Ref. Ares(2022)4166304 - 04/06/2022

1. INTRODUCTION

1.1. Purpose and Scope of the Survey

Geological observations and geotechnical measurements based on boring were carried out to determine the geological, structural and geotechnical characteristics of the area where the Intermodal Terminal Logistics Centre will be built (Figure 1) within the borders of Tekirdağ province, Ergene district, Karamehmet neighbourhood. With the common interpretation of the studies, the bed thicknesses in the area and their continuity in the soil were determined, and a soil survey report was prepared to determine the allowable soil stress of the base bed, local soil class, soil group, soil amplification and dynamic-elastic parameters.

This study was carried out to be submitted to the Ministry of Transport in the form of a soil and sub-surface survey report based on boring, upon determining the geology and soil condition of the plot area, pursuant to the contract signed with International Consulting Expertise (ICE). The studies were performed in July-October 2021.

Within the scope of this project, lithological, physical properties, geological structure, discontinuity, mass movements and soil subsidence of the soil resulting from the amount of pressure-strain on the same have been examined.

In the area of investigation, engineering geology and geotechnical findings and calculations are used to be able to determine the areas to be improved. It is also among the objectives of this report to facilitate the selection of the necessary soil improvement studies to make the soil suitable for construction, and to contribute to the selection of the appropriate sub-surface by determining the bearing capacity of soil.

With the literature study performed prior to the investigation, investigation studies conducted in the region were evaluated. All surface and underground geological information obtained during both regional studies and local studies of geological and geotechnical origin has been taken into consideration, thereby ensuring the expansion of the content of the project.

Introductory information was provided about the geographical location of the study area and its surroundings, transportation opportunities to the region and vegetation characteristics, and its geomorphology was examined with the help of existing topographical maps and field observations and evaluated in line with the purpose of the project.

To determine the physical properties of the lithological structure, the horizontal and vertical changes and underground structural positions of the units and to recognize their mechanical properties, 21 boreholes (ANNEX 2) were opened, and 10 Seismic Refraction-MASW, 5 Microtremors (ANNEX 7) were performed. Necessary laboratory tests (Annex 6) were performed on the samples taken from different depths from the boreholes. Besides, Geological observations and measurements were made in these boreholes. These studies pertaining to the area of investigation are shown on the measurement location map (ANNEX 3).

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1.2. Introduction of the Area of Investigation

1.2.1. Geomorphological and Environmental Information

The area of investigation is located within the borders of Tekirdağ province, Ergene district, Karamehmet neighbourhood (Figure 1).

Transportation: The area of investigation located in the city centre and transportation here is provided by road-rail. Çerkezköy - Ergene, Çorlu - Ergene, Tekirdağ, İstanbul, Edirne, Kırklareli roads, are available for transportation in summer and winter.

The area of investigation is the area within the borders of Tekirdağ province, Ergene district, Karamehmet neighbourhood, as specified below.

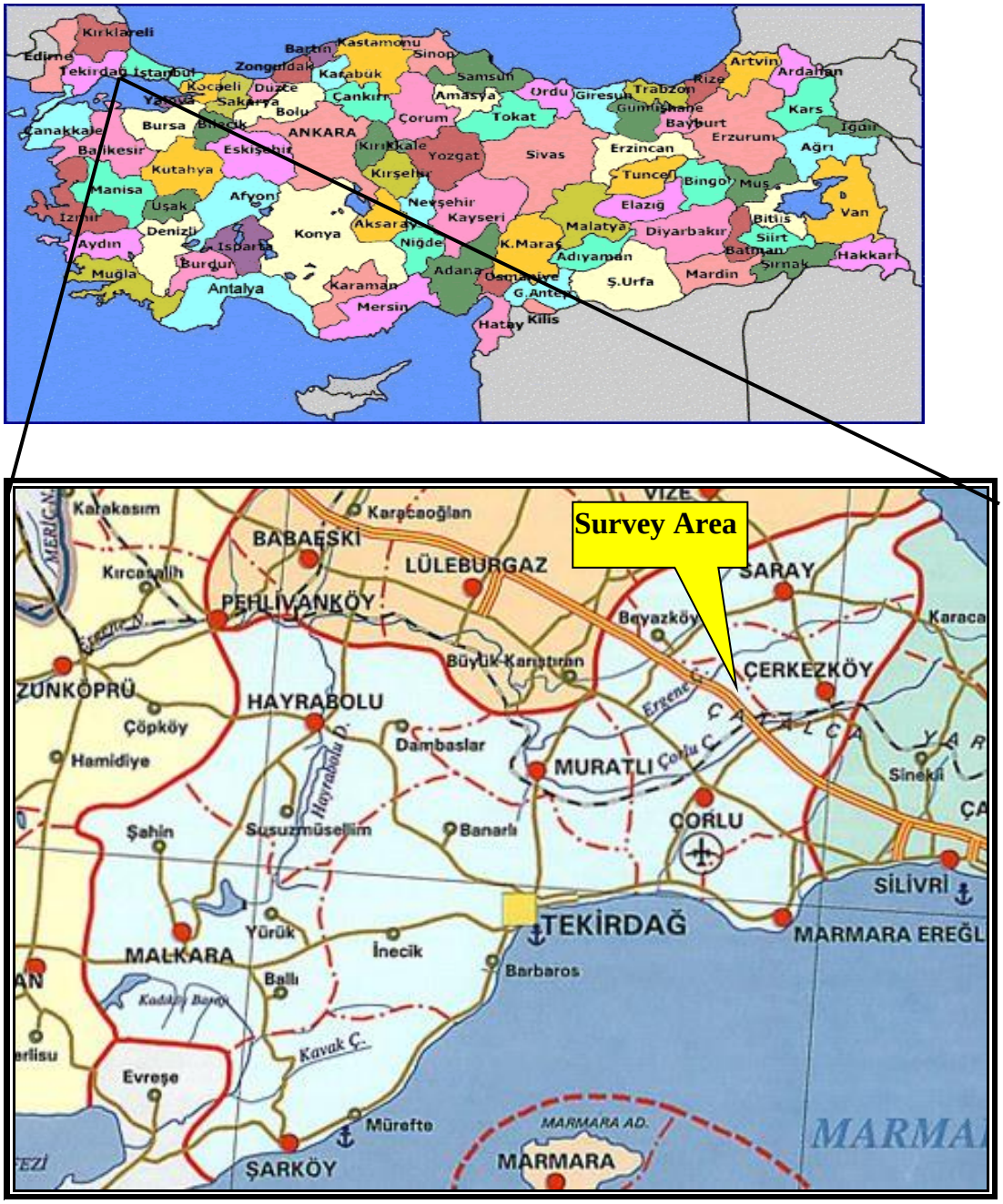

Figure 1: Area of Investigation Site Location Map

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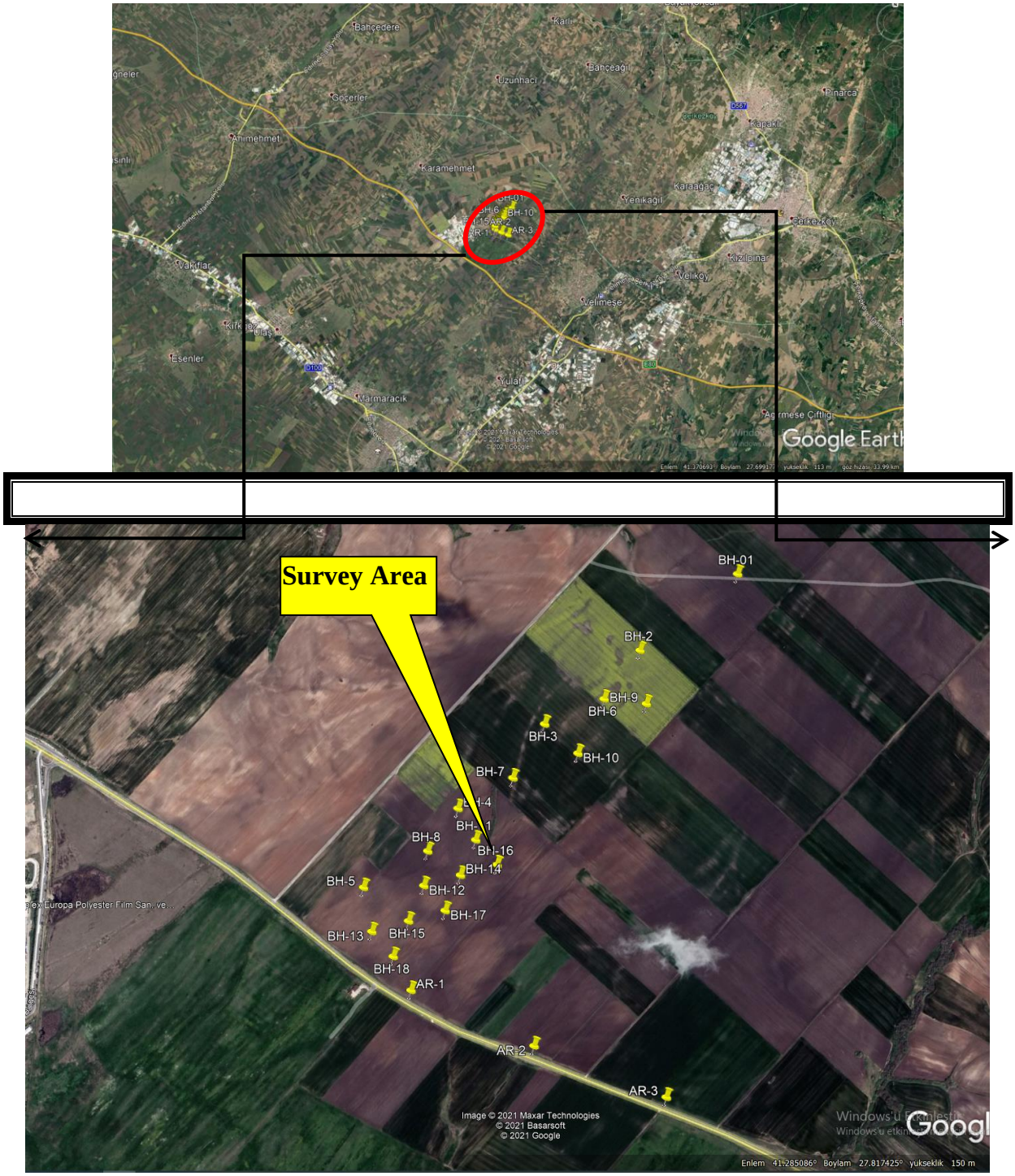

Figure 2: Satellite Image of the Area of Investigation.

