

GEOTECHNICAL OPINION

GEOTECHNICAL OPINION based on the preliminary survey of soil and water conditions for the purpose of the facility location within the area of the Wałbrzych Special Economic Zone in Opole (Plots No. 602/1, 617/1, 619/6, 624, 625/1, 627, 631/4, 618, 630/2)

Investor:

Opole Town Hall

Rynek-Ratusz, 45-015 Opole

Drafted by:

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M.Sc., Eng. Jarosław Łukasiński

Rybnik, November 2018

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1. Introduction and general information

Investor:	Opole Town Hall Rynek-Ratusz, 45-015 Opole
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Contractor:	BIO – GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik
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The legal basis for the study is the Regulation of the Minister of Transport, Construction and Maritime Economy dated 25 April 2012 on defining the geotechnical conditions for foundations of building structures (i.e. *Official Journal Dziennik Ustaw Ustaw* No. 2012, , item 463).

The commissioned geotechnical survey included the examination of soil and water conditions present within the site earmarked for investment.

The following reference materials were used in the development of this document:

- 1:50000 Geological Map of Poland – Opole North sheet;
- data from site inspection and own archival materials (geotechnical studies);
- results of borehole analyses and field tests;
- laboratory tests;
- applicable standards.

2. Location of the area under study

According to the physico-geographical division, the area under study lies in the Niemodlin Plain mesoregion, which is part of the Silesian Lowland macroregion.

As far as administrative division is concerned, the area of the potential project is located:

- town – Opole
- municipality – Opole
- county – Opole
- region – Opolskie

In accordance with the order, the survey was conducted in the area of Wrocławska Street. The location of the surveys carried out is shown on the general overview map (Appendix 1).

3. Scope of work performed

In accordance with the order, 15 test boreholes were drilled to the depth of 9.0 m below the ground level in the locations indicated by the Designer. A total of 135 running

meters of drilling were completed. Detailed location of the boreholes is shown on the documentation map (Appendix No. 2).

The boreholes were delineated with a hand-held GPS device on the basis of geographical coordinates, and then checked for correctness using the rectangular measurement method with reference to the nearest existing site details.

The boreholes were drilled with a WG-1 mechanical drilling rig, using a dry method, with an auger with a diameter of 82 mm. Macroscopic analysis of the soil in the boreholes was carried out to determine their stratigraphy, genesis, lithology and basic physical properties (colour, dampness, state).

Water content (NW) samples were taken from cohesive and organic soils and natural granulation (NU) samples from non-cohesive soils.

The groundwater table in the boreholes was analysed.

After conducting field tests, the boreholes were backfilled with the excavated material, following the sequence of the layers drilled through. The boreholes and the method of their backfilling did not change the geotechnical parameters of the subsoil or the natural environment.

The field works were conducted under the constant supervision of a qualified geologist, Marcin Małecki, M.Sc.

4. Geological structure

The geological structure was characterised on the basis of activities carried out with the use of the Detailed Geological Map of Poland.

The ground surface is covered by a layer of soil.

The upper layer is formed by Quaternary fluvio-glacial and alluvial terrace formations (classified as medium dense sand, medium and fine sands, cohesive soil of various degree of plasticity, as well as hard plastic and plastic aggregate muds).

The Quaternary soils are underlined by Miocene clays and sands (classified as medium dense medium sands and semi-hard and hard plastic silty clays).

5. Water conditions

Base on the boreholes drilled in November 2018 it was found that the groundwater table is generally confined and free in places.

The results of the hydrogeological survey are presented in the table below:

Borehole No.	Depth of drilled groundwater table <i>[m.b.g.l.]</i>	Depth of stabilised groundwater table <i>[m.b.g.l.]</i>	Drilled groundwater table elevation <i>[m.a.s.l.]</i>	Stabilized groundwater table elevation <i>[m.a.s.l.]</i>	Water seeping horizon <i>[m.b.g.l.]</i>
O1	5.2	2.8	155.1	157.5	-
O2	6.0	3.9	154.2	156.3	-
O3	4.8	2.5	152.7	155.0	-
O4	2.9	2.9	157.1	157.1	-
O5	-	-	-	-	4.5
O6	7.0	2.1	147.7	152.6	2.1
O8	-	-	-	-	4.5
O9	-	-	-	-	6.0
O10	3.0	3.0	156.1	156.1	-
O12	-	-	-	-	7.5
O13	-	-	-	-	4.2
O14	4.0	2.8	152	153.2	-
O15	-	-	-	-	6.0

It should be taken into account that depending on the season and weather conditions, periodical fluctuations of groundwater table level and intensity of seepage are possible. In the wet season (intense precipitation, snowmelt) the water table level and the intensity of seepage may increase, while in the dry season it may decrease.

It should also be considered that the survey were carried out at isolated spots and that there are long distances between the boreholes. It is possible that water conditions in some areas may differ from those found in the boreholes.

The results of hydrogeological observations made during the field work have been presented in the borehole sheets and geotechnical cross-sections attached.

6. Geotechnical conditions

The natural subsoil was divided into geotechnical layers on the basis of the boreholes drilled and laboratory work, in compliance with **PN-81/B03020** and **PN-86-B-02480** standards.

Two genetic groups of formations were identified in the documented ground:

- group I – comprising Quaternary fluvio-glacial and alluvial terrace formations;
- group II – comprising Miocene clays and sands.

Due to different physical and mechanical parameters and genesis of the soil, the soil was divided into the following geotechnical layers:

- **Ia layer:**

Includes natives non-cohesive soils – loamy sand and gravel mix. The soils of low dampness and watered, semi-dense, with a generally accepted density index $I_D = 0.50$. They were classified as problematic swelling soils.

- **Ib layer:**

Includes native non-cohesive soils – loamy medium sands, locally with some gravel content and with cohesive soil intercalations. The soils are of low dampness, damp and watered, medium dense, with a generally accepted density index $I_D = 0.50$. The soils were classified as problematic swelling soils and, in the area of cohesive soil intercalations, slightly swelling.

- **Ic layer:**

Includes native non-cohesive soils – locally loamy fine sands with silt loam intercalations. The soils are of low dampness, damp and watered, medium dense, with a generally accepted density index $I_D = 0.40$. They were classified as non-swelling soils, problematic swelling soils in loamy areas and low-swelling soils in areas with cohesive intercalations.

- **Id layer:**

Includes native compact-cohesive soils – silty clay loam and clay loams. The soils are of low dampness, semi-dense and dense, with a generally accepted liquidity index $I_L = 0.00$. They were classified as low-swelling soils. Consolidation group C was adopted for them.

- **Ie layer:**

Includes native cohesive soils – silty clay loam, sandy clay loam, loamy sands, clays, sandy loams and clay loams. The soils are of low dampness, in hard plastic condition, with generally accepted liquidity index $I_L = 0.10$. They were classified as low-swelling soils (clay loams) and high-swelling (loams, loamy sands). Consolidation group C was adopted for them.

- **If layer:**

It includes native compact-cohesive soils – silty clay loams with some content of organic parts. The soils are of low dampness, in hard plastic condition, with generally accepted liquidity index $I_L = 0.10$. Due to the content of organic parts, geotechnical parameters were decreased by 30%. These soils were classified as high-swelling. Consolidation group C was adopted for them.

- **Ig layer:**

Includes native semi-cohesive and compact-cohesive soils – silty clay loams, loams and sandy loams. The soils are of low dampness, in hard plastic condition, with generally accepted liquidity index $IL = 0.20$. They were classified as low-swelling soils (clay loams) and high-swelling (loams). Consolidation group C was adopted for them.

- **Ih layer:**

Includes native cohesive soils – sandy loams, silty clay loams, silt loams, loams and loamy sands. The soils are moist, in a plastic state with a generally accepted liquidity index $IL = 0.35$. They were classified as high-swelling soils. Consolidation group C was adopted for them.

- **Ii layer:**

It includes native low-cohesive and semi-cohesive soils – silts and silt loams. The soils are moist, in the soft-plastic state, with the generally accepted liquidity index $IL = 0.70$. They were classified as high-swelling soils. Consolidation group C was adopted for them.

- **Ij layer:**

Includes organic soils – aggregate muds. The soils are slightly damp and damp, in hard-plastic and plastic state. These soils are classified as high-swelling and highly compressible. No standard parameters are given for them.

- **Ik layer:**

Includes native highly-cohesive soils – clays. The soils are of low dampness, in hard-plastic state, with a generally accepted liquidity index $IL = 0,05$. They were classified as low-swelling soils. Consolidation group D was adopted for them.

