



Vortrag

Freitag, 06. Oktober 2023, 09:00 Uhr

„Performing“ an der Donau: Umfangreiche Studien und Untersuchungen für ein sicheres HDD-Projekt

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Firma: Atanasiu & Skills; HDI

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Lecture

Friday, 06th October 2023, 09:00 am

Performing at the Danube: in-depth studies and investigations for a safe HDD project

Speaker: Dragos Atanasiu, Alcyme Rambaud

Company: Atanasiu & Skills; HDI

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Performing at the DANUBE: Indepth studies and investigations for a safe HDD project

Summary

- Abstract
- Project Presentation
- Danube challenge
- Geotechnical study
- Issue raised up by initial geology
- Final optimized profile
- HDD Design
- HDD successful



Abstract

The undercrossing of the Danube and the Borcea arm with the crude oil pipelines was carried out in two stages, in **1968 and 1978** respectively.

Given the age of the pipelines, in order to ensure optimal conditions for transporting crude oil from the port of Constanta to mainland refineries and to avoid the risk of damage with serious environmental consequences, work started on upgrading and rebuilding the pipelines.

- Design and build contract : **€26.5 million**
- Scope of work : design and install **2 new 20" and 28" crude oil transport pipelines**
- Works started in **May 2022**
- Completion in **March 2023** (4 months ahead of the contracted deadline).

Project Presentation – Involved companies

- Client :



- Contractor (HDI – CIS GAZ JV) :



- Engineering, permitting and geology :



Project presentation – Specifications

- FETESTI - 3 parallel crossings
 - 8" / 20" / 28"
 - 1263 m

- CERNAVODA - 3 parallel crossings
 - 8" / 20" / 28"
 - 1460 m



Danube challenge

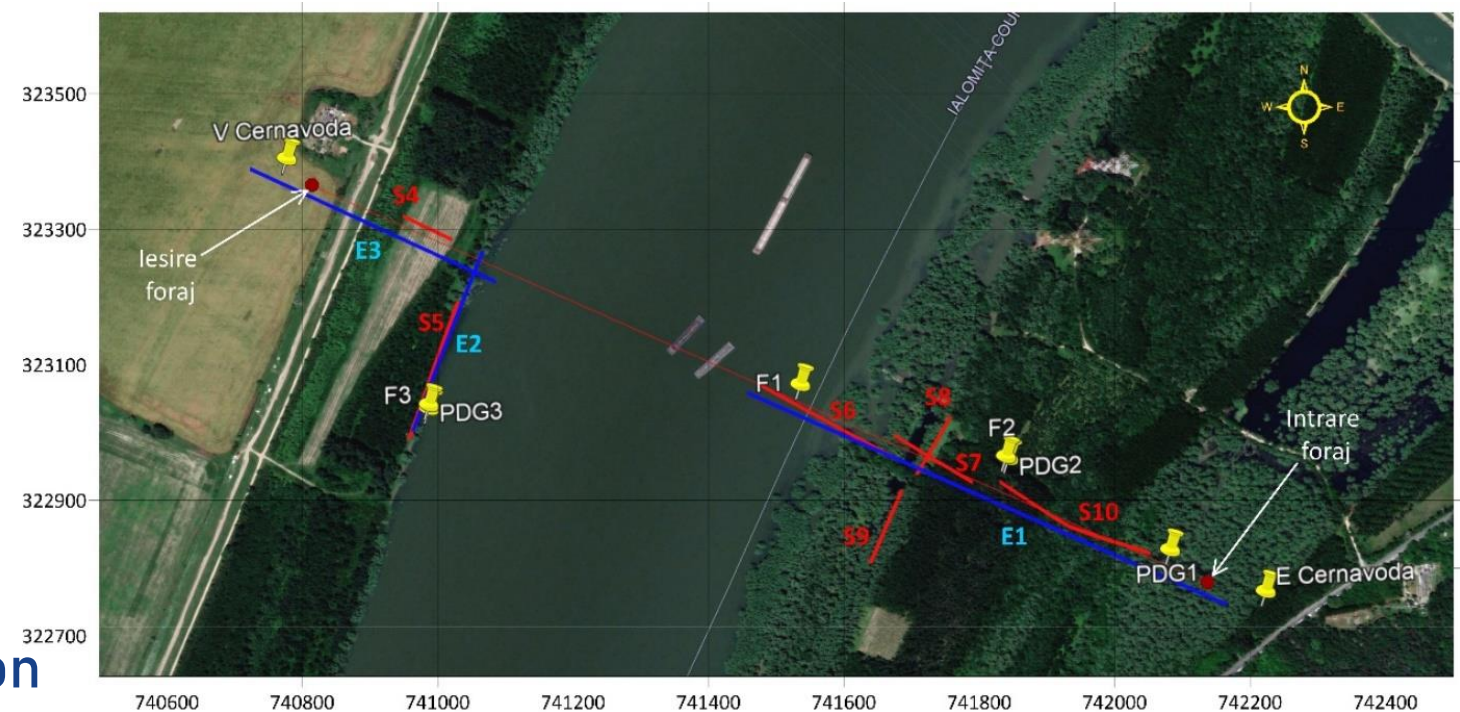
- Danube = bad reputation to be crossed by HDD
 - Alluvial bed sitting on bed rock
 - Rocky / alluvial interface
- } Stay in the upper alluvial layer