1.2.2. Zoning Plan Status

The area of investigation is located within the borders of Tekirdağ province, Ergene district, Karamehmet neighbourhood and included within the zoning plan borders of Ergene district.

According to the planning made by the Ministry of Transport; it is determined as the area for the Intermodal Terminal Logistics Centre.

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As per law no. 7269, there is no prohibited area taken for the area of investigation.

1.2.3. Information About the Building Block

The purpose of allocation of the area of investigation in the zoning plan is the construction of the Intermodal Terminal Logistics Centre. In the zoning plan prepared by the Ministry of Transport, there is no prohibition decision about construction of a building.

The surrounding of the area of investigation is agricultural land and there are no structures in the immediate vicinity of the area.

There is a 0-5% slope in the investigation, and there are no flowing or dry streams that will cause overflow and flooding. In the borings performed at a depth of 20.0-50.0 meters in the investigation, water was encountered starting from a depth of 3.20-10.00 meters.

However, surface waters that may result from due to seasonal precipitation in the long term and leachate that will affect the foundation must be isolated and removed from the foundation very quickly with drainage systems. Contour drainage measures must be taken against surface waters. Again, no mass movements such as landslides and creeps (creepage) etc. were observed in the area.

Building Use Class	Purpose of Use of the Building	Building Importance Factor (*I*)
BUC = 1	**Buildings that need to be used after an earthquake, buildings where people are concentrated for a long time, buildings where valuable goods are stored and buildings containing dangerous substances** a) Buildings that must be used immediately after an earthquake (Hospitals, dispensaries, healthcare centers, fire brigade buildings and facilities, PTT and other communication facilities, transportation stations and terminals, power generation and distribution facilities, province, governorate and municipality administration buildings, first aid and disaster planning stations) b) Schools, other educational buildings and facilities, student residences and dormitories, military barracks, prisons, etc. c) Museums d) Buildings where toxic, explosive, flammable, etc. substances are located or stored	1.5
BUC = 2	**Buildings where people are concentrated for a short time** Shopping malls, sports facilities, cinemas, theatres, concert halls, houses of worship, etc.	1.2
BUC = 3	**Other buildings** Other buildings that do not fall under the scope of definitions given for BUC=1 and BUC=2 (Houses, workplaces, hotels, building type industrial structures, etc.)	1.0

Chart 1: AFAD, 2018. Building Earthquake Regulation of Turkey - Table 3.1. Building Use Classes and Building Importance Factors.

Building Use Class of the structure to be constructed in the investigation is included in **BUC=1-3** with a **Building Importance Factor** of **1.5-1.0.**

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1.2.4. Climate Information

The survey area and its surroundings are located in the Marmara climate zone in terms of climate, and are the transition area between the Mediterranean and the Black Sea. It is exposed to wind and precipitation from the Sea of Marmara in the south and from the Balkans and the Black Sea in the north. Summers are hot and dry while winters are cool and rainy. It is below 0°C for 30 days and above +30°C for 15 days a year. Generally, a temperate climate prevails.

1.2.5. Natural Disaster Hazards

In the survey area, there is no obstacle to construction in terms of natural disasters. There is no disaster area decision taken in according to law no. 7269, and it is evaluated as an area that does not carry the risk of natural disasters such as creep, sliding, rockfall, landslide, flooding, subsidence, etc.

No current creeps were found in the investigation. Considering the elevations in the region, the elevation does not put the area of investigation in a risky position in terms of flooding. However, no river system with a high flow rate that could cause flooding was observed in the area close to the site. Taking into consideration the regional climate, there is no risk of an avalanche.

Earthquake Condition and Risk Analysis

Earthquakes are earth tremors that occur because of fractures, which are defined as faults in geology and created by deformations in the earth's crust with internal dynamic processes. The magnitude of the earthquake depends on the amount of energy released during the fracture (faulting). The energy released by fracture generally decreases steadily with distance from the Centre of fracture. However, sometimes unfavourable soil conditions resulting from local geological properties disrupt this situation and cause the destructive effect of the earthquake to be more than expected despite being far from the source. For this reason, when evaluating the earthquake potential of any region, the faults (active faults) and local soil characteristics that cause earthquakes must be well-known.

With a general definition, seismicity is determined as a function of tectonic activity in that region. It covers the parameters, frequency and epicentral intensity-distance relations of earthquakes occurring in the region. In other words, it means establishing all the characteristics of the earthquakes occurring in the region. The purpose of determining the seismicity of a region is to help with the preparation of earthquake resistant construction projects. For this reason, the most important issue is to predict the largest earthquake force that will occur in the region within a certain time interval.

Enforcement of the enclosed Decision on Turkey's Earthquake Hazard Map and Parameters was decided upon by the Council of Ministers on 22.01.2018 according to article 2 of law no. 7269 dated 15.05.1959, upon the letter of the Deputy Prime Minister's Office (Disaster and Emergency Management Presidency) no. 6925 dated 12.01.2018. According to the Turkey's Earthquake Hazard Maps, which were put into effect with the resolution of the Council of Ministers no. 2018/11275 dated 22/01/2018, with a 10% probability of exceedance in a 50-year period (recurrence period of 475 years), the maximum ground acceleration of the area of investigation is 0.17, and it is in the medium hazard class.

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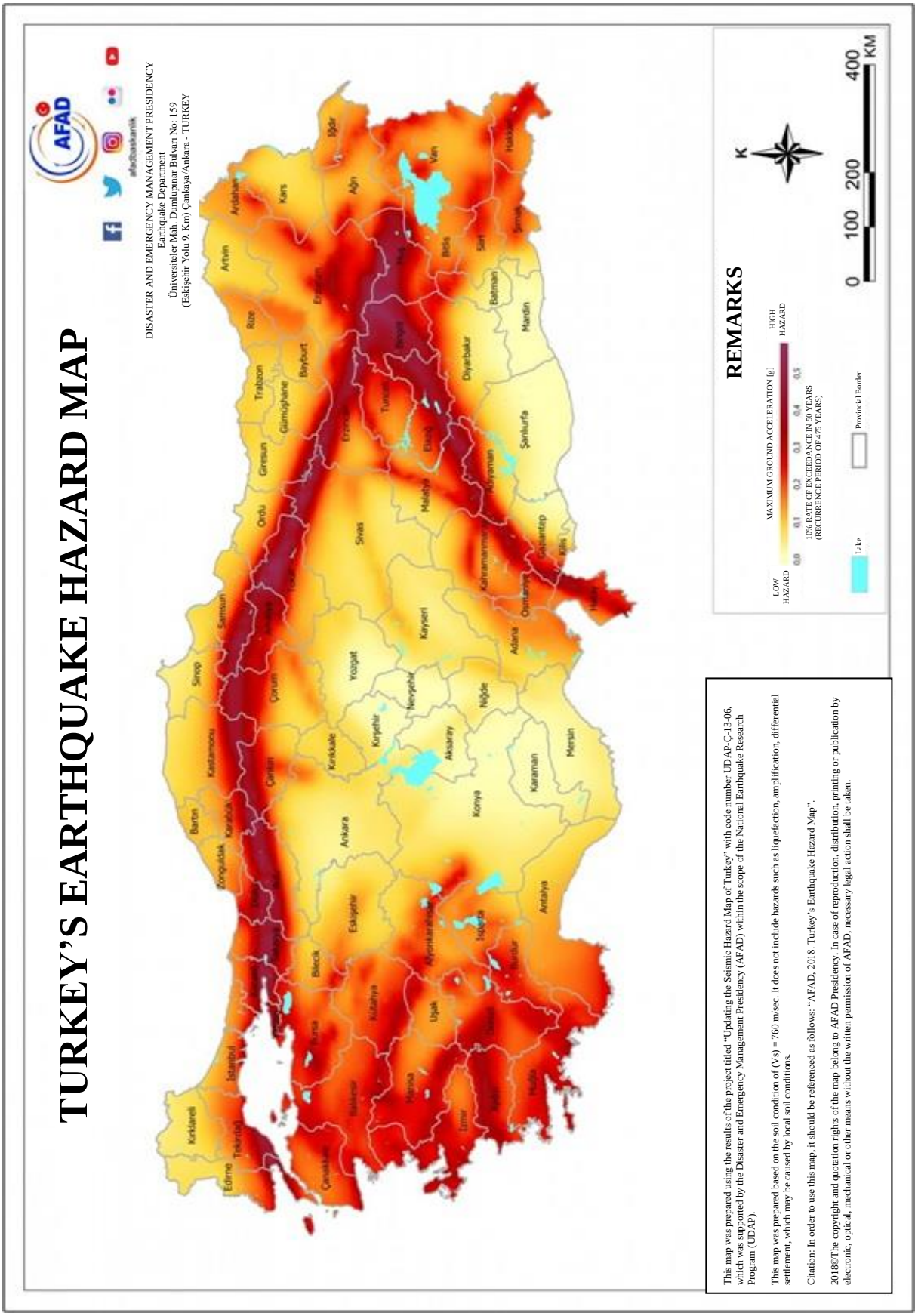

Figure 3: Turkey's Earthquake Hazard Map (AFAD, 2018)