- **Ila layer:**

Contains native non-cohesive soils – loamy medium sands. The soils are watered, in semi-dense state, with a generally accepted density index $ID = 0.50$. They were classified as problematic swelling soils.

- **Ilb layer:**

Includes native very cohesive soils – silty clays. The soils are of low dampness, semi-dense, with a generally accepted liquidity index $IL = 0,00$. They were classified as low-swelling soils. Consolidation group D was adopted for them.

- **Ilc layer:**

Includes native very cohesive soils – silty clays. The soils are of low dampness, in hard-plastic state, with a generally accepted liquidity index $IL = 0,05$. They were classified as low-swelling soils. Consolidation group D was adopted for them.

- **Ild layer:**

Includes native very cohesive soils – silty clays. The soils are of low dampness, in hard-plastic state, with a generally accepted liquidity index $IL = 0,10$. They were classified as low-swelling soils. Consolidation group D was adopted for them.

The geotechnical parameters of soils were determined using the "B" method, taking as the leading feature the liquidity index for cohesive and organic soils, and the density index for non-cohesive soils.

The description of geotechnical layers is supplemented by the attached borehole sheets (Appendix No. 3) and geotechnical cross-sections (Appendix No. 4). The cross-sections were made for the purpose of preliminary survey and due to a large distance between holes they should be considered as indicative. The structure of soil can significantly vary between the boreholes. In case of planned facility construction it is recommended that the borehole grid be extended and geotechnical cross-sections completed with additional profiles. The values of geotechnical parameters for the identified layers are contained in the summarized results of laboratory tests – Appendix 5, 6 and 7 and Appendix 8 – table of standard geotechnical parameters.

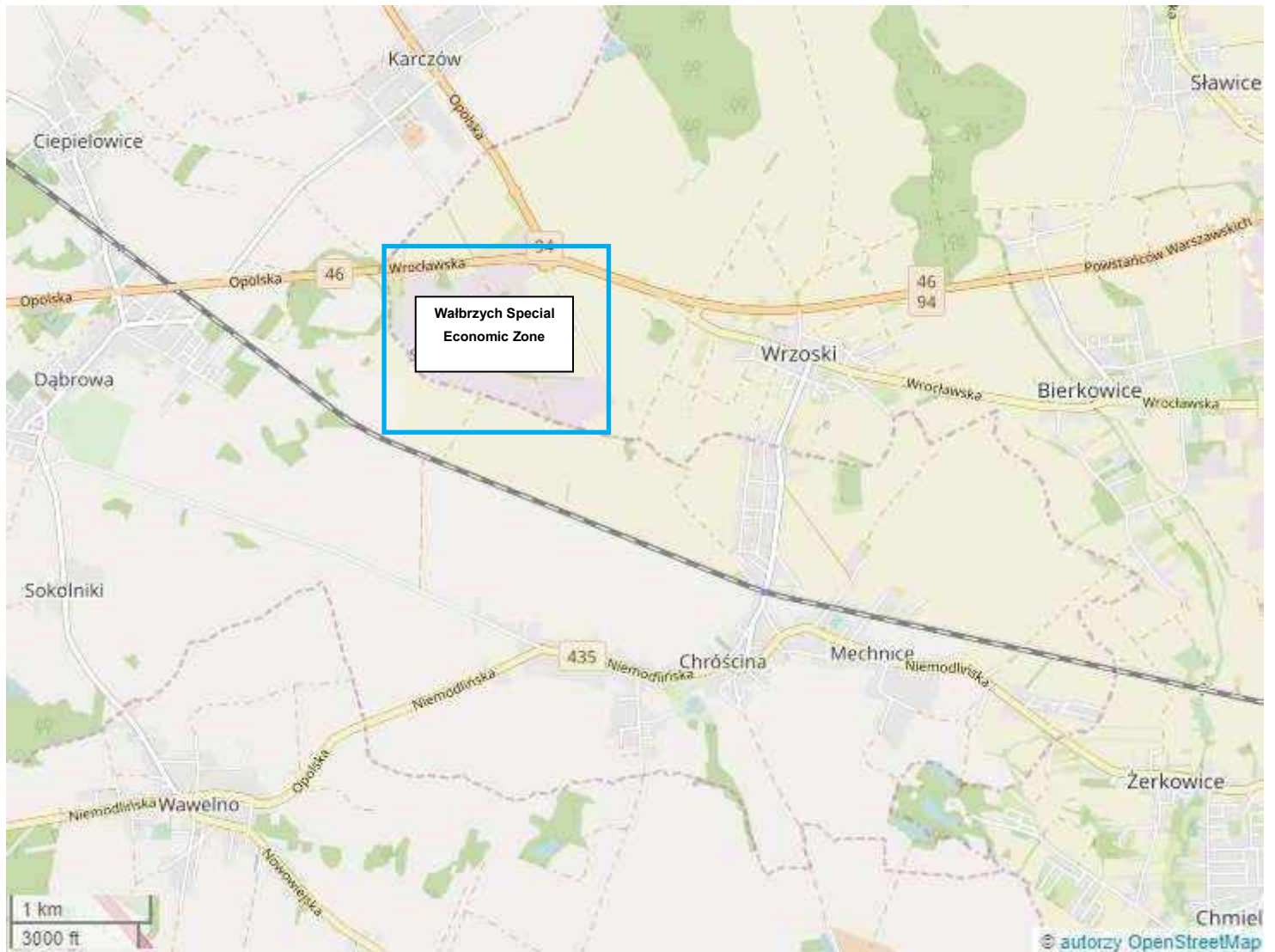
7. Summary

1. As a result of the survey work carried out for preliminary identification of ground and water conditions, 15 boreholes were drilled in November 2018. The detailed lithological structure of the area under study is presented in borehole sheets (Appendix No. 3) and geotechnical cross-sections (Appendix No. 4).
2. It was found that the groundwater table is generally confined and free in places. Water seepage was also observed (see Section 5 for a detailed description of soil water conditions). It should also be considered that the survey was carried out at isolated spots and that there are long distances between the boreholes. It is possible that water conditions in some areas may differ from those found in the boreholes.
3. The native soil comprises Quaternary fluvio-glacial and alluvial terrace formations, under which there are Miocene clays and sands.
4. The boreholes show that the soil is made up of load-bearing soils (layer Ia, Ib, Ic, Id, Ie, Ik, IIa, IIb, IIc, IId) and medium bearing soils (layer If, Ig, Ih), locally with lenses of soft-plastic and organic soils (layer Ii, Ij). It should be noted that the surveys were conducted for the purpose of preliminary identification only, and the boreholes are far apart from one another. Soil and water conditions between individual boreholes may change. At the stage of project design it is recommended to extend the grid of boreholes in order to specify water conditions and also to determine the thickness and deposition of poorly load-bearing soils.

5. For the purpose of construction of parking lots and access roads, it is proposed to assume load-bearing capacity group G2 in areas of occurrence of subsoil sandy soils with a thickness greater than 1 m, group G3 in places where compact cohesive soils occur, and in the area of the remaining boreholes – G4.
6. Catalogue of Material Expenditures No. 2-01 – Buildings and Earthworks – the subsoil contains soils in workability category II (sands, silts), III (loam, aggregate mud) and IV (clay loams, clays).
7. The standards ground frost depth for this area is 1.0 m.b.s.l.

8. Index of literature and reference materials

- Geological Map of Poland – scale 1: 50,000
- E. Stupnicka „Geologia regionalna Polski”
- A. Wieczysty „Hydrogeologia inżynierska”
- Z. Pazdro „Hydrogeologia ogólna”
- Z. Wiłun „Zarys geotechniki”
- Regulation of the Minister of Transport, Construction and Maritime Economy dated 25 April 2012 on defining the geotechnical conditions for foundations of building structures (i.e. Official Journal Dziennik Ustaw No. 2012, , item 463);
- Catalogue of Material Expenditures No. 2-01 – Buildings and Earthworks – Ministry of Spatial Economy and Construction, 1997.
- Standards: PN – 81/B – 03020, PN – 86/B – 02480, PN – 74/B – 04452, PN – B – 06050, PN-80 B-01800.