→ Where is the rock / Where is the interface ?

Geotechnical study

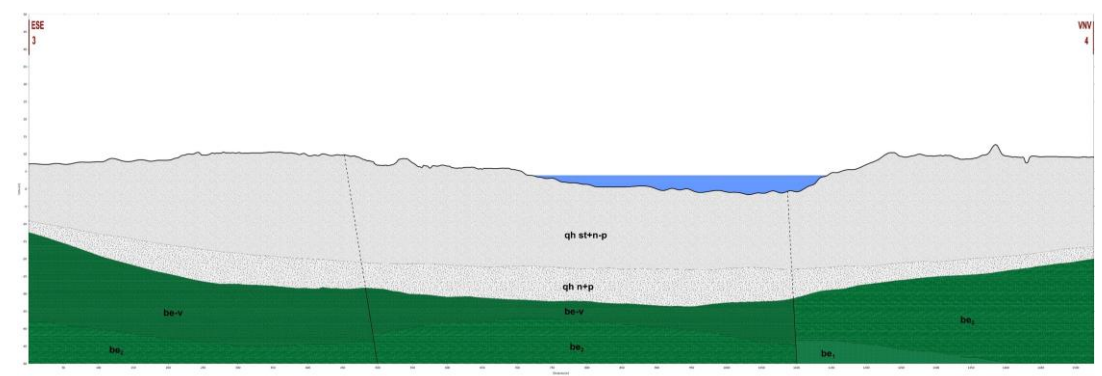
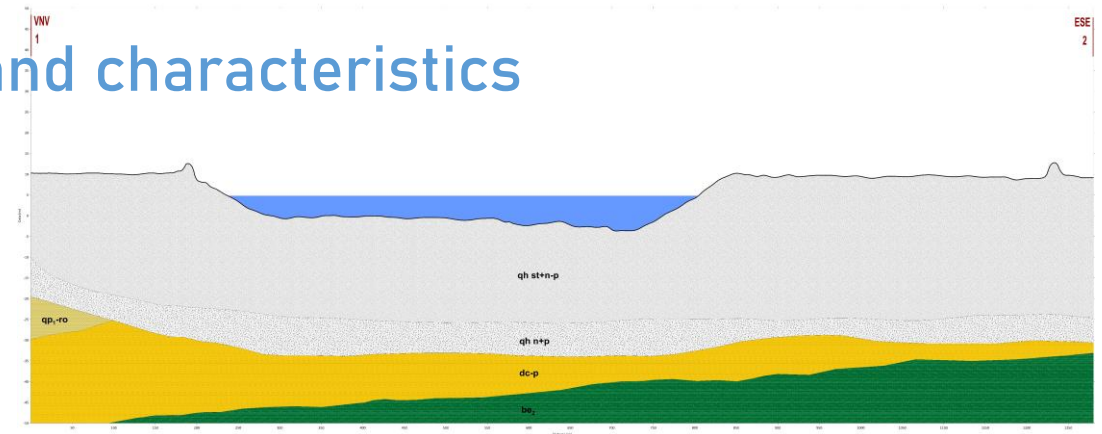
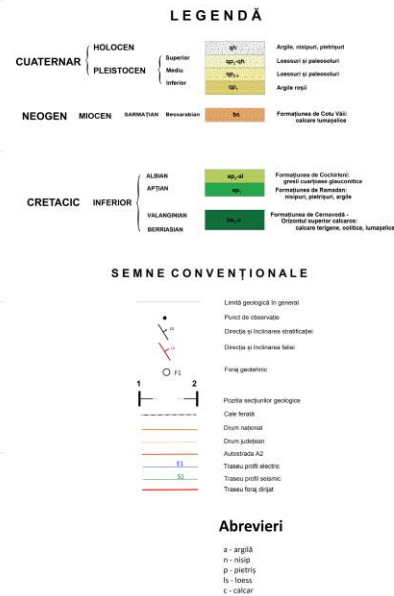
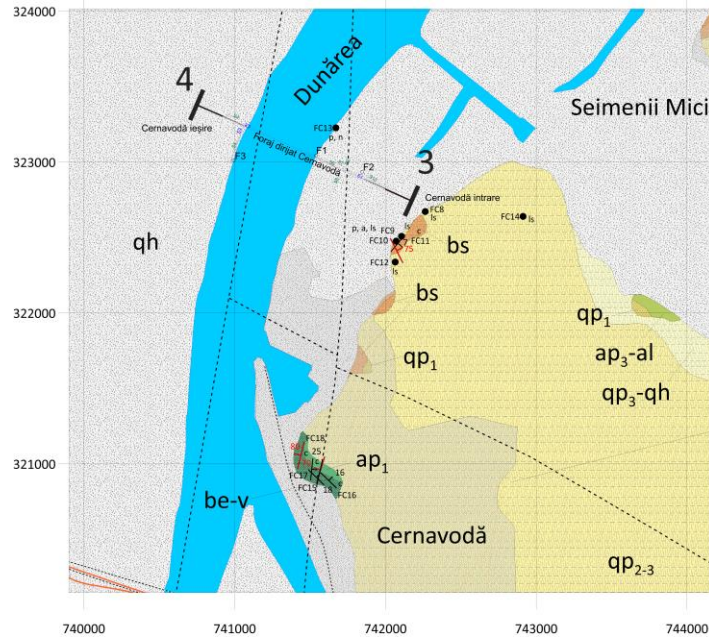
- Geological mapping
- Field investigations
 - Drilling and sampling
 - Seismic surveys
 - Geoelectric surveys
 - Geomagnetic surveys
 - Dynamic probing
- Laboratory analyses
 - Physical and mechanical analyses
 - Mineralogical analyses
- Data processing and correlation
- Integrated interpretation
- Deliverables