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List of District-Centreed Earthquakes Falling in a Circle within a Radius of 100 Km												
NO	**ORIGIN DATE**	**ORIGIN TIME**	**LATITUDE**	**LONGITUDE**	**DEP. (km)**	**Xm**	**MD**	**ML**	**Mw**	**Ms**	**Mb**	**Location**
1	28.10.2015	16:20:02.02	40.822	27.7642	14.3	4.5	0	4.5	4.3	0	0	THE SEA OF MARMARA
2	27.11.2013	04:13:37.52	40.8455	27.9187	10.8	4.7	0	4.7	4.6	0	0	OFF THE COAST OF MARMARA EREGLISI-TEKIRDAG (THE SEA OF MARMARA)
3	07.06.2012	20:54:25.83	40.854	27.9235	14.9	5.1	0	5.1		0	0	OFF THE COAST OF MARMARA EREGLISI-TEKIRDAG (THE SEA OF MARMARA)
4	25.07.2011	17:57:20.81	40.8112	27.7382	17	5.2	0	5.2		0	4.9	THE SEA OF MARMARA
5	23.03.2002	02:36:10.60	40.81	27.84	12	4.8	4.8	4.3		0	0	THE SEA OF MARMARA
6	20.09.1999	21:28:00.00	40.69	27.58	16	5	5	0		0	0	THE SEA OF MARMARA
7	12.12.1993	17:21:26.20	41.51	28.82	28	4.8	4.5	0		0	4.8	OFF THE COAST OF OSMANLI - ISTANBUL (THE BLACK SEA)
8	08.03.1991	09:23:13.00	40.85	27.91	11	4.5	0	4		0	4.5	OFF THE COAST OF MARMARA EREGLISI-TEKIRDAG (THE SEA OF MARMARA)
9	12.02.1991	09:54:58.90	40.8	28.82	10	5	0	5		4.8	4.8	THE SEA OF MARMARA
10	24.04.1988	20:49:33.30	40.88	28.24	11	5.1	0	4.9		5.1	5	THE SEA OF MARMARA
11	27.04.1985	12:33:06.90	40.74	27.38	9	4.6	0	4.6		0	4.4	GAZIKOY-SARKOY (TEKIRDAG)
12	12.07.1982	14:46:14.00	41	27.83	25	4.6	0	4.3		0	4.6	YENICIFTLIK-MARMARAEREGLISI (TEKIRDAG)
13	12.03.1981	04:06:00.60	40.8	28.09	12	4.7	0	4.7		0	4.7	THE SEA OF MARMARA
14	15.06.1978	00:26:45.00	40.79	27.68	28	4.6	0	4.4		0	4.6	THE SEA OF MARMARA
15	01.05.1971	13:45:27.40	40.95	27.99	13	4.9	0	4.9	4.7	4.4	4.6	MARMARAEREGLISI (TEKIRDAG)
16	06.08.1967	14:09:33.00	41	28.8	10	4.5	4.4	4.4	4.5	4.3	4.4	KUCUKCEKMECE (ISTANBUL)
17	31.07.1967	07:12:05.00	40.6	27.62	4	4.5	4.3	4.3	4.5	4.2	4.2	THE SEA OF MARMARA
18	26.07.1959	17:07:06.20	40.91	27.54	10	5.5	5.3	5.3	5.5	5.4	5.3	BARBAROS - (TEKIRDAG)
19	26.10.1954	10:34:28.60	40.56	27.52	10	4.8	4.7	4.6	4.8	4.6	4.7	EKINLIK-MARMARA (BALIKESIR)
20	13.03.1952	06:30:01.80	41.02	28.14	11	5.2	4.9	4.9	5.2	4.9	4.9	THE SEA OF MARMARA
21	16.06.1942	05:42:34.40	40.8	27.8	20	5.7	5.4	5.4	5.7	5.6	5.4	THE SEA OF MARMARA
22	10.10.1929	23:00:54.80	41.11	27.46	15	4.7	4.6	4.6	4.7	4.5	4.6	YESILSIRT-MURATLI (TEKIRDAG)
23	10.06.1925	04:45:00.00	41	29	8	4.6	4.5	4.5	4.6	4.4	4.6	KADIKOY (ISTANBUL)
24	26.10.1923	12:13:16.00	41.2	28.6	24	5.3	5	4.9	5.3	5	5	YASSIOREN-ARNAVUTKOY (ISTANBUL)
25	13.10.1919	07:54:10.00	41.5	28	12	4.7	4.6	4.6	4.7	4.5	4.6	GUNGORMEZ-SARAY (TEKIRDAG)
26	22.01.1907	02:41:00.00	41	29	12	4.7	4.6	4.6	4.7	4.5	4.6	KADIKOY (ISTANBUL)

Chart 2: Data for probabilistic earthquake hazard analysis of the region (taken from **http://udim.koeri.boun.edu.tr**.)

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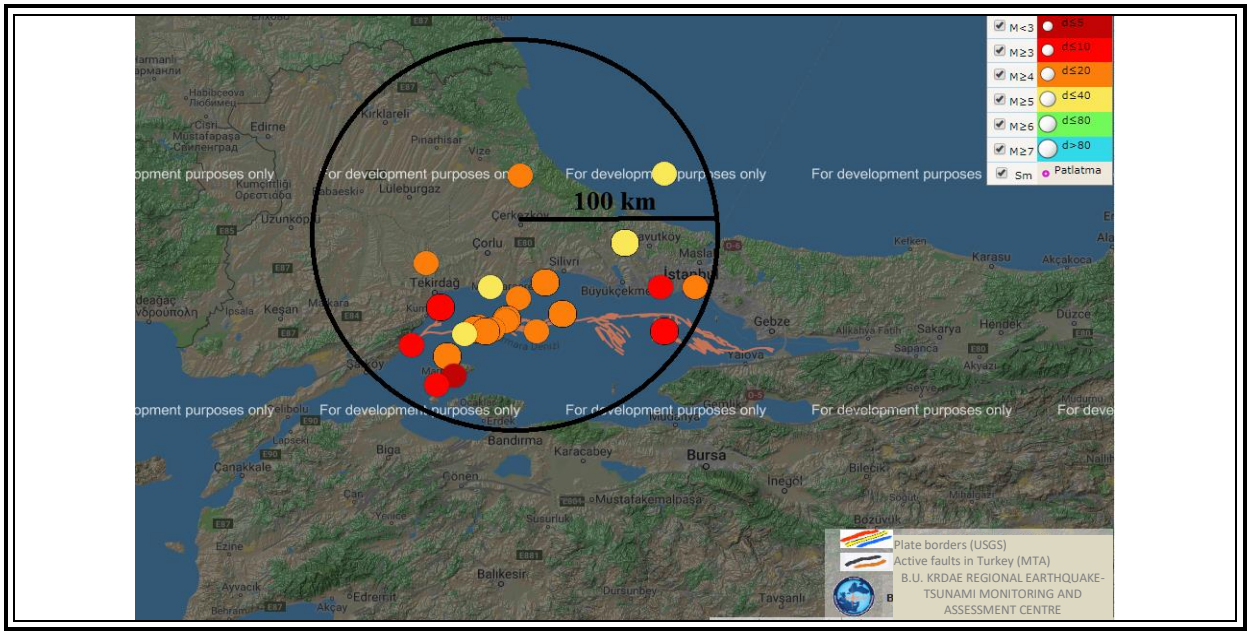


Figure 4: Earthquakes within a 100-km radius with the Centre being the area of investigation

PROBABİLİSTİK DEPREM TEHLİKE ANALİZİ

		YIL	120			
Poison Olasılık Dağılımı ile Deprem Risk Analizi						
Regresyon için Veri Sayısı	3					
Büyüklük (M) Aralıkları	4.5 ≤ M <5.0	5.0 ≤ M < 5.5	5.5 ≤ M <6.0	6.0 ≤ M <6.5	6.5 ≤ M <7.0	7.0 ≤ M <7.5
Ni (Oluşum Sayıları)	17	7	2			
Ortalama Büyüklük(M) yada (Xi)	4,7	5,2	5,7			
ΣNi (Kümülatif Oluş Sayıları)	26	9	2	0	0	0
ΣNi/t	0,216666667	0,075	0,016666667	0	0	0
Log ΣNi/t yada (Yi)	-0,664207898	-1,124938737	-1,77815125	0	0	0

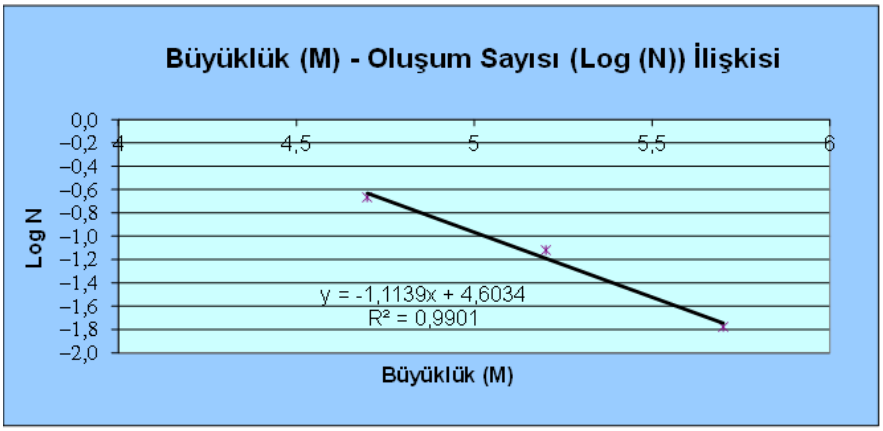
ΣXi	15,6000000	a	4,603406137
ΣYi	-3,5672979	b	-1,113943352
ΣXi^2	81,6200000		
ΣXiYi	-19,1069207		
$(\Sigma xi)^2$	243,3600000		

Log (N) = a - b* M

Legend for the figure above:

Turkish	**English**
PROBABİLİSTİK DEPREM TEHLİKE ANALİZİ	PROBABILISTIC EARTHQUAKE HAZARD ANALYSIS
Poison Olasılık Dağılımı ile Deprem Risk Analizi	Earthquake Risk Analysis with Poisson Probability Distribution
YIL	YEAR
Regresyon için Veri Sayısı	Number of Data for Regression
Büyüklük (M) Aralıkları	Magnitude (M) Ranges
Ni (Oluşum Sayıları)	Ni (Numbers of Occurrence)
Ortalama Büyüklük (M) ya da (Xi)	Average Magnitude (M) or (Xi)
(Kümülatif Oluş Sayıları)	(Cumulative Numbers of Occurrence)
yada	or

Chart 3: Probabilistic Earthquake Hazard Analysis for Tekirdağ Province, Ergene district.



Legend for the figure above:

Turkish	English
Büyüklük (M) - Oluşum Sayısı (Log (N)) İlişkisi	Relation Between Magnitude (M) -Number of Occurrences (Log (N))
Büyüklük (M)	Magnitude (M)

Chart 4: The relation between magnitude-number of occurrences obtained for Tekirdağ Province, Ergene district (The calculations were made with soil geophysical analysis program.)