APP. NO. 1

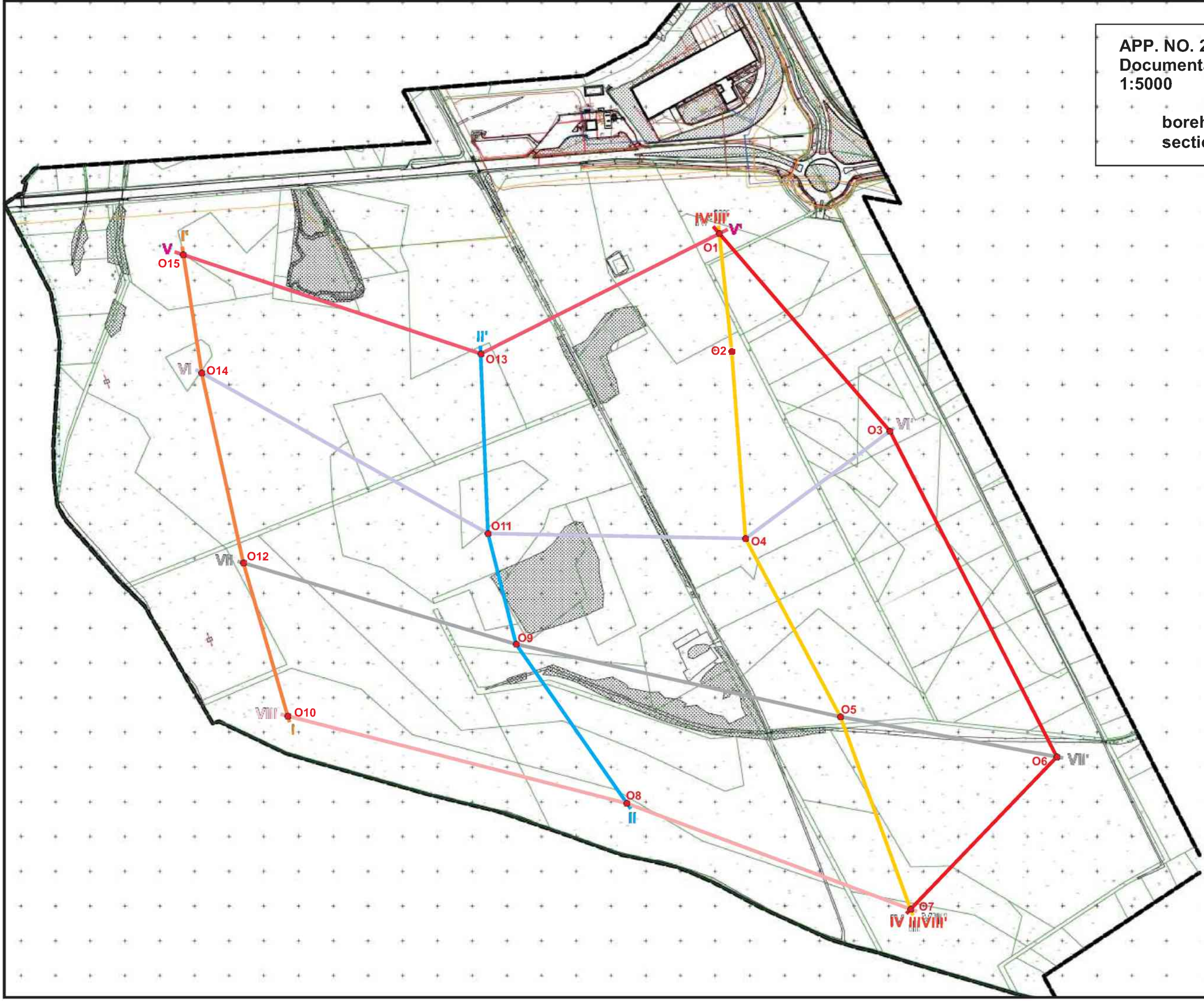
General overview map of the area under study

Area under study

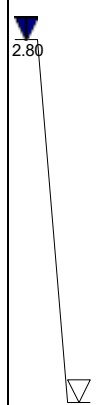


APP. NO. 2
Documentation map scale:
1:5000

borehole ● O1
section line —



BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O1				App. No.: 3.1 Boring rig: WG-1		
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 160.30 m.a.s.l. Scale 1: 50 Drilling date: 2018-11		
	Water table depth [m.b.g.l.]	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition
1	2	3	4	5	6	7	8	9	10	11
						soil	Gb			
					0.20	brown-grey silty clay loam with medium sand intercalations	GπZ//Ps	Id		pzw
					1.50	brown clay				
					3.60	brown-grey clay	I	Ik	mw	tpl
					5.20	strongly loamy medium sand with spots of silt loam	Ps+G//Gπ	lb	nw	szg
					6.00	grey silty clay loam	GπZ	Ie	mw	tpl
					6.60	loamy sand and gravel mix	Po+G	Ia	nw	szg
					7.50	cherry-grey silty clay	Iπ	IIc	mw	tpl
					9.00					



Quaternary
Quaternary
Tertiary
Miocen

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O2				App. No.: 3.2 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 160.20 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
1	Water table depth [m.b.g.l.]	Stratigraphy	Lithological profile	Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition		
1	2	3	4	5	6	7	8	9	10	11	
					0.20	soil grey loamy medium sand	Gb Ps+G				
					0.50	sandy loam with brown medium sand intercalations	Gp//Ps	lg	w	szg	
					1.50	brown-grey silty clay loam					
					2.20	grey silty clay loam					
					4.50	light-grey strongly loamy fine sand	GπZ	le	mw	tpl	
					6.00	grey-brown loamy fine sand	Pd+G	lc	nw	szg	
					8.00	brown aggregate mud	Nm	lj			
					8.20	brown-grey silty clay loam with admixture of organic parts	GπZ+org	lf	mw	tpl	
					9.00						

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O3				App. No.: 3.3 Boring rig: WG-1		
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 157.50 m.a.s.l. Scale 1: 50 Drilling date: 2018-11		
	Water table depth [m.b.g.l.]	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition
1	2	3	4	5	6	7	8	9	10	11
					0.20	soil brown loamy medium sand with admixture of gravel	Gb			
					1.0		Ps+Ż+G		mw	
					1.50	strongly loamy medium sand with grey-brown loamy sand intercalations	Ps+G//Pg	lb		szg
					2.0					
					3.0	grey silt			w	
					4.0		Π	li		mpl
					4.80	grey-brown loamy medium sand	Ps+G	lb	nw	szg
					5.40	grey silt loam	Gπ	li	w	mpl
					5.60	strongly loamy fine sand with spots of grey silt loam				
					6.0					
					7.0		Pd+G//Gπ	lc	nw	szg
					8.0					
					9.0					
					9.00					

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O6				App. No.: 3.6 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 154.70 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
1	Water table depth [m.b.g.l.]	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
1	2	3	4	5	6	7	8	9	10	11	
						soil	Gb				
					0.20	grey-brown loamy fine sand	Pd+G	Ic		szg	
					0.50	grey silty clay loam					
			1.0								
			2.0								
	2.10	Quaternary					GπZ	Id		pzw	
	3.00	Quaternary									
			3.0								
			4.0								
			4.50			grey silty clay					
			5.0								
			6.0				Iπ	IIId		tpl	
			7.0								
		Tertiary									
		Miocene									
			7.00		7.00	grey loamy medium sand	Ps+G	IIa	nw	szg	
			7.50		7.50	grey silty clay					
			8.0				Iπ	IIb	mw	pzw	
			9.0								
			9.00		9.00						

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. 07				App. No.: 3.7 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 156.90 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
	[m.b.g.l.]		[m]		[m]						
1	2	3	4	5	6	7	8	9	10	11	
						soil	Gb				
					0.20	grey-brown sandy clay loam with fine sand intercalations	Gpz//Pd	le		tpl	
			1.0		1.00	grey-brown silty clay loam					
			2.0								
			3.0								
			4.0								
			5.0		4.50	grey silty clay loam	Gπz	ld			
			6.0								
			7.0								
			8.0								
			9.0		9.00						

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O8				App. No.: 3.8 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 157.80 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
	[m.b.g.l.]		[m]		[m]						
1	2	3	4	5	6	7	8	9	10	11	
		Quaternary Quaternary				soil	Gb				
					0.20	brown loamy medium sand with admixture of gravel and with loam sand intercalations	Ps+Ż+G//Pg	lb	mw	szg	
			1.0		0.90	ochre sandy loam	Gp	lg		tpl	
			2.0		1.50	brown silty clay loam with fine sand intercalations	Gπz/I//Pd	lh	w	pl	
			3.0		3.00	grey silty clay loam with fine sand intercalations			mw	pzw	
			4.0								
			5.0								
			6.0								
			7.0		6.70	grey silty clay	Iπ	IIb			
			8.0								
9.0		9.00									