Geotechnical study

- Geologic Mapping

- Identification of the local geology and characteristics
- Geologic map
- Geologic sections



Geotechnical study

- Field investigations
 - Drilling and sampling
 - Dynamic probing
 - Seismic Surveys
 - Geoelectric surveys
 - Geomagnetic surveys



Geotechnical study

- Laboratory analyses
 - Geotechnical analyses
 - Mineralogic study on thin sections (samples from wells) – identification of which geologic formations described in literature have been encountered in the geotechnical wells

Tabel 1

Nr. ord.	Cod proba	Nr. foraj	Cota probă (m)	Fracțiuni procentuale (%)										Natura terenului	
				Argilă		Pruf (0.002-0.063 mm)				Nisip (0.063-2.0 mm)					Pietris (2.0-63 mm)
				Cl (0.002 mm)	FS (0.0063 mm)	MS (0.0063-0.02 mm)	CS (0.02-0.063 mm)	FSs (0.063-0.2 mm)	MSs (0.2-0.63 mm)	CSs (0.63-2.0 mm)	CSs (0.63-2 mm)	FCr (0.2-0.63 mm)	MGr (6.3-20 mm)	CGr (20-63 mm)	
1.	2217/P31	F3	10.0	-	-	-	6	70	24	0	-	-	-	-	Nisip
2.	2218/P32		15.0	-	-	-	8	71	18	3	-	-	-	-	Nisip
3.	2219/P33		20.	-	-	-	-	81	16	3	-	-	-	-	Nisip
4.	2220/P34		26.0	-	-	-	-	73	18	9	-	-	-	-	Nisip
5.	2221/P35		29.0	-	-	-	-	34	60	6	-	-	-	-	Nisip
6.	2222/P36	31.0	-	-	-	-	-	26	46	28	-	-	-	Nisip	
7.	2223/P37	36.0	23	21	14	10	32	-	-	-	-	-	-	Argila prafosă	
8.	2224/P38	39.0	22	19	24	8	27	-	-	-	-	-	-	Argila prafosă	
9.	2225/P41	F4	9.00	-	-	-	10	-	-	-	-	-	-	-	Nisip
10.	2226/P42		15.60	32	10	18	7	67	14	9	-	-	-	-	Argila nisipoasă
11.	2227/P43		24.0	-	-	-	-	33	21	10	-	-	-	-	Nisip
12.	2228/P44		27.0	-	-	-	-	69	21	10	-	-	-	-	Nisip
13.	2229/P45		32.0	-	-	-	-	50	38	12	-	-	-	-	Pietris cu nisip
14.	2230/P46	34.0	-	-	-	-	5	12	18	24	32	12	2	Nisip	
15.	2231/P47	37.0	-	-	-	-	-	69	20	6	-	-	-	Nisip	
16.	2232/P48	45.0	14	6	10	8	33	19	10	-	-	-	-	Nisip argilos	
17.	2233/P51	F5	6.0	-	-	-	6	73	16	5	-	-	-	-	Nisip
18.	2234/P52		12.0	-	-	-	-	10	80	10	0	-	-	-	Nisip
19.	2235/P53		16.0	-	-	-	-	4	86	10	-	-	-	-	Nisip
20.	2236/P54		17.0	-	-	-	-	2	90	6	2	-	-	-	Nisip
21.	2237/P55		19.0	-	-	-	-	-	77	19	4	-	-	-	Nisip
22.	2238/P56	21.00	-	-	-	-	-	75	19	6	-	-	-	Nisip	
23.	2239/P57	23.0	-	-	-	-	-	68	24	8	-	-	-	Nisip	
24.	2240/P58	26.0	-	-	-	-	-	10	19	10	46	15	-	Pietris cu nisip.	
25.	2241/P59	30.0	-	-	-	-	-	28	64	8	-	-	-	Nisip	
26.	2242/P510	35.0	-	-	-	-	-	28	48	19	5	-	-	Nisip	
27.	2243/P511	39.0	-	-	-	-	-	21	15	-	-	-	-	Argila prafosă	