Poison Olasılık Dağılımı

		Rm = 1- e-(N(M) *D)				Ortalama
		D (Yıl) için Olasılık (%)	D (Yıl) için Olasılık (%)	D (Yıl) için Olasılık (%)	D (Yıl) için Olasılık (%)	Tekrarlama Periyodu
N(M)	Büyüklük (M)	10	50	75	100	(Yıl)
0,389638	4,5	98,0	100,0	100,0	100,0	3
0,108066	5	66,1	99,5	100,0	100,0	9
0,029972	5,5	25,9	77,7	89,4	95,0	33
0,008313	6	8,0	34,0	46,4	56,5	120
0,002306	6,5	2,3	10,9	15,9	20,6	434
0,000639	7	0,6	3,1	4,7	6,2	1564
0,000177	7,5	0,2	0,9	1,3	1,8	5639

Legend for the figure above:

Turkish	English
Poison Olasılık Dağılımı	Poisson Probability Distribution
Büyüklük (M)	Magnitude (M)
D (Yıl) için Olasılık (%)	Probability (%) for D (Year)
Ortalama Tekrarlama Periyodu	Average Recurrence Period
Yıl	Year

Chart 5: Probabilistic risk values calculated in percentage values for various years and earthquake magnitudes obtained for Tekirdağ Province, Ergene district (The calculations were made with soil geophysical analysis program.)

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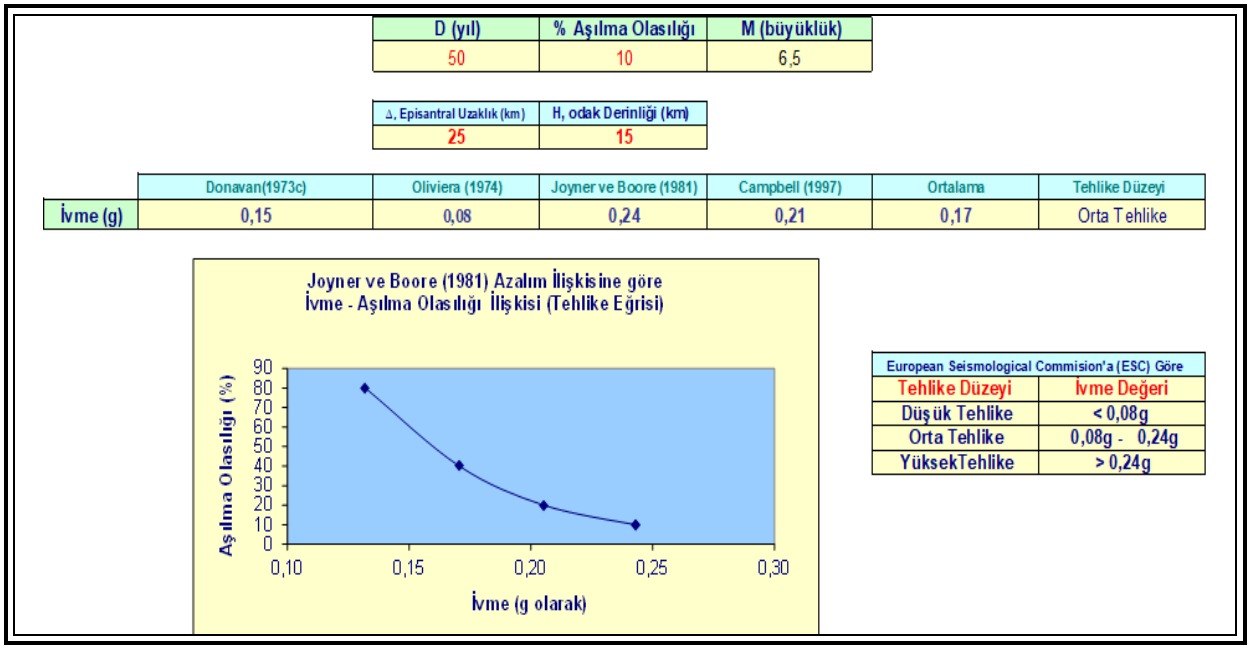

Legend for the figure above:

Turkish	**English**	**Turkish**	**English**
Yıl	Year	Ortalama	Average
% Aşılma Olasılığı	Probability of Percentage in %	Tehlike Düzeyi	Hazard Level
M (büyüklük)	M (magnitude)	Orta Tehlike	Medium Hazard
Episantral Uzaklık (km)	Epicentral Distance (km)	European Seismological Commission'a (ESC) göre	According to European Seismological Commission (ESC)
Odak derinliği (km)	Focal depth (km)	İvme Değeri	Acceleration Value
İvme (g)	Acceleration (g)	Düşük Tehlike	Low Hazard
Joyner ve Boore	Joyner and Boore	Yüksek Tehlike	High Hazard

Chart 6: Earthquake magnitude for 50 years and 10% exceedance rate obtained for Tekirdağ Province, Ergene district and hazard curve according to Joyner and Boore (1981) attenuation relationship model for various exceedance rates and acceleration values that may occur in case such earthquake is in one of the seismic zones mentioned in the deterministic earthquake hazard analysis. (The calculations were made with soil geophysical analysis program.)

The earthquake magnitude, whose probability of exceedance once in 50 years does not exceed 10%, is calculated as 6.5.

Upon examination of Chart 5, it is possible to see the % analysis of earthquakes that may occur between 4.5 and 7.5 magnitudes. Accordingly, the return period is 120 years for an earthquake with a magnitude of 6.0 and 434 years for an earthquake with a magnitude of 6.5. Besides; while the probability of occurrence of an earthquake with a magnitude of 7.0 within 10 years is 0.6%, the probability of occurrence of an earthquake with a magnitude of 7.0 within a 50-year time frame, which may be considered as the lifetime of a standard structure, is determined as 3.1%. The probability calculations determined for other earthquake magnitudes may be seen from the chart.

EARTHQUAKE GROUND MOTION LEVELS
Earthquake Ground Motion Level-1 (DD-1)
DD-1 Earthquake Ground Motion describes a very rare earthquake ground motion where the probability of exceeding the spectral magnitudes in 50 years is 2% and the corresponding recurrence period is 2475 years. This earthquake ground motion is also called the largest earthquake ground motion considered.
Earthquake Ground Motion Level-2 (DD-2)
DD-2 Earthquake Ground Motion describes a rare earthquake ground motion where the probability of exceeding the spectral magnitudes in 50 years is 10% and the corresponding recurrence period is 475 years. This earthquake ground motion is also called the standard design earthquake ground motion.
Earthquake Ground Motion Level-3 (DD-3)
DD-3 Earthquake Ground Motion describes a frequent earthquake ground motion where the probability of exceeding the spectral magnitudes in 50 years is 50% and the corresponding recurrence period is 72 years.
Earthquake Ground Motion Level-4 (DD-4)
DD-4 Earthquake Ground Motion describes a very frequent earthquake ground motion where the probability of exceeding the spectral magnitudes in 50 years is 68% (the probability of exceeding in 30 years is 50%) and the corresponding recurrence period is 43 years. This earthquake ground motion is also called the service earthquake ground motion.

Chart 7: Earthquake Ground Motion Levels.

Local Soil Class	Soil Type	(Vs)30 m/sec.	(N60)30 [pulse /30 cm]	(Cu)30 [kPa]
ZA	Solid, hard rocks	> 1500	-	-
ZB	Slightly weathered, medium solid rocks	760 – 1500	-	-
ZC	Very firm sand, gravel and hard clay layers or weathered, very cracked weak rocks	360 – 760	> 50	> 250
ZD	Medium firm-firm layers of sand, gravel or very stiff clay	180 – 360	15-50	70-250
ZE	Profiles with layers of loose sand, gravel or soft - stiff clay or a layer of soft clay (cu < 25 kPa) with a total thickness of more than 3 meters, meeting the conditions of PI > 20 and w > 40%	< 180	< 15	< 70
ZF	Soils requiring site-specific research and evaluation: 1) Soils with the risk of subsidence and potential collapse under earthquake effect (liquefiable soils, highly sensitive clays, collapsible weak cement soils, etc.), 2) Peat with a total thickness of more than 3 meters and/or clays with a high organic content, 3) High-plasticity (PI >50) clays with a total thickness of more than 8 meters, 4) Very thick (> 35 m) soft or medium stiff clays.			

Chart 8: Local Soil Classes **(AFAD, 2018.** According to **Building Earthquake Regulation of Turkey**)

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- Soil Class: **ZD**

Map Spectral Acceleration Coefficients and Design Spectral Acceleration Coefficients

Dimensionless map spectral acceleration coefficients are defined in the scope of Turkey's Earthquake Hazard Maps for four different earthquake ground motion levels:

(a) Short period *map spectral acceleration coefficient* S_S

(b) *Map spectral acceleration coefficient* for 1.0-second period S_1

The map spectral acceleration coefficients corresponding to the geometric mean of the earthquake effects in two perpendicular horizontal axes are defined as dimensionless coefficients by dividing the map spectral accelerations by the gravitational acceleration for 5% damping ratio, taking as the basis the reference soil condition [$(Vs)_{30}$=760 m/sec.] for a specific earthquake ground motion level.

The map spectral acceleration coefficients S_S and S_1 are converted into the design spectral acceleration coefficients S_{DS} and S_{D1} as follows:

$$S_{DS} = S_S F_S$$

$$S_{D1} = S_1 F_1$$

Here, F_S and F_1 show the local soil effect coefficients defined in the table. Horizontal and vertical elastic design spectrums are defined by making use of the design spectral acceleration coefficients.

Local Soil Effect Coefficients

Local soil effect coefficients F_S and F_1 are given below, depending on the local soil classes. Linear interpolation may be used for the intermediate values of the map spectral acceleration coefficients in the tables.