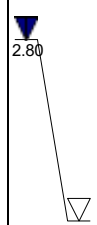
BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. 09				App. No.: 3.9 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 157.90 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
	[m.b.g.l.]		[m]		[m]						
1	2	3	4	5	6	7	8	9	10	11	
		Quaternary Quaternary				soil	Gb				
					0.20	brown loamy fine sand	Pd+G	lc	mw	szg	
					0.60	grey-brown sandy loam	Gp	lg		tpl	
					1.50	brown silty clay loam	GπZ				
					2.00	brown silty clay loam with fine sand intercalations	GπZ/Pd	lh	w	pl	
					2.90	grey silty clay loam					
					4.50	dark-grey strongly loamy fine sand	Pd+G	lc	w	szg	
					5.00	grey silty clay					
					7.00		Iπ	IIb	mw	pzw	
					9.00						

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O11				App. No.: 3.11 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 160.20 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
	[m.b.g.l.]		[m]		[m]						
1	2	3	4	5	6	7	8	9	10	11	
		Quaternary	Quaternary			soil	Gb				
					0.20	grey-brown strongly loamy fine sand	Pd+G	lc	mw	szg	
					0.50	grey-brown loam	G	lh	w	pl	
					0.90	brown silty clay loam	G _π Z	lg		tpl	
					1.40	grey-brown silty clay loam					
					2.0						
					3.0	grey silty clay loam	G _π Z	ld	mw	pzw	
					4.0						
					5.0						
					6.0	grey silty clay loam with fine sand intercalations	G _π Z//Pd				
	7.0										
	7.50	grey silty clay	I _π	IIb							
	8.0										
	9.0										
					9.00						

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O12				App. No.: 3.12 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 157.30 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
	[m.b.g.l.]		[m]		[m]						
1	2	3	4	5	6	7	8	9	10	11	
						soil	Gb				
					0.20	brown-grey silty clay loam with fine sand intercalations	G _π Z//Pd	Id	mw	pzw	
					1.0						
					2.0						
					3.0						
					3.00	grey silty clay loam	G _π Z				
					4.0						
					5.0						
					6.0						
					7.0						
					7.50	grey silty clay	I _π	IIc		tpl	
					8.0						
					9.00						

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O13				App. No.: 3.13 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 159.50 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
	[m.b.g.l.]		[m]		[m]						
1	2	3	4	5	6	7	8	9	10	11	
 4 4.20		Quaternary Quaternary				soil	Gb				
					0.20	dark-brown loamy fine sand	Pd+G	lc		szg	
					0.40	grey-brown silty clay loam					
				1.0			GπZ	ld		pzw	
				2.0	1.50	brown loamy sand with fine sand intercalations	Pg//Pd	le	mw	tpl	
				3.0	2.50	brown silty clay loam		lg			
				4.0	3.30	light-grey loamy sand with fine sand intercalations	Pg//Pd	lh	w	pl	
				5.0	4.00	grey loamy sand with fine sand intercalations					
				6.0	4.60	grey loam with fine sand intercalations	G//Pd	le	mw	tpl	
				7.0	6.00	light-grey strongly loamy fine sand		Pd+G	lc	w	szg
				8.0	7.50	brown loam	G	lg		tpl	
				9.0	8.00	grey silty clay	Iπ	IIb	mw	pzw	
	9.00										

BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik			GEOTECHNICAL BOREHOLE SHEET Profile No. 014				App. No.: 3.14 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie			Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 156.00 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth [m.b.g.l.]	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition
1	2	3	4	5	6					
						soil	Gb			
					0.20	brown/light-grey strongly loam fine sand	Pd+G	lc		szg
					1.50	light-grey sandy loam	Gp	le	mw	tpl
					3.00	light-grey loamy fine sand	Pd+G	lc	w	szg
					3.40	light-grey sandy loam	Gp	le	mw	tpl
					4.00	light-grey loamy fine sand	Pd+G	lc	nw	szg
					4.50	grey clay loam	Gz	le	mw	tpl
					6.50	light-grey strongly loamy fine sand with silty loam intercalations	Pd+G//Gπ	lc	nw	szg
					9.00					