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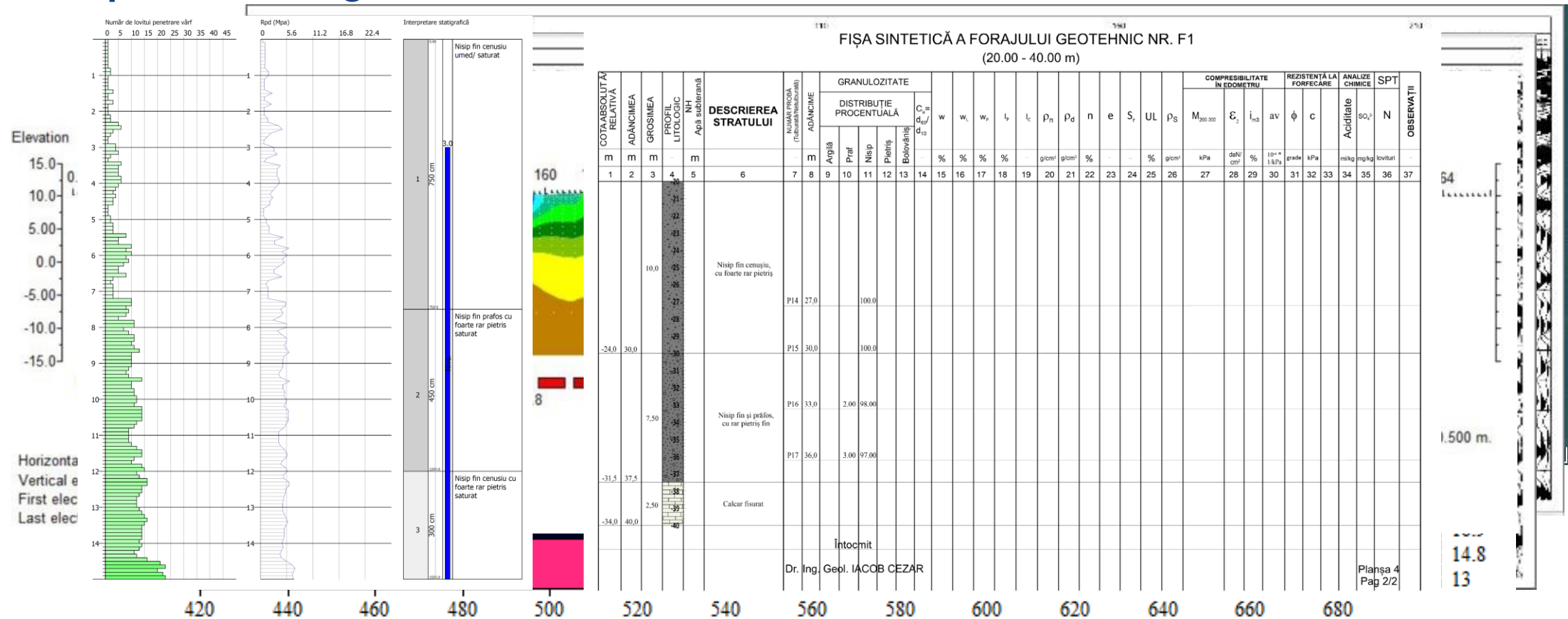
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Ex.2/2