Local Soil Effect Coefficients for the short period region

Local Soil Class	Local Soil Effect Coefficient F_S for the short period region					
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S = 1.25$	$S_S \ge 1.50$
ZA	0.8	0.8	0.8	0.8	0.8	0.8
ZB	0.9	0.9	0.9	0.9	0.9	0.9
ZC	1.3	1.3	1.2	1.2	1.2	1.2
ZD	1.6	1.4	1.2	1.1	1.0	1.0
ZE	2.4	1.7	1.3	1.1	0.9	0.8
ZF	*Site-specific soil behavior analysis shall be carried out* (Building Earthquake Regulation 2018)					

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***Local Soil Effect Coefficients* for 1.0 second period**

Local Soil Class	*Local Soil Effect Coefficient* F_1 for 1.0 second period					
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 = 0.50$	$S_1 \ge 0.60$
ZA	0.8	0.8	0.8	0.8	0.8	0.8
ZB	0.8	0.8	0.8	0.8	0.8	0.8
ZC	1.5	1.5	1.5	1.5	1.5	1.4
ZD	2.4	2.2	2.0	1.9	1.8	1.7
ZE	4.2	3.3	2.8	2.4	2.2	2.0
ZF	*Site-specific soil behavior analysis shall be carried out* (Building Earthquake Regulation 2018)					

Here, S_{DS} and S_{D1} represent the defined design spectral acceleration coefficients, and T represents the natural vibration period. The horizontal design spectrum is defined depending on the corner periods T_A and T_B and S_{DS} and S_{D1}.

$$T_A = 0.2\frac{S_{D1}}{S_{DS}} \quad ; \quad T_B = \frac{S_{D1}}{S_{DS}}$$

S_S : Short period map spectral acceleration coefficient [dimensionless]

S_1 : Map spectral acceleration coefficient for 1.0 second period [dimensionless]

PGA : Maximum ground acceleration [g]

PGV : Maximum ground speed [cm/sec.]

S_S = 0.700 S_1 = 0.195

***F_S* = 1,240 *F_1* = 2,210**

***PGA*=0.293, *PGV*=17.973**

$S_{DS} = S_S * F_S$ = 0.700 x 1,240 = 0.868
$S_{D1} = S_1 * F1$ = 0.195 x 2,210 = 0.431

S_{DS} : Short period design spectral acceleration coefficient [dimensionless]
S_{D1} : Design spectral acceleration coefficient for 1.0 second period [dimensionless]

T_A=0.2*S_{D1}/S_{DS}, T_B=S_{D1}/S_{DS},
T_A = 0.099 (s)
T_B = 0.496 (s).
The period for transition to the constant displacement region is taken as: T_L = *6.0 s.*

T_{AD}= TA/3, T_{BD}= T_B/3,
T_{AD} = 0.033 (s)
T_{BD} = 0.165 (s).

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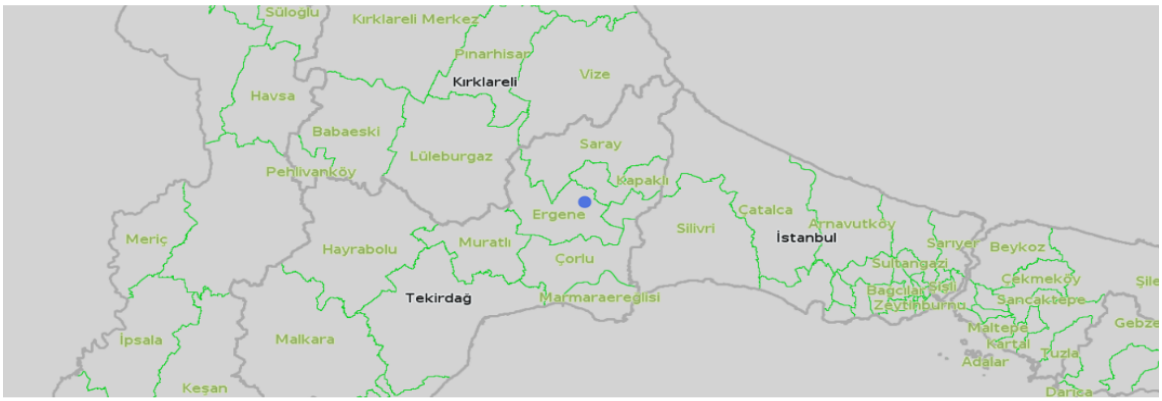
The period for transition to the constant displacement region is taken as: T_{LD} = *3.0 s.*

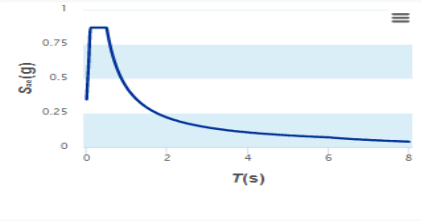
Report Title:	ÇERKEZKÖY INTERMODAL TERMINAL LOGISTICS CENTRE	
Earthquake Ground Motion Level:	DD-2	Earthquake ground motion level with a probability of exceedance of 10% in 50 years (repetition period of 475 years)
Local Soil Class	ZD	Medium firm - firm layers of sand, gravel or very stiff clay
Latitude	41.280643°	
Longitude	27.83378°	



Outputs

S_S = 0.700	S_1 = 0.195	S_{DS} = 0.868	S_{D1} = 0.431
PGA = 0.293	PGV = 17.973		

Horizontal Elastic Design Spectrum



$$S_{ae}(T) = \left(0.4 + 0.6\frac{T}{T_A}\right)S_{DS} \qquad (0 \le T \le T_A)$$

$$S_{ae}(T) = S_{DS} \qquad (T_A \le T \le T_B)$$

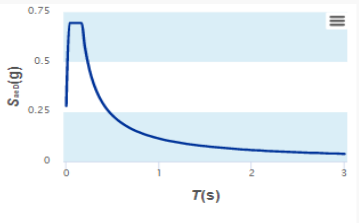
$$S_{ae}(T) = \frac{S_{D1}}{T} \qquad (T_B \le T \le T_L)$$

$$S_{ae}(T) = \frac{S_{D1}T_L}{T^2} \qquad (T_L \le T)$$

$$T_A = 0.2\frac{S_{D1}}{S_{DS}} \qquad T_B = \frac{S_{D1}}{S_{DS}} \qquad T_L = 6s$$

T_A = 0.099 (s) T_B = 0.496 (s) T_L = 6.000 (s)

Vertical Elastic Design Spectrum



$$S_{aeD}(T) = \left(0.32 + 0.48\frac{T}{T_{AD}}\right)S_{DS} \qquad (0 \le T \le T_{AD})$$

$$S_{aeD}(T) = 0.8S_{DS} \qquad (T_{AD} \le T \le T_{BD})$$

$$S_{aeD}(T) = 0.8S_{DS}\frac{T_{BD}}{T} \qquad (T_{BD} \le T \le T_{LD})$$

$$T_{AD} = \frac{T_A}{3} \qquad T_{BD} = \frac{T_B}{3} \qquad T_{LD} = \frac{T_L}{2}$$

T_{AD} = 0.033 (s) T_{BD} = 0.165 (s) T_{LD} = 3.000 (s)

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1.2.6. Information about Structure

The construction material of the structures planned to be built on the site is reinforced concrete, and the purpose of use is as the Intermodal Logistics Centre Building.

- **Earthquake Design Classes**

Depending on the Building Use Classes and the Short Period Design Spectral Acceleration Coefficient defined for **DD-2** earthquake ground motion level, the Earthquake Design Classes (EDC) to be taken as the basis in the design under the effect of earthquake in the Regulation shall be determined according to Table-3.

$S_{DS}=S_S*F_S$

Short Period Design Spectral Acceleration Coefficient at DD-2 Earthquake Ground Motion Level (S_{DS})	Building Use Class	
	BUC=1	BUC=2.3
$S_{DS}<0.33$	EDC=4a	EDC=4
$0.33\leq S_{DS}<0.50$	EDC=3a	EDC=3
$0.50\leq S_{DS}<0.75$	EDC=2a	EDC=2
$0.75\leq S_{DS}$	EDC=1a	EDC=1

Chart 9: Earthquake Design Classes (EDC)

- **Building Height Classes**

In case of design under earthquake effect, buildings are divided into *Building Height Class* (BHC) in terms of their heights. Height ranges are given in Chart 11 based on the Earthquake Design Classes in Chart 10.

Building Height Class	Building Height Ranges Defined According to Building Height Classes and Earthquake Design Classes [m]		
	EDC = 1, 1a, 2, 2a	EDC = 3, 3a	EDC = 4, 4a
BHC=1	HN>70	HN>91.0	HN>105
BHC=2	56<HN<=70	70<HN<=91.0	91<HN<=105
BHC=3	42<HN<=56	56<HN<=70	56<HN<=91
BHC=4	28<HN<=42	42<HN<=56	
BHC=5	17.5<HN<=28	28<HN<=42	
BHC=6	10.5<HN<=17.5	17.5<HN<=28	
BHC=7	7<HN<=10.5	10.5<HN<=17.5	
BHC=8	HN<=7	HN<=10.5	

Chart 10: Building Height Ranges Defined According to Building Height Classes and Earthquake Design Classes.

Building height class of the structures is BHC=8.

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2. GEOLOGY

2.1. Regional Geology

The area of investigation is located within the borders of the Thrace Basin.

The sediments in the Thrace basin with a thickness of up to 9000 meters were deposited in the sedimentary environment at four different periods. These are Palaeocene - Middle Eocene sequence, Middle Eocene - Lower Oligocene sequence, Lower Oligocene - Lower Miocene sequence and post-Upper Miocene sequence. The sub-surface of the basin is composed of Paleozoic metamorphic belonging to the Strandja Massif in the north and Upper Cretaceous magmatics intersecting them, metamorphics and magmatics of the Rhodope massif in the west, Istanbul Paleozoic sediments in the east and Upper Cretaceous ophiolitic complex (melange) in the south.

Paleocene - Middle Eocene sequence

The oldest unit in the Thrace basin is the ***Lört Limestone***. The unit, which is exposed on the northern coasts of the Gallipoli peninsula with steep cliffs, consists of clay and silt limestones with a thin medium bed and a grey-coloured freshly fractured structure. The unit, whose base could not be observed, has a thickness of 290 meters (Önal, 1986). Since this formation, which shows deep marine properties as opposed to Globotruncana and Globorotalia fossils, cannot start with these facies, there must be different units underneath it (Saner, 1985). In their study, Okay and Tanse (1992) argue that these limestones are not autochthonous anyway and that they contain olistolith in the ophiolitic complex. Their age is Upper Cretaceous - Paleocene (Önal, 1986).