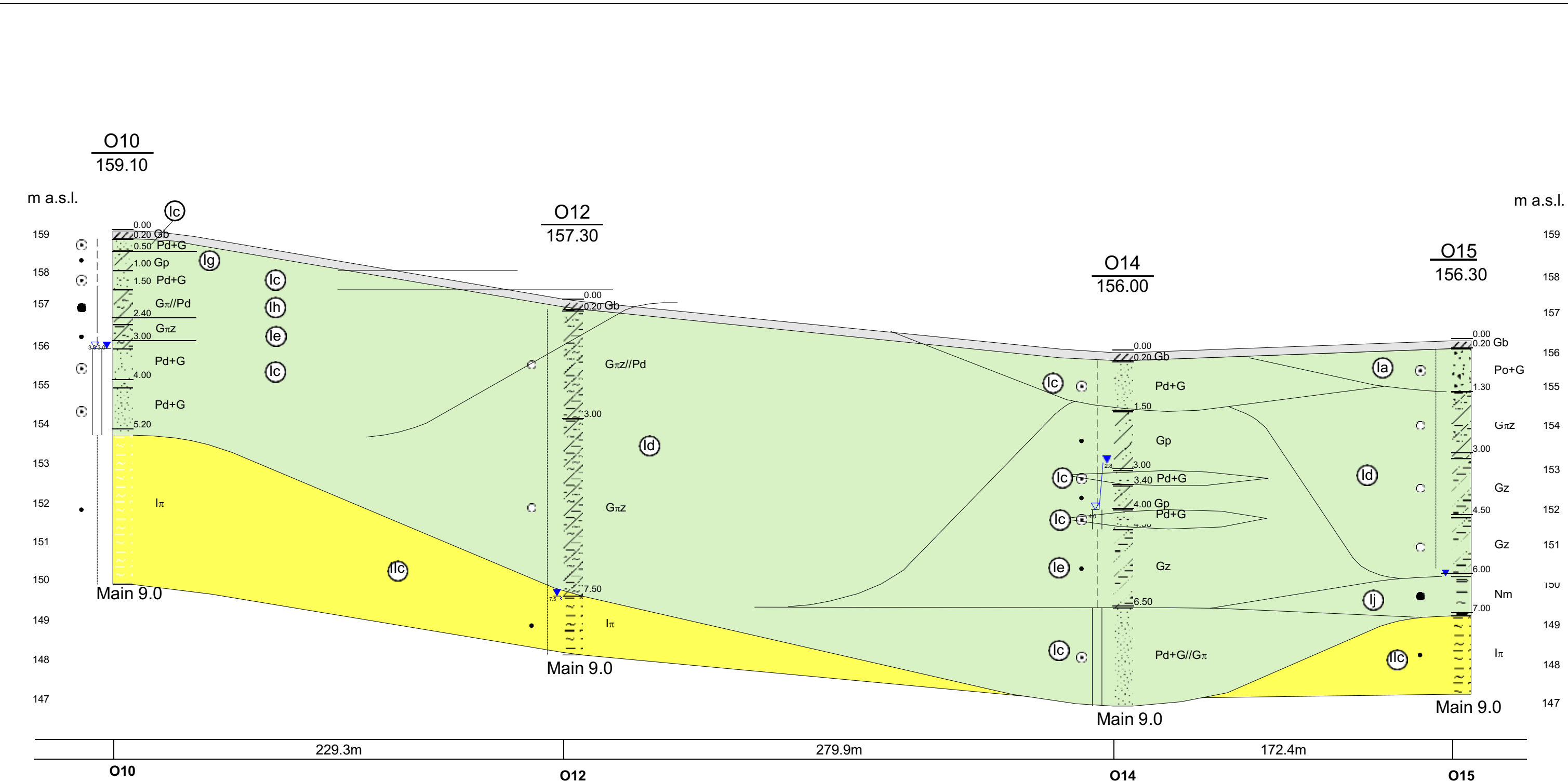


2.80

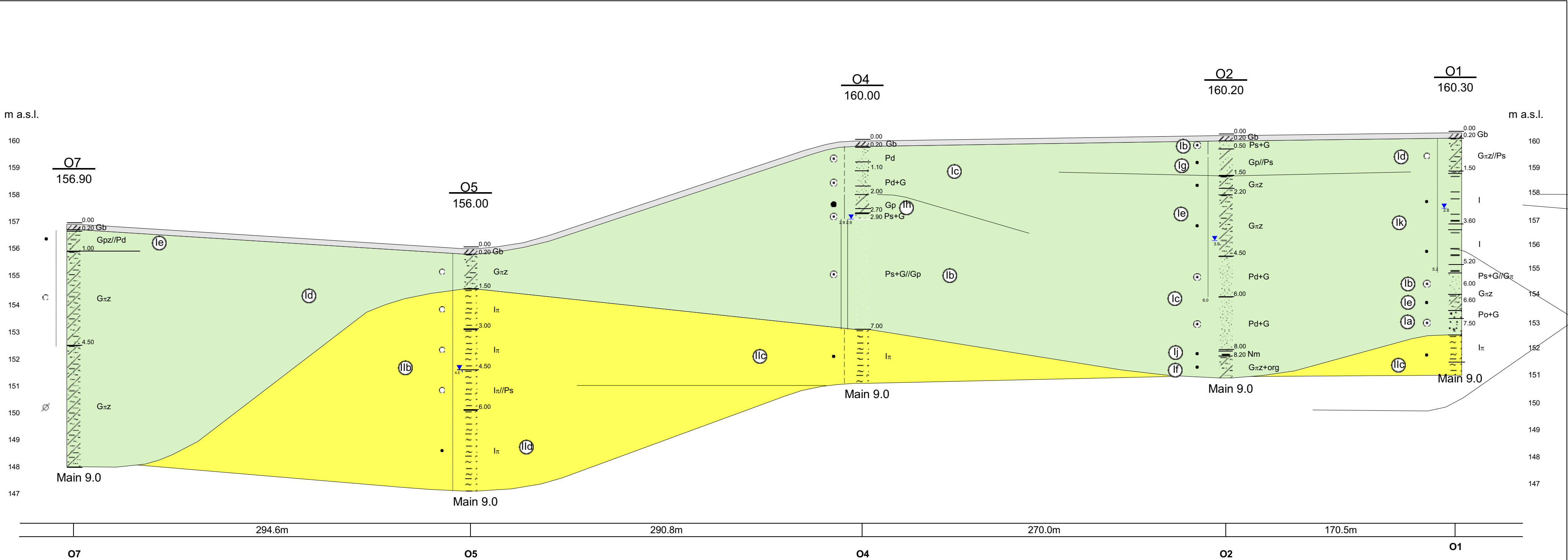
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Quaternary
Quaternary

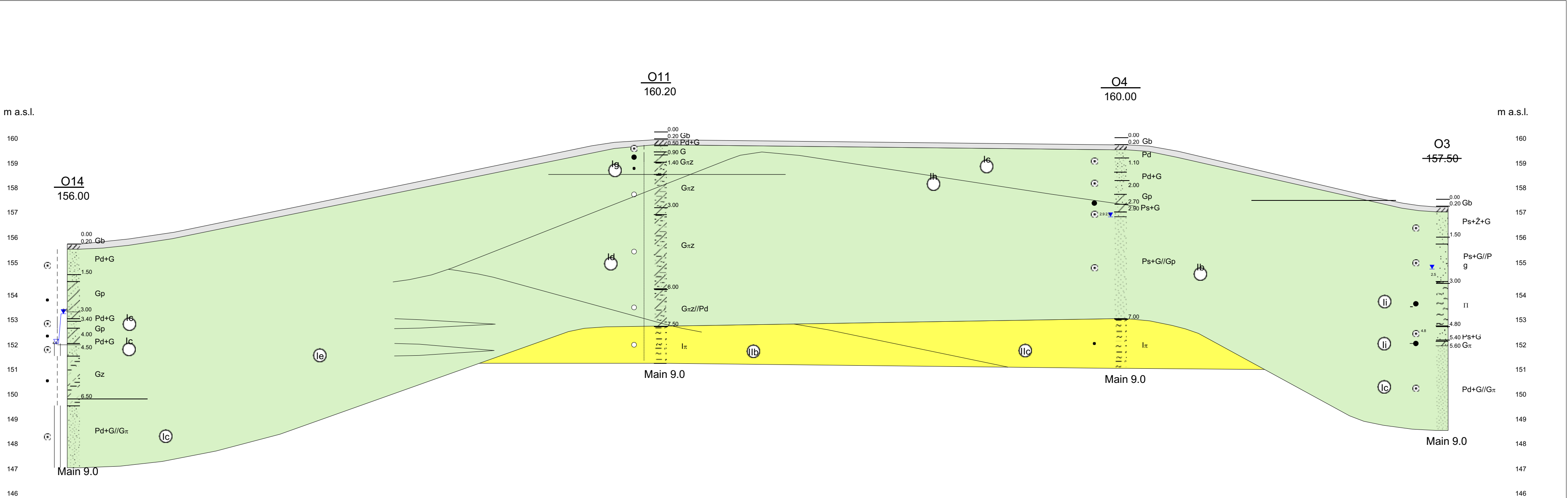
BIO-GEO Wioleta Małecka ul. Łączna 99E, 44-200 Rybnik				GEOTECHNICAL BOREHOLE SHEET Profile No. O15				App. No.: 3.15 Boring rig: WG-1			
Area: ul. Wrocławska Town: Opole County: Opole Province: Opolskie				Site: Preliminary survey for the purpose of facility location Investor: Opole Town Hall Boreholes made by: BIO-GEO Geological supervision: Marcin Małecki, M.Sc.				Drilling system: Mechanical-rotary Ordinate: 156.30 m.a.s.l. Scale 1: 50 Drilling date: 2018-11			
	Water table depth	Stratigraphy	Lithological profile		Depth	Lithological description	Soil symbol	Geotechnical layer	Moisture level	Soil condition	
	[m.b.g.l.]		[m]		[m]						
1	2	3	4	5	6	7	8	9	10	11	
		Quaternary Quaternary				soil	Gb				
				0.20		brown loamy sand and gravel mix	Po+G	la		szg	
				1.0							
				1.30		dark-grey silty clay loam	G _π Z				
				2.0							
				3.0		3.00	brown-grey clay loam	Gz	ld	mw	pzw
				4.0							
				5.0		4.50	light-grey clay loam				
				6.0		6.00	brown aggregate mud	Nm	lj	w	pl
				7.0		7.00	light-grey silty clay				
8.0				I _π	llc	mw	tpl				
9.0		9.00									



BIO-GEO Wioleta Małecka				App. No.: 4.1	
ul. Łączna 99E, 44-200 Rybnik					
	Date	Name	Signatu re	Geotechnical cross-section I-I'	Scale 1: 2000 100
Developed by		M.Sc., Eng. J. Łukasieński			
Verified by					

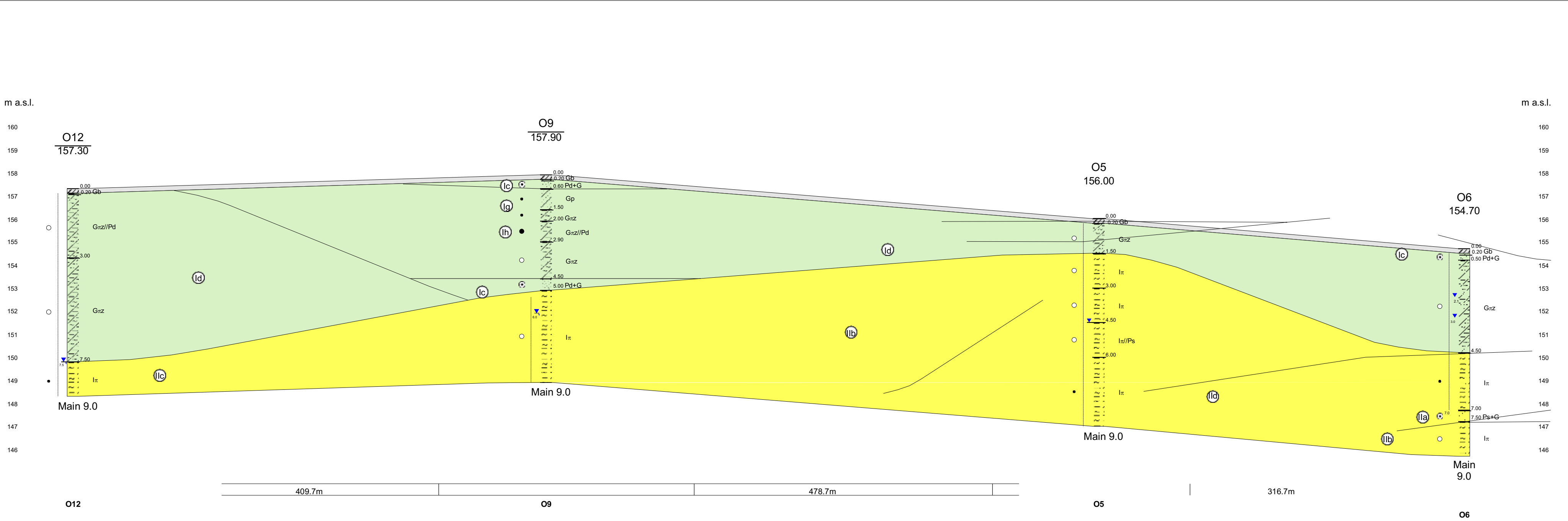


BIO-GEO Wioleta Małecka				App. No.: 4.3	
ul. Łączna 99E, 44-200 Rybnik					
	Date	Name	Signatu re	Geotechnical cross-section III-III'	Scale 1: <u>2000</u> 100
Developed by		M.Sc., Eng. J. Łukasieński			
Verified by					

