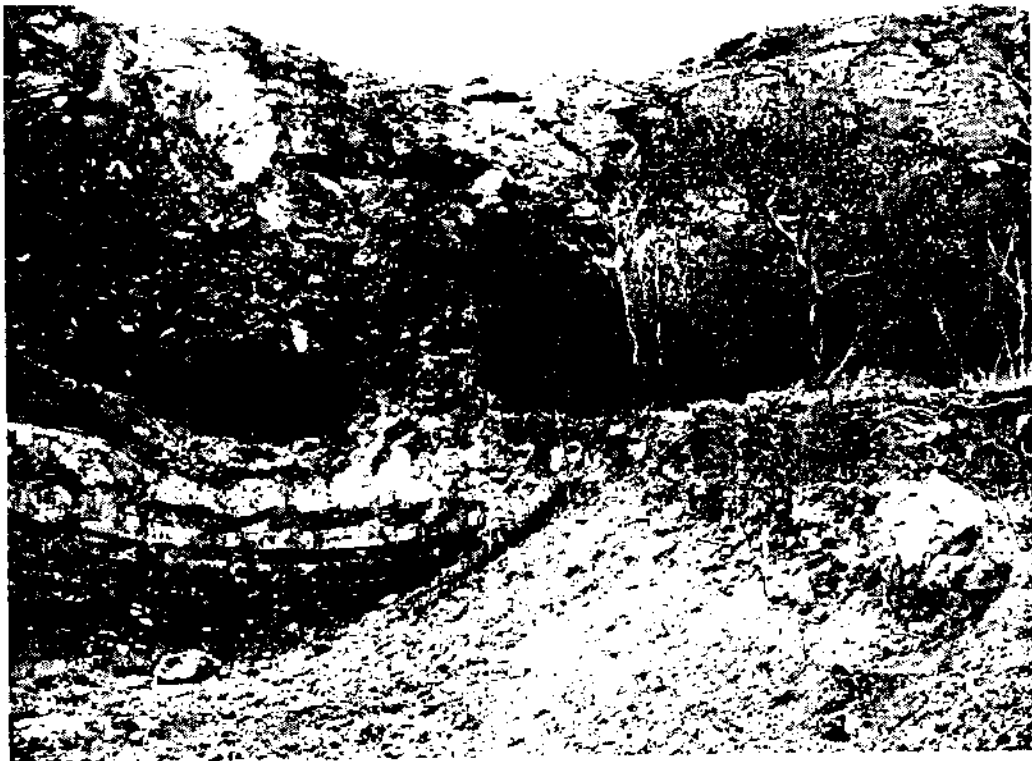
Pic 5.



Pic 6.



Pic. 7



Pic. 8