On the Lört limestone, there is the *Karaağaç formation*, which starts with reef limestones with shallow marine properties with parallel unconformity, continues with deep marine fan and turbidites with pebbly sandstone-sandstone and mudstone alternations that become coarser towards the top, and consists of prodelta siltstone and marls and prodelta sands at the top. This formation is observed on the southern coast of Saros Bay and its thickness is about 1500 – 2000 meters. Its age is Paleocene - Lower Eocene (Saner, 1985). However, it was taken only as Lower Oligocene by Siyako (1992).

At the top of this succession, there is the *Fıçıtepe formation* consisting of red colored mudstone, sandstone, and conglomerate lenses in harmony. The unit, which is fluvial sediment, has a thickness of 1000 meters and crops out on the Gallipoli peninsula parallel to the Saros Bay. Its age is Lower - Middle? Eocene (Saner, 1985; Sümengen and Terlemez, 1991).

Middle Eocene - Lower Oligocene Sequence

Middle Eocene - Lower Oligocene aged units form the bottom of the sequence in the entire Thrace basin except the Gallipoli peninsula. The oldest unit is the *Gaziköy formation*, which is represented by outer fan deposits consisting of thin-bedded sandstone-shale alternations and turbidites with well-developed gradation. In addition, rhyolite tuffs are rarely found in the unit. The base of the unit is visible, but there must be another unit under it since it is not possible to start with the deep marine features. The thickness of the unit outcropping in Uçmakdere area along the coast of the sea of

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Marmara to the south of the basin is about 800 - 1000 meters and its age is Middle - Upper Eocene (Turgut et al., 1983; Aksoy, 1987).

Gaziköy formation is followed by *Hamitabat formation* with transitions. It consists of middle-upper fan deposits with coarse-grained, high sand/shale ratio, thick-bedded scattered gravel-containing debris flow tuff levels. Its formation outcrops in wide areas in the south-southwest of the basin. According to the boring data, it is located underground in the northwest. Its thickness is around 900 - 1000 meters and its age is Upper Eocene - Lower Oligocene (Turgut et al., 1983; Aksoy, 1987).

While the Hamitabat formation continues its deposition in the deep sea, the Koyunbaba formation consisting of coarse clastics, the Soğucak formation consisting of reef limestones and limestones and the Ceylan formation with clay limestone, shale alternations was deposited in the shallower southern and northern shelf areas by transgression of the same sea to the south and north.

Among the foregoing, the Koyunbaba formation consists of block gravel, sand-sized material, and limestones. It outcrops in the entire northern Thrace and in the southwest around the Saros Bay. The age of the unit, whose thickness goes up to 150 meters, is Middle - Upper Eocene (Keskin, 1971, 1974; Kasar, 1987; Ediger et al., 1995a).

The Koyunbaba formation is followed by the Soğucak formation consisting of limestone and reef limestones with transitions. Its lithology consists of hard, solid, beige-white colored reef limestones (patch reef) on shelf slopes and paleo heights, and alternating gray-beige colored limestone and clay limestone in other areas (Görür et al., 1983; Turgut et al., 1991). Outcrops of this unit are observed along the northern Thrace shelf, in the Kuleli-Babaeski uplift and in the southwest shelf area around the Saros Bay. Its thickness goes up to 300 meters. Its age is Middle - Upper Eocene - Lower Oligocene (Keskin, 1971, 1974; Kasar, 1987; Ediger et al., 1995a).

Soğucak formation is followed by Ceylan formation with lateral and vertical transitions. The unit, which is composed of clay limestone, gray-dark gray shale and tuffs with limestone interlayers, also has lateral and vertical transitions with the Hamitabat formation with deep marine features. Its outcrops are also observed on the northern Thrace shelf, the Kuleli-Babaeski uplift and the southwest shelf, and are found in large areas underground. Its thickness is around 400 – 1000 meters, and its age is Upper Eocene - Lower Oligocene (Keskin, 1971, 1974; Kasar, 1987; Ediger et al., 1995a).

Lower Oligocene - Lower Miocene Sequence

After the deposition of the Middle Eocene - Lower Oligocene units in the Thrace basin, the deposition which was transgressive until this time gave way to regression and, as a result, the lagoon and deltaic units began to be deposited.

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With this sudden regression, the Mezardere formation, which is deeper in the basin, consists of greenish grey, laminated prodelta shale and also contains sand and tuff layers, was deposited in the middle and southern parts of the basin. The age of the unit, which has a thickness of 500-1200 meters, is Lower Oligocene (Keskin, 1971, 1974; Aksoy, 1987; Kasar, 1987; Ediger et al., 1995a). While this unit was deposited in deep areas, the Pınarhisar formation, consisting of gravel, sand and conglomerated limestones, was deposited with transitions with the Mezardere formation in shallow sea-lagoon areas following short-term erosion in the north of the basin (Kasar, 1987, 1995). This formation has a thickness of 100 m, and its age is Lower Oligocene (Gökçen, 1974; Umut et al., 1983; Kasar, 1987).

Afterwards, the Osmancık formation dating back to the Middle Oligocene and consisting of prodelta sands and silts having a thickness of 300-900 m (Aksoy, 1987; Ediger et al., 1995a) was deposited on these two units, followed by the Danişment formation consisting of delta plain deposits with abundant coal levels dominated by sand, gravel and clays. Thickness of the Danişment formation goes up to 800 meters and its age is Upper Oligocene - Lower Miocene (Aksoy, 1987; Ediger et al., 1995a).

Post-Upper Miocene Sequence

The Middle Eocene represents an uplift or nondeposition in the Thrace basin. Therefore, the Upper Miocene units are located over the other units unconformably and consist of units deposited in two different environments. The first of these is the sequence, which starts with the Gazhanedere formation consisting of terrestrial clastics observed around Şarköy - Mürefte in the southeast of the basin, continues with the shallow marine Kirazlı formation and has the shallow marine Alçıtepe formation at the top. Its total thickness is more than 1000 meters (Turgut et al., 1983; Saner 1985). The second one is the sequence made up of the Çekmece formation consisting of terrestrial clastics observed between the area around Çekmece Lake and the Golden Horn in the east of the basin and the Bakırköy formation consisting of lacustrine limestone. Its total thickness does not exceed 100 meters (Arıç, 1989; Şen et al., 1995). Besides, apart from the foregoing, there is the Ergene group, which consists of terrestrial clay, sand and gravels with a thickness of up to 1000 meters, which is located over these units unconformably in the entire Thrace basin.

DEVELOPMENT OF THE THRACE BASIN

It is controversial what kind of a basin the Thrace basin developed as. First, while Keskin (1974) claimed that it developed as an intermontane basin, Saner (1982) stated that it was a fore-arc basin. According to Turgut (1987), the basin was formed by the stretching motions that occurred because of the collision of the Sakarya continent and the Pontide continent, which continued from the Upper Cretaceous to Miocene after the subduction of the intra-Pontide ocean. Turgut and Atalik (1988) stated that the basin was formed by stresses on the Tethys basement and Yılmaz and Sungurlu (1991) stated that the basin was formed as an interior depression basin (interior sag basin). Based on the latest studies, while Okay and Görür (1995) propose

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that this basin developed as an arc-related basin of the intra-Pontide ocean, with the intra-Pontide ocean between the Sakarya continent and the Pontide continent remaining open until the end of the Oligocene, Üşümezsoy et al., (1995) propose another alternative. According to the researchers, the basin stretched out in the late Paleocene and Eocene when the Moesya platform began to subduct under the Thrace block in the Late Cretaceous.

In the light of this information, the development of the basin should be as follows. Upper Cretaceous - Middle Paleocene ophiolitic melange (including lört limestone) forms the basement of the basin, consisting of serpentinite, metadiabase, radiolarian chert and pelagic limestones (Aral and Tansel, 1992). Thereupon, the Karaağaç formation, which starts with the Lower Eocene reef limestones, continues with turbitidic units and ends with deltaic sediments at the upper levels, was firstly developed transgressively and then regressively (Saner, 1985; Önal, 1986). With the terrestrialization of the environment, this unit was followed by the Lower Eocene - Middle Eocene Fıçıtepe formation consisting of terrestrial fluvial sediments. Therefore, a basin was opened and closed in the region after the ophiolitic overlapping. After a short erosion period, because of a rapid re-opening in the Middle Eocene, the Gaziköy formation, which changed from shallow to deep sea, and subsequently the Hamitabat formation began to be deposited. With the beginning of the deposition of the Hamitabat formation, the Koyunbaba clastics, Soğuca reef limestones and Ceylan shales were deposited in the shelf areas transitionally with this unit (Turgut et al., 1983; Turgut et al., 1991). This deposition continued uninterruptedly until the lower Oligocene.

As a result of the tectonism that developed in the Lower Oligocene (Kasar, 1987), the transgression that had continued until this time ended and gave way to regression. As a result of this, after short erosion in the north, Pınarhisar formation in shallow marine-lagoon conditions, and in deeper parts, the Mezardere formation consisting of prodelta shales began to be deposited. These were followed by the Osmancık formation consisting of prodelta sands and silts in the Middle Oligocene and the Danişment formation formed in the delta plain environment in the Upper Oligocene - Lower Miocene (Aksoy, 1987).

After the deposition of the Danişment formation, the region was uplifted and turned into an erosional area. With the North Anatolian Fault Zone and the Thrace Fault Zone starting to develop in the Upper Miocene, the units deposited until this time were subjected to intense deformation (Perinçek, 1991). Marine units in the south and terrestrial units in the east were deposited in the Upper Miocene in the small basins developed on account of these faultings.