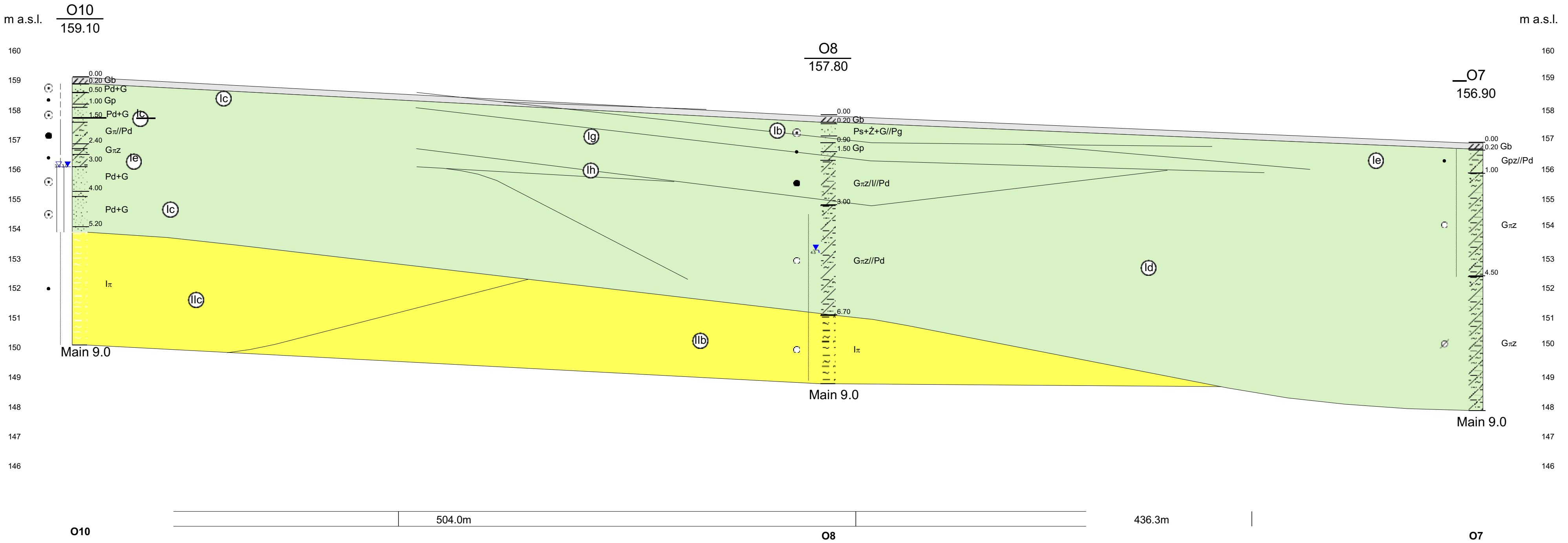


O14 472.6m O11 370.9m O4 259.0m O3

BIO-GEO Wioleta Małecka				App. No.: 4.6
ul. Łączna 99E, 44-200 Rybnik				Scale
	Date	Name	Signat ure	Geotechnical cross-section VI-VI'
Developed by		M.Sc., Eng. J. Łukasinski		
Verified by				



BIO-GEO Wioleta Małecka				App. No.: 4.7	
ul. Łączna 99E, 44-200 Rybnik					
	Date	Name	Signature	Geotechnical cross-section VII-VII'	Scale 1: 2000 100
Developed by		M.Sc., Eng. J. Łukasinski			
Verified by					



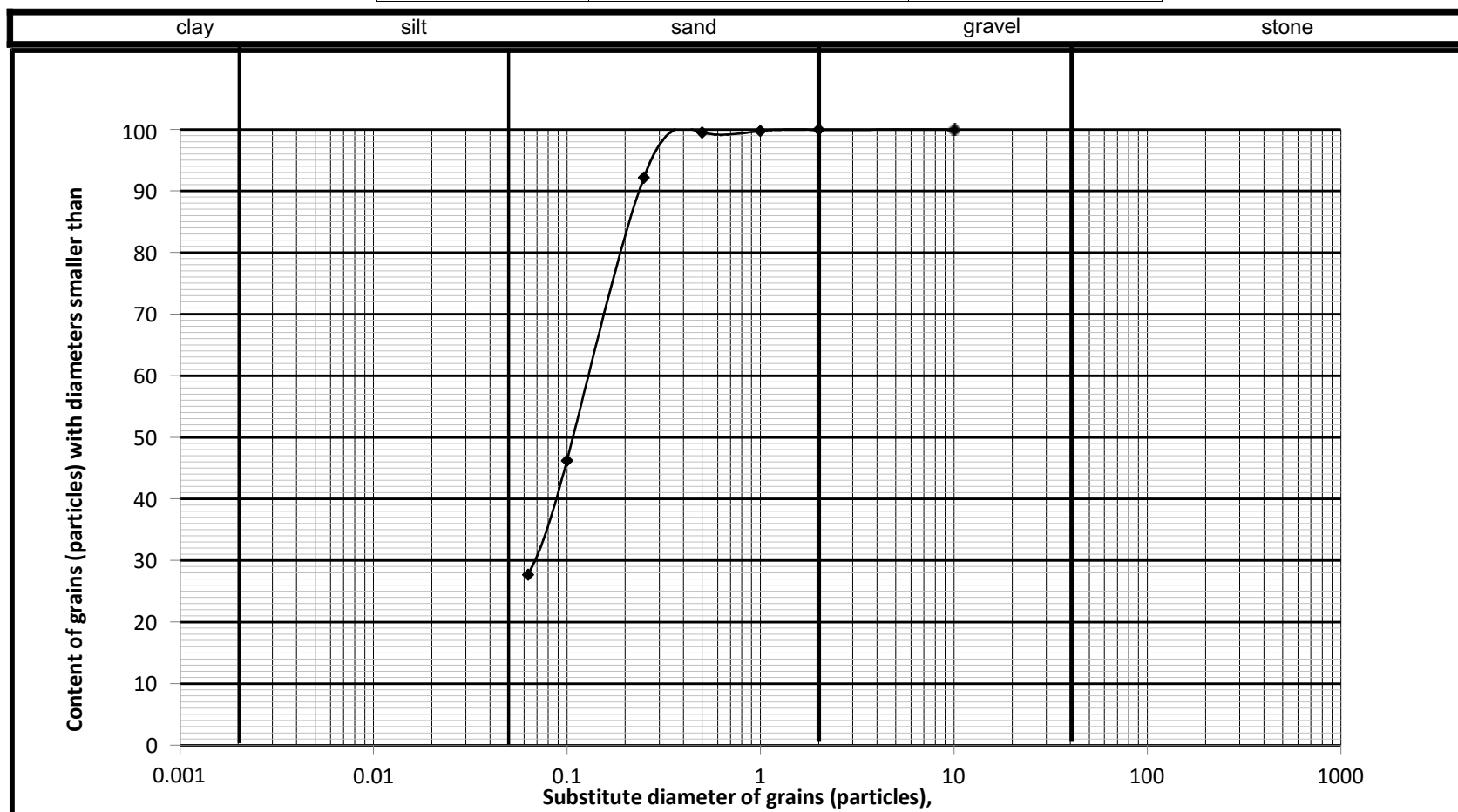
BIO-GEO Wioleta Małeczka				App. No.: 4.8
ul. Łączna 99E, 44-200 Rybnik				Scale 1: 2000 100
	Date	Name	Signature	Geotechnical cross-section VIII-VIII'
Developed by		M.Sc., Eng. J. Łukasiński		
Verified by				

BIO-GEO Wioleta Małecka
 ul. Łączna 99E, 44-200
 Rybnik

GRAIN-SIZE DISTRIBUTION CURVE – GRANULOMETRIC ANALYSIS (acc. to PN-86/B-02480)