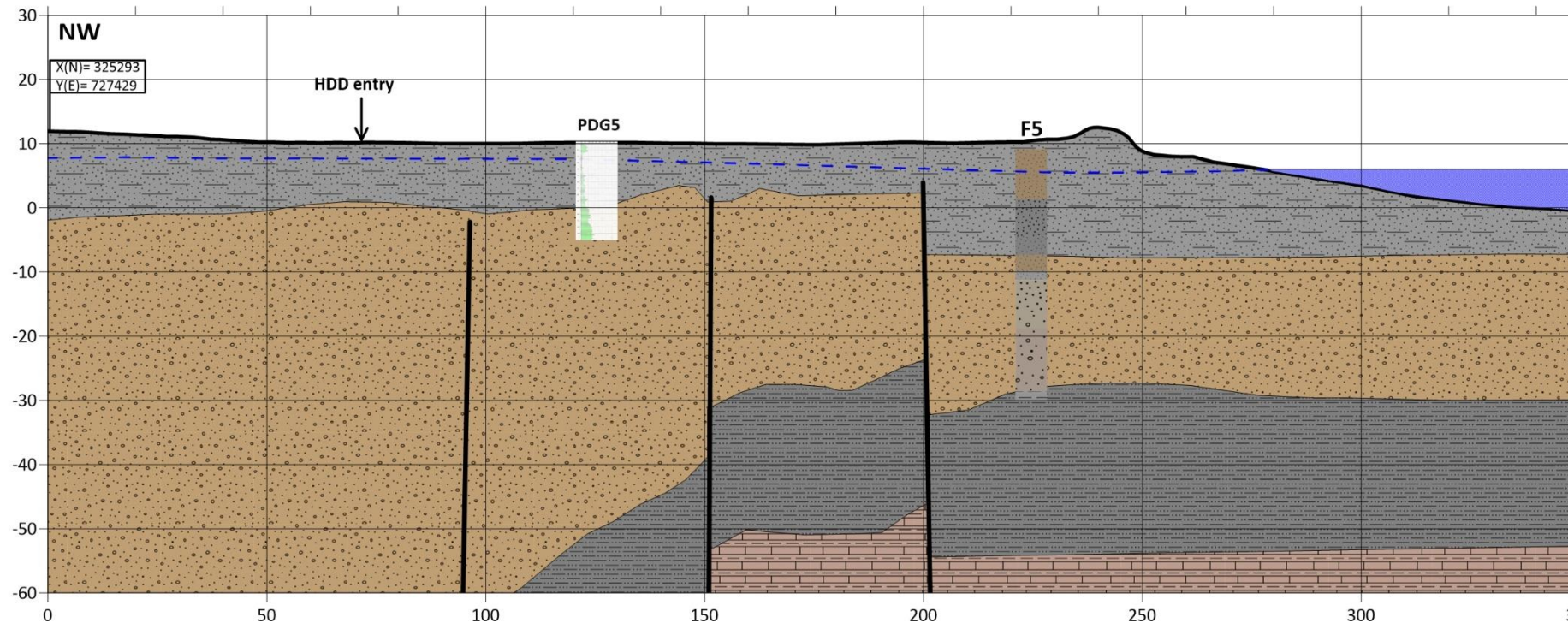
Geotechnical study

- Data processing and correlation



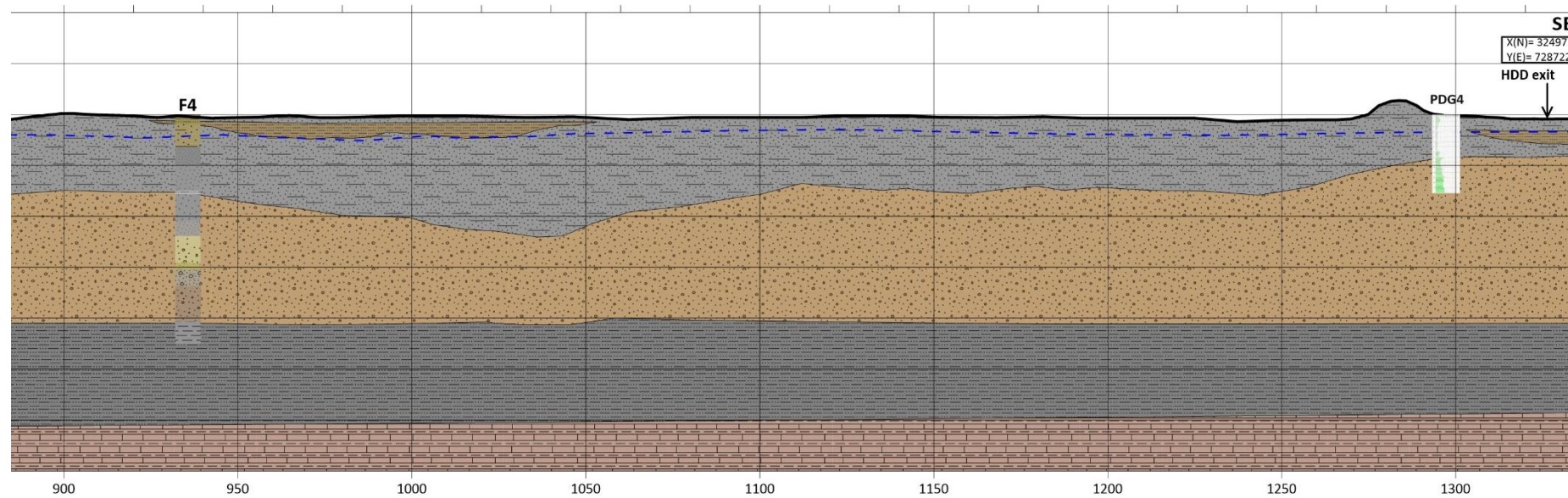
Geotechnical study

- Integrated interpretation



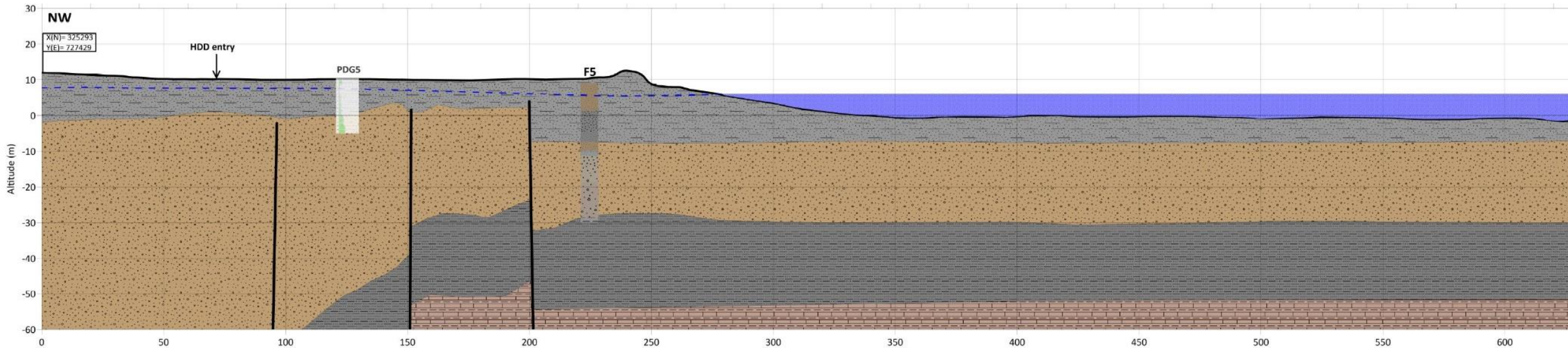
Geotechnical study

- Integrated interpretation



Geotechnical study

- Deliverables – lithologic profiles – FETESTI



Fine and silty sand with sandy clay lenses

- formation of holocene age, associated with Danube's depositional activity;
- is mostly made of fine sand and silt; locally, sandy clays occur in lenses, with thicknesses up to 1 m, with firm consistency and medium plasticity;
- the formation is loose down to 8 m, and loose to compact deeper;
- the permeability is low to medium, with low risk for drilling fluid loss;
- medium to high risk for drill hole collapse for 0-8 m depth interval;
- NSPT=7 (0-8 m depth); NSPT = 19 (>8 m depth);
- Density = 1.85 - 1.95 g/cm³

Clay and silty clay

- formation of holocene age, typical for the right bank of the river;
- is made of clays and silty clays, firm and with medium plasticity;
- very low permeability. No risks of drilling fluid loss;
- Density = 1.80 g/cm³