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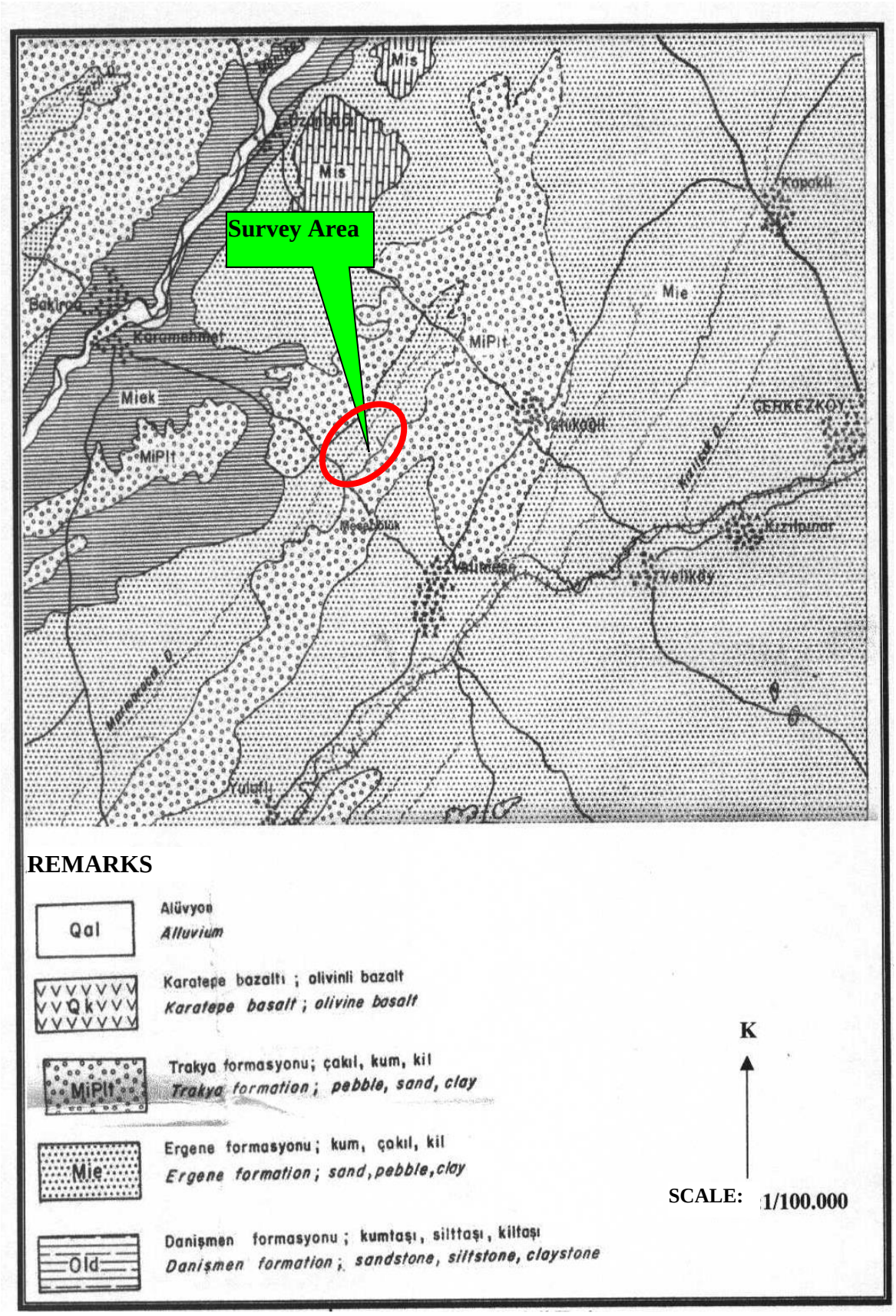

Figure 5: Geological Map of the Area of Investigation and Its Close Surroundings (1/100000 scale) (MTA-2004)

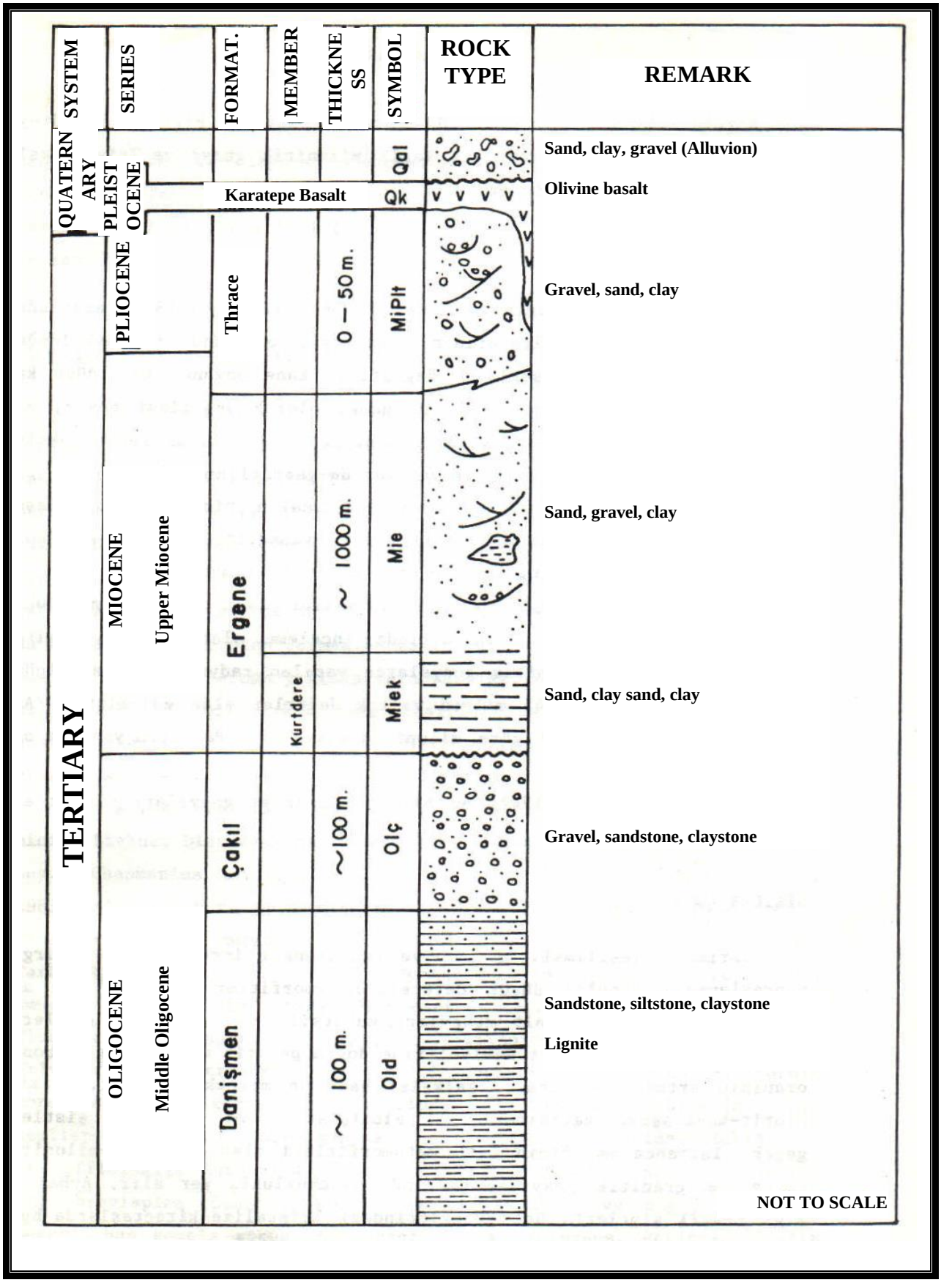

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Figure 6: Generalized Stratigraphic Column Section of the Area of Investigation (MTA-2004)

2.1.1. Structural Geology and Active Tectonics

The base rock of the area of investigation is composed of the sedimentary sequence of Ergene formation, which is made up of white, yellowish, cross-bedded, clay and gravel lens, loosely compacted sands. Ergene formation is observed as unconformable over Danişment formation. Clay lenses between large and small-scale planar and trough cross-bedded gravels and sands present limited dispersal. In the cross beds, the current is generally southward and unidirectional. Cross-bedded gravel and sands may be interpreted as channel deposits, while fine sand, silt and clays may be interpreted as flood plain deposits. Based on some vertebrate fossils found, this unit was given an Upper Miocene age.

Çebeci and Sinanlı formations, members of Kurtdere, are also distinguished within the Ergene group (Figure 1 Generalized stratigraphic section of the area of investigation).

It has been observed that Thrace formation subsided with angular unconformity on Ergene group located in the investigation.

The units observed in and around the area of investigation (ANNEX 1) may be seen on the Geological Map of the Area of Investigation.

Turkey is located on a mountain formation system that we call the Alpine-Himalayan Belt. On this belt where young and active tectonic movements are observed, the earth's crust sporadically descends, rises, folds, and gets fractured. Fractures of the earth's crust, on the other hand, cause earthquakes. The branches of the North Anatolian Fault Zone, which approach the Marmara region from the east, are at the forefront of the geological elements that determine the earthquake hazard in Bursa. The North Anatolian Fault is divided into three main branches in the east of the Gulf of Izmit and proceeds to the Sea of Marmara. The crustal blocks separated by these three main fracture zones make right-left and up-down movements. Geological and seismological studies show that left-right movements reach up to 2-2.5 cm a year. In the Marmara region, the crustal deformations drift in the north-south direction at a rate of 7.0 mm a year, are compressed at a rate of 10 mm and formed as a right-sided faulting at a rate of 20 mm (Eyidoğan, 1988). Due to this tectonic formation, three depressions located in the northern half of the Sea of Marmara at a depth of approximately 1200 meters and blocks based on a large pull-apart system were formed between the Gulf of Izmit and the Gaziköy -Gelibolu fault segments of the northern branch of the North Anatolian Fault (Barka and Kadinsky-Cade, 1988). One of these depressions is located between the Bosphorus entrance and Kartal, the second between Küçükçekmece and Silivri, and the third is located off the coast of Tekirdağ. These depressions are suddenly separated by two NE-SW trending ridges. These are called the Middle Marmara ridge and the Western Marmara ridge. The depths of these ridges vary between 450 and 700 meters. Due to these deformations, the Marmara Region is in a very active state in terms of earthquakes.