Compiled by: B.Sc. Martyna Banaś

Borehole No.	Sampling depth	Soil type
O2	4.5-6.0 m.b.g.l.	Pd+G



$f_k = 0 \%$
 $F_z = 0.06 \%$
 $F_p = 72.28 \%$
 $f_{\pi+1} = 27.66 \%$



APPENDIX 5.2 – AUDIT REPORT

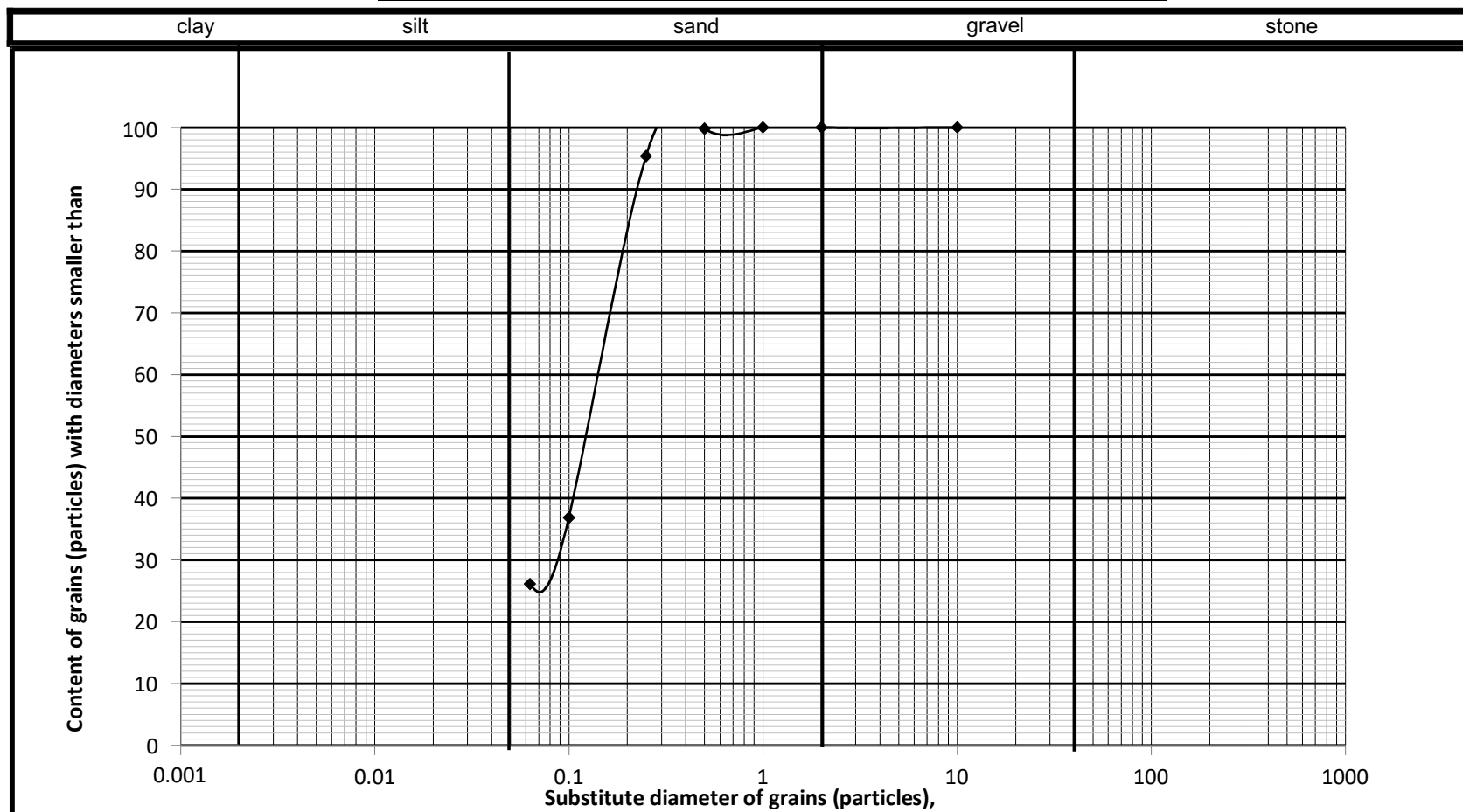
Address: Opole, Wrocławska

BIO-GEO Wioleta Małecka
ul. Łączna 99E, 44-200
Rybnik

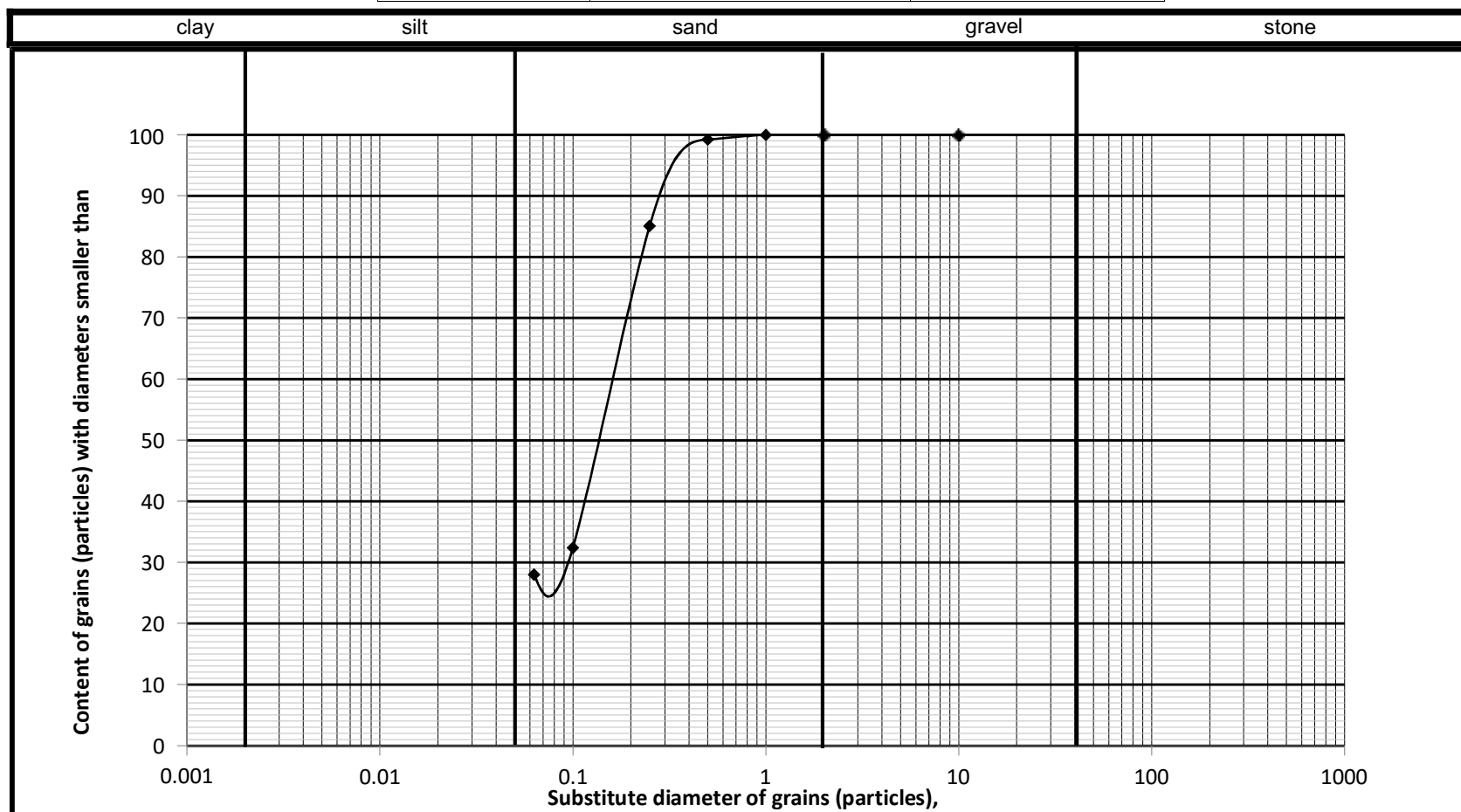
GRAIN-SIZE DISTRIBUTION CURVE – GRANULOMETRIC ANALYSIS (acc. to PN-86/B-02480)