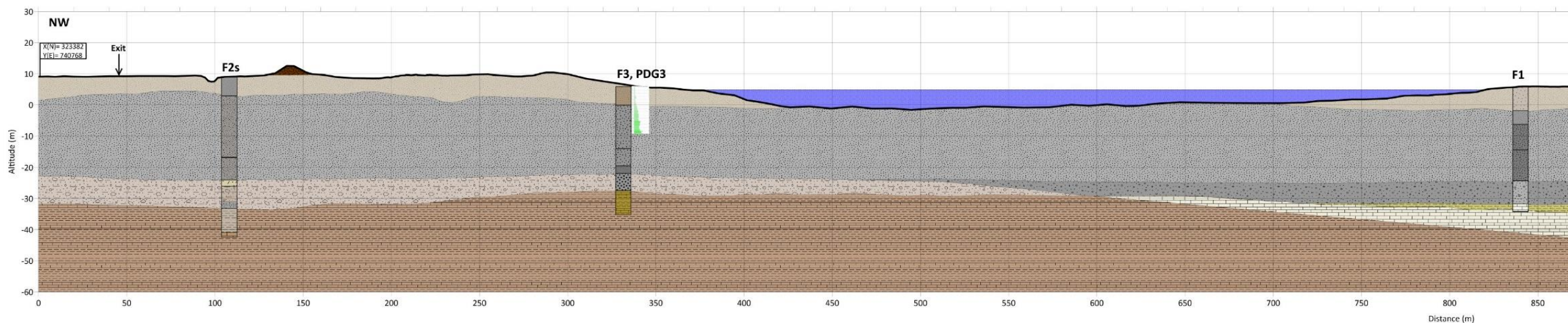
Middle-coarse sand and gravel with sand

- formation of lower pleistocene age;
- is mostly made of middle to fine sand with rare gravel, with metric levels of gravel mixed with sand;
- the sand is mostly coarse;
- where gravel is present, it's mostly fine, containing also middle and coarse fractions;
- the formation is dense, with a compaction degree of more than 80%;
- the permeability is average, with low to average risk for drilling fluid loss;
- low risk for drill hole collapse;

Geotechnical study

• Deliverables – lithologic profiles – CERNAVODA

Interpretative lithologic profile for undercrossing Danube river near Cernavoda through horizontal directional drilling



Fine and silty sand, with sandy clay lenses

- Holocene age formation;
- made of fine sand and silt; locally, sandy clay lenses occur, with medium plasticity and firm consistency, with thicknesses of up to 1 m;
- the formation is loose, with 30% compaction grade;
- medium permeability, moderate risk for fluid losses;
- moderate-high risk for drill hole collapse;
- NSPT=7;
- Density = 1.85 - 1.95 g/cm³.

Sand

- Holocene age formation;
- made of fine to medium sand, with silty levels;
- the granulometry is mostly homogenous;
- the formation is dense, with a compaction grade of 50-80%;
- the permeability is reduced-medium, with a reduced to moderate risk for fluid losses;
- reduced-moderate risk for drill hole collapse;
- NSPT = 40;
- Density = 2.00 g/cm³.

Coarse sand with rare gravel

- Holocene age formation;
- made of coarse sand and fine gravel;
- the formation is medium dense, with a compaction grade of 50%;
- the permeability is medium to high, with a moderate-high risk for fluid losses;
- moderate risk for drill hole collapse;
- NSPT = 28;
- Density = 2.00 g/cm³.

Gravel with sand

- Holocene age formation;
- made of gravel and sand;
- the formation is medium dense, with a compaction grade of 40%;
- high permeability, with high risk for fluid losses;
- moderate risk for drill hole collapse;
- NSPT = 20;
- Density = 2.00 g/cm³.

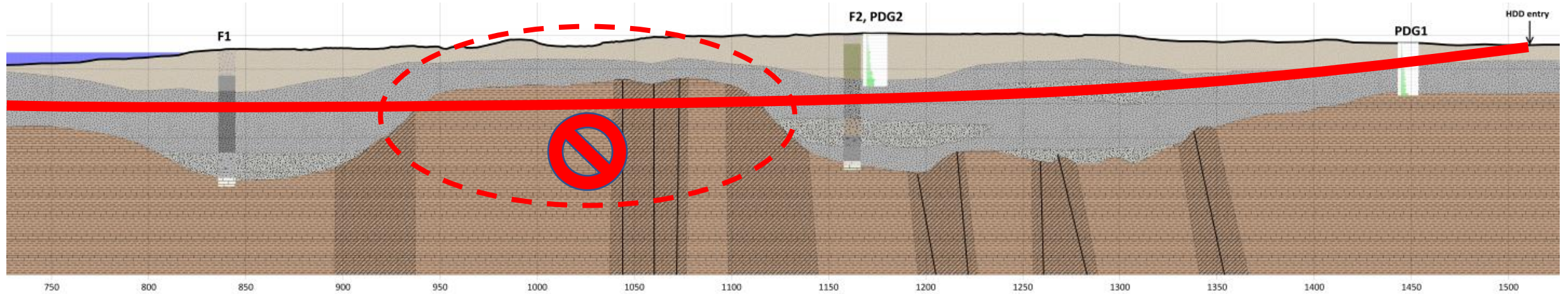
Gravel with clays

- Pleistocene age formation;
- made of gravel and coarse sand, with rare quartz boulders, poorly tied with clays;
- compaction grade of 60%;
- medium permeability, with moderate risk of fluid losses;
- reduced to moderate risk for drill hole collapse;
- NSPT = 30;
- Density = 2.00 g/cm³.