Compiled by: B.Sc. Martyna
Banaś

Borehole No.	Sampling depth	Soil type
10	3.0-4.0 m.b.g.l.	Pd+G



Borehole No.	Sampling depth	Soil type
O3	6.0-7.5 m.b.g.l.	Pd+G



$f_k = 0 \%$
 $f_z = 0 \%$
 $F_p = 72.02 \%$
 $f_{\pi+1} = 27.98 \%$

APPENDIX NO. 6 – SUMMARY OF LABORATORY TEST RESULTS

Address: Opole, Wrocławska

Compiled by: B.Sc. Martyna Banaś

Sample taken			Macroscopic examination					GRAIN SIZE ANALYSIS				PHYSICAL CHARACTERISTICS				CONSISTENCY			
								action content [%]								Limits		Index of plasticity	Degree of plasticity
Borehole No.	Sampling depth in m.b.g.l	Type of sample	Soil type and colour		Moisture content	Roll test s	Soil condition	mm >2,0 gravel	> 0,05 sand	>0,002 dust	Type of soil	Weight loss on oxidation [%]	Natural moisture level	Bulk density	Specific density	Liquid	plastic		
														W _{n p}	ρ _s	W _L	W _p	I _p	L
													[%]	[g/cm ³]	[g/cm ³]	[%]	[%]	[%]	
1.	2.	3.	4.		5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
O3	3.0-4.8	NW	Π	grey	w	3	mpl						27.1			29.8	20.9	8.9	0.70
O6	4.5-7.0	NW	Ιπ	grey	mw	1	tpl						38.5			80.3	32.6	47.7	0.12
O4	2.0-2.7	NW	Gp	grey-brown	w	2-3	pl						16.7			25.9	11.9	14.0	0.34
O1	1.5-3.6	NW	I	brown	mw	1	tpl						18.8			69.4	16.8	52.6	0.04
O4	7.0-9.0	NW	Ιπ	grey	mw	1	tpl						25.5			68.8	23.3	45.5	0.05
O1	3.6-5.2	NW	I	grey-brown	mw	1	tpl						20.5			82.7	17.9	64.8	0.04
O2	4.5-6.0	NW	Pd+G	light-grey	w			0.06	72.28	27.66			24.6						
O5	1.5-3.0	NW	Ιπ	grey	mw	0	pzw						27.1			74.2	26.8	47.4	0.01
O2	2.2-4.5	NW	Gπz	grey	w	1	tpl						22.4			42.5	19.9	22.6	0.11
O5	6.0-9.0	NW	Ιπ	grey	mw	1	tpl						28.3			69.8	24.1	45.7	0.09
O8	1.5-3.0	NW	Gπz/I	brown	w	3-4	pl						33.5			52.3	24.0	28.3	0.34
O10	3.0-4.0	NW	Pd+G	dark-grey	w			0	73.9	26.1			30.8						
O13	6.0-7.5	NW	Pd+G	light-grey	w			0	72.02	27.98			23.0						

APPENDIX NO. 7 – SUMMARY OF TEST RESULTS

ANALYSIS OF ORGANIC CONTENT BY OXIDATION

Sampling place	Layer penetration [m.b.g.l.]	Soil type	Content of organic matter [%]
O2	8.2-9.0	Gπz+org	1.90
O15	6.0-7.0	Nm	16.21

APPENDIX NO. 8

Table of geotechnical parameters according to PN – 81/B – 03020;

characteristic value $x(n)$

material factor $\gamma_{(m)}$

design value $x(r)$

*determined by field and laboratory tests

** irrigated ground

Geotechnical layer	Soil type	Liquidity index	Density index	Natural moisture content	Bulk density	Consistency	Angle of internal friction	Initial loading modulus	Secondary loading modulus	Oedometric modulus of primary compression	Oedometric modulus of secondary compression	Soil consolidation symbol	
		I_L	I_D	W_n	ρ [t·m ⁻³]	C_u [kPa]	Φ_v [°]	E_o [MPa]	E [MPa]	M_o [MPa]	M [MPa]		
-	Gb	Soil – remove from surface											
Ia	Po	-	0.50*	4-18**	1.75-2.05**	-	38.5	138	138	153	153	-	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.58-1.85**		34.7						$x(r)$
Ib	Ps	-	0.50*	5-22**	1.70-2.00**	-	33.0	80	89	95	105	-	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.53-1.80**		29.7						$x(r)$
Ic	Pd	-	0.40*	6-24**	1.65-1.90**	-	30.0	38	48	51	64	-	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.49-1.71**		27.0						$x(r)$
Id	Gz, Gπz	0.00*	-	18-22	2.00-2.10	30.0	18.0	34	57	48	81	C	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.80-1.89		27.0						16.2
Ie	Gπz, Gpz, Pg, G, Gp, Gz	0.10*	-	12-22	2.00-2.20	22.0	16.5	26	43	37	62	C	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.80-1.98		19.8						14.9
If	Gπz+org	0.10*	-	24	1.95	15.0	11.6	18	30	26	43	C	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.76		13.5						10.4
Ig	Gπz, G, Gp	0.20*	-	12-22	2.00-2.20	17.0	15.0	21	35	29	49	C	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.80-1.98		15.3						13.5
Ih	Gπz, Gπ, Gp, G, Pg	0.35*	-	16-28	1.90-2.10	12.0	12.5	15	25	21	35	C	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.71-1.89		10.8						11.3
Ii	Π, Gπ	0.70*	-	26-32	1.90-1.95	6.0	7.0	7	12	10	17	C	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.71-1.76		5.4						6.3
Ij	Nm	Organic soils – aggregate mud – highly compressible, no standard parameters are specified for them											
Ik	I	0.05*	-	27	2.00	57.0	12.0	20	25	35	43	D	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.80		51.3						10.8
IIa	Ps	-	0.50*	22**	2.00**	-	33.0	80	89	95	105	-	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.80**		29.7						$x(r)$
IIb	Iπ	0.00*	-	33	1.90	60.0	13.0	22	28	39	49	D	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.71		54.0						11.7
IIc	Iπ	0.05*	-	33	1.90	57.0	12.0	20	25	35	43	D	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.71		51.3						10.8
IId	Iπ	0.10*	-	33	1.90	54.0	11.5	17	21	31	38	D	$x(n)$
					0.9		0.9						$\gamma_{(m)}$
					1.71		48.6						10.4

I	Quaternary – fluvio-glacial and alluvial terrace formations
II	Miocene – clays and sands

EXPLANATION OF SYMBOLS AND LETTERS USED IN CROSS-SECTIONS

MADE GROUND

NB embankment
nN uncompacted fill

NATIVE ORGANIC SOILS

H humus $2\% < l_{om} \leq 5\%$
Nm aggregate mud $5\% < l_{om} \leq 30\%$
T peat $30\% < l_{om}$

NATIVE MINERAL SOILS (NON-ROCKY)

KW	weathered rocks	rocky
KWg	weathered loam	
KR	rubble	
KRg	loamy rubble	
KO	pebbles	coarse-grained
Z	gravel	
Zg	loamy gravel	
Po	all-in aggregate	
Pog	loamy all-in aggr.	fine-grained non-cohesive
Pr	coarse sand	
Ps	medium sand	
Pd	fine sand	
Pπ	silty sand	fine-grained cohesive
Pg	loamy sand	
πp	sandy silt	
π	silt	
Gp	sandy loam	
G	loam	
Gπ	silt loam	
Gpz	sandy clay loam	
Gz	clay loam	
Gπz	silty clay loam	
lp	sandy clay	
I	clay	
Iπ	silty clay	

ROCKY SOIL

ST hard rock
SM soft rock

OTHER NON-TYPICAL SOIL

NOT COVERED BY THE STANDARD

Kr chalk
Gy gyttja
Cb lignite
Ck hard coal

ADDITIONAL GROUND DESCRIPTION MARKS

+ additives
// intercalations (interbedding)
/ soil limit
() supplementary component of e.g. embankment
1 borehole No.
50.14 elevation

BOREHOLES WITH SAMPLES

 natural structure sample (NNS)
 natural moisture content sample (WW)
 groundwater sample (WG)

BOREHOLE WATER MARKING

 interpreted max. ground water level
 piezometric water level (PRW) determined during drilling and elevation
 drilled ground water level
 watered ground
 seepage

PROBING TYPE DESIGNATION

 SPT cylindrical probe (stroke number)
 light-impact penetrometer probing graph

SOIL STATE

 semi-solid	 loose
 hard plastic	 semi-loose
 plastic	 dense
 soft plastic	
 liquid	

OTHER PICTOGRAMS

 number of geotechnical layer
 projection of the designed facility, number and amount of storeys, designed foundation level
 lithological-stratigraphic boundaries (layers) on the cross-sections