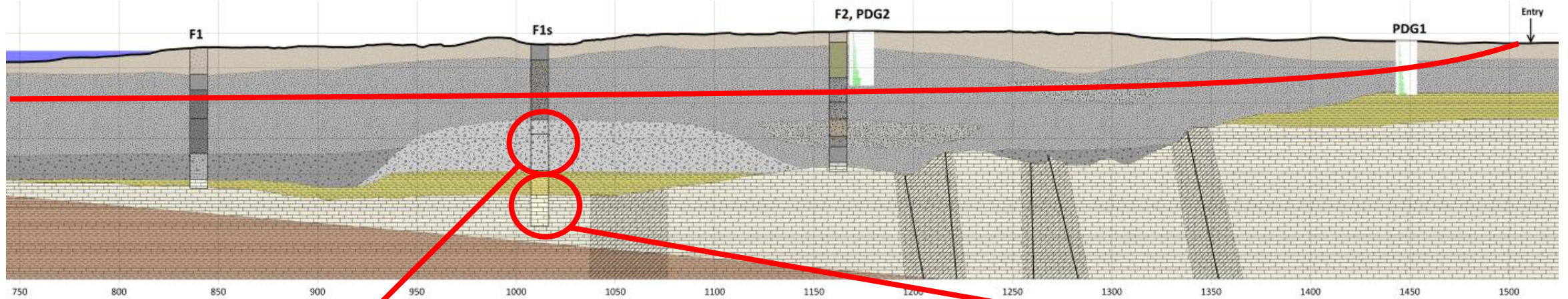
Marly shale

- weathering zone of the Cretaceous marly limestone;
- made of calcareous shales, with high plasticity and stiff consistency, with limestone fragments embedded of boulder sizes;
- impermeable formation, no risk for fluid losses;
- no risk for drill hole collapse;
- Density = 2.10 g/cm³.

Issue raised up by initial geology

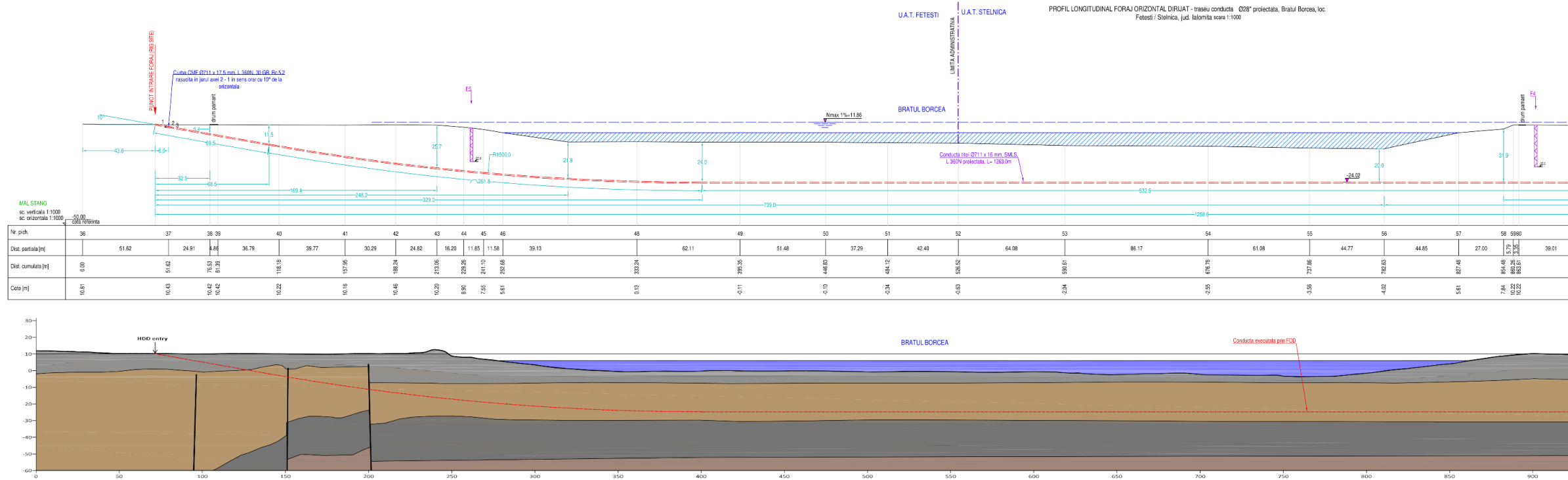


Final optimized profile



HDD Design

- Deliverables – drilling profile – FETESTI



HDD successful

- No rock formation crossed
- Drilling cuttings revealed investigation accuracy
- Drilling speed rate as expected