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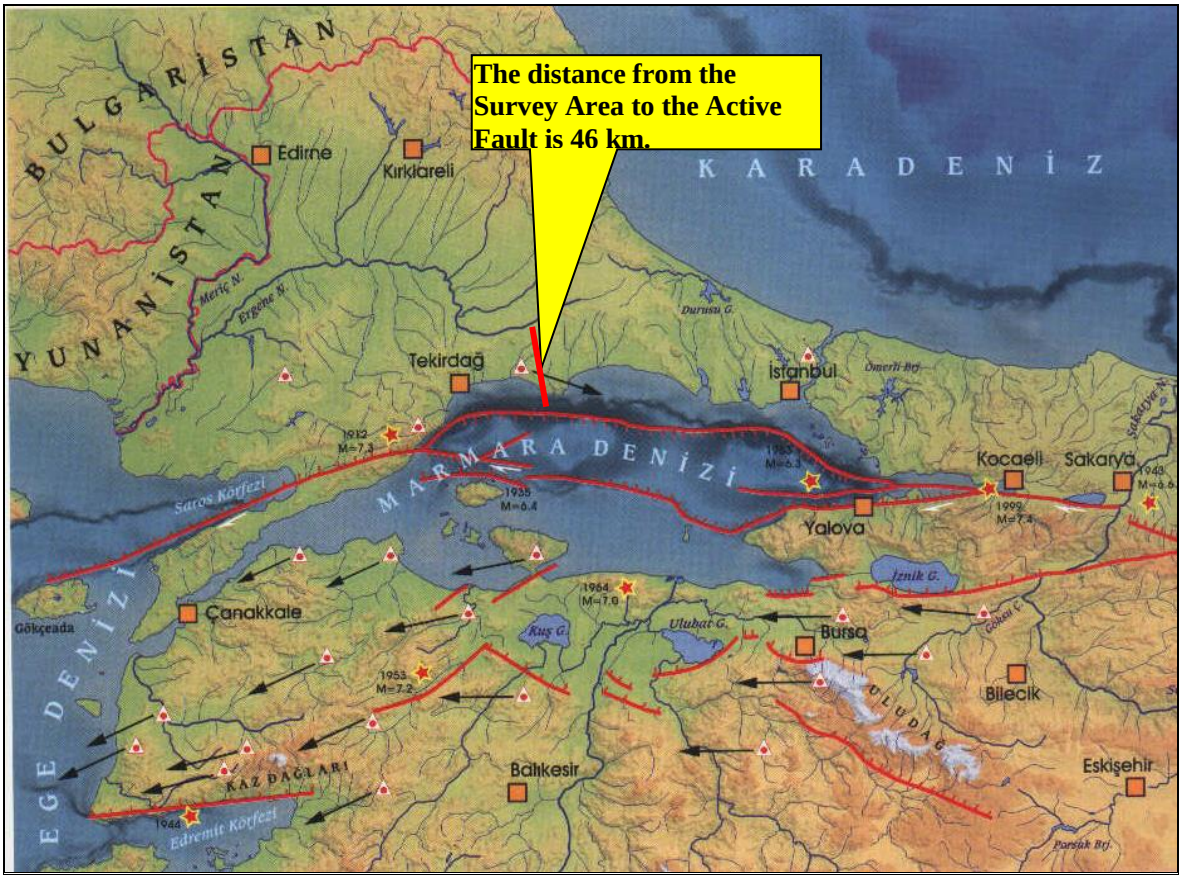


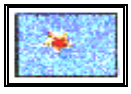
Taken from Atlas magazine..



Fault



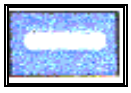
Normal fault: the teeth show the falling block



Epicentre of the earthquake



Date and magnitude of the earthquake



Surface formed after the earthquake

Figure 7: Branches of the North Anatolian Fault in and Around the Sea of Marmara and the Distribution of the Fault Ratios Forming these Branches.

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3. FIELD RESEARCH

7 ea. 20.00 meter-, 8 ea. 25.00 meter-, 3 ea. 35.00 meter-, 1 ea. 40.00-meter and 2 ea. 50.00 meter-deep boreholes (starting and completion dates of the borings; (SK-14-29: 28.06.2021, SK-6-7-12: 29.06.2021, SK-15-20-24: 30.06.2021, SK-8-16-18: 01.07.2021, SK-19-26-28: 02.07.2021, SK-30-33-37: 03.07.2021, SK-25-35-36: 05.07.2021, SK-21-23: 06.07.2021, SK-10-27: 07.07.2021, SK-1-11: 08.07.2021, SK-5-9: 09.07.2021, SK-17-22: 10.07.2021, SK-31-32: 12.07.2021, SK-2-3: 13.07.2021, SK-4-13: 14.07.2021, SK-34: 15.07.2021)) were opened with the aim of determining physical properties of the lithological structure, the horizontal and vertical changes and underground structural positions of the units and recognizing their mechanical properties, and 10 ea. Seismic Refraction-MASW, 5 ea. Microtremors were performed. Necessary laboratory tests were carried out on the samples taken from the borehole at JEOLAB ZEMİN LABORATORY in Istanbul (Direct Shear test, Triaxial Pressure test, Water content, Natural-Dry Unit Weight, Odometer test, Swelling Pressure, Swelling Percentage, Atterberg Limits, Sieve analysis tests).

3.1. Geophysical Studies

Geophysical methods were used during the field studies performed at TEKİRDAĞ Province, Ergene district, Karamehmet neighbourhood, -- Layout, -- Block, -- Plot. According to the measurements made, efforts were made to establish the seismic velocities and elastic parameters. The measurement value was taken along a spread traverse for the dynamic elasticity parameters. Straight shots were made to determine the P and S wave velocities, a velocity curve was drawn by making use of these parameters and a depth calculation was made.

3.1.1. Seismic Studies

There are different methods available for investigating various sections of the Earth. However, these are very expensive and provide local information. Geophysical methods, on the other hand, establish the changes of the earth in a wide area very quickly. Geophysical explorations do not eliminate the need for boring. However, they help to minimize time and economic factors by better guiding the exploration/research program

When a foundation borehole is opened, many static properties of the place where it is opened are determined. But its properties during the time when there is a movement cannot be determined. Since an earthquake is a dynamic event, information about the soil must be known depending on the movement.

Since geological surveys reveal the static structure of the soil and geophysical studies reveal its structure in motion (moving-dynamic), they are complementary to each other.

3.1.1.1. Seismic Refraction

In the seismic refraction application, twelve channel SARA-DOREMI brand Seismic Device was used, and the device consists of 24 ea. P, 24 ea. S geophones, an optical unit that can provide multi-channel automatic signal graphics with special connection units, geophone cables, a trigger sledgehammer and a pad.

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For seismic spread layout, offset (out-of-group receiver) distance was established as 2.0 meters, and geophone (in-group receiver) intervals as 2.0 meters.
In order to determine the P and S wave velocities, straight and reverse shots were made and the path-time graph was drawn from the arrival times of the shots, based on which the velocities and depth were found and the dynamic elasticity parameters of the soil were calculated.

3.1.1.2. Surface Wave Analysis Method (Multichannel Analysis Surface Waves-MASW)

Surface waves were characterized as noise in other seismic methods until recently and were removed from the data. Afterwards, thanks to the developing technology and software, the information conveyed by the surface waves began to be examined as well. It has been an effective way in the calculation of shear wave, which is an indicator of the soil resistance, and has played an important role in various research.

Vs30 value can be calculated properly with MASW (Multichannel Analysis Surface Waves) technique, which is one of the surface wave analysis methods. Vs30 is one of the basic parameters used in UBC and Eurocode-8 international standards. In surface wave analysis methods, the dispersive properties of Rayleigh waves is used to calculate the variation of the shear wave velocity (Vs) with depth of layered underground structures. Surface wave methods can be grouped under two main groups as active source and passive source methods. Passive-sourced methods have a deeper penetration power. It can be used effectively especially in areas where it is required to reach the bedrock depth. Whereas, at a first glance, this method provides advantages in terms of being easily applicable on the field, problems arising from geometry during data acquisition, and the margin of error in the determination of layers close to the surface are disadvantages. In addition, the MASW method has a more limited depth of penetration, and more successful results are obtained with the use of active source. Especially in Vs30 studies, it has an effective use due to the significance of the first 30 meters, and the fact that it provides sound results in the detection of thin layers. The biggest advantage over other methods is that the source can be controlled. The S wave velocity structure of the ground can be determined by using active and passive source surface wave methods.

This is performed in a 2-step process. The first of these is to determine the dispersion curve of the study area. The aim of all surface wave methods is to obtain the dispersion curve of the study area. The way of obtaining the dispersion curve differs for all methods. The second step is the inversion process. During this process, the layer parameters for the 1D environment are obtained by using the dispersion curve.

In order to determine the S wave velocities from the geophysical studies carried out in the field within the scope of the Soil Investigation Report, and thus to reveal the dynamic/flexibility properties of the ground, which cannot be calculated by

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geotechnical studies; density (□), maximum shear modulus (Gmax), Young's modulus (Ed), Poisson's ratio (□), bulk modulus (K), seismic velocity ratio (Vp/Vs) and Vs30 (m/s) values were calculated for each layer determined (Ercan, 2001).

Dynamic and Static Parameters Obtained from Geophysical Methods:
To determine the P and S wave velocities, a single profile shot was performed, the layer velocities were calculated by evaluating the records obtained from the shots in the seismic SeisImager software program, and the elastic parameters of the soil were determined from these velocities.

a. Seismic P Wave (Longitudinal Wave Velocity (V_p))

These waves are called compression or primary waves. During the propagation of these waves, cubic expansion or volume change occurs due to compression. The direction of vibration, which represents compression and expansion in longitudinal waves, is the same as the direction of wave propagation. Therefore, P wave velocity will be low in compressible (loose) soils, and high in relatively incompressible soils (rock).

P wave velocity (m/s)	Detachability
300–600	**Very Easy**
600–900	**Easy**
900–1500	**Average**
1500–2100	Difficult
2100–2400	Very Difficult
2400–2700	Extremely Difficult

Table 11: *P wave velocity with the detachability of floors or rocks (Bilgin, 1989)*

The P wave velocities of the 10 lines obtained in the field, and the detachability of the soils for each layer are as follows.

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LINES	LAYERS	THICKNESS	P WAVE VELOCITY	DETACHABILITY
Line 1	Layer 1	3,8	537	Very Easy
	Layer 2	6,3	865	Easy
	Layer 3	--	1085	Medium
Line 2	Layer 1	3,8	646	Easy
	Layer 2	8,7	938	Medium
	Layer 3	--	1115	Medium
Line 3	Layer 1	3,8	625	Easy
	Layer 2	12,5	902	Medium
	Layer 3	--	1152	Medium
Line 4	Layer 1	3,8	747	Easy
	Layer 2	12,5	1044	Medium
	Layer 3	--	1216	Medium
Line 5	Layer 1	3,8	760	Easy
	Layer 2	6,3	1044	Medium
	Layer 3	--	1160	Medium
Line 6	Layer 1	3,8	756	Easy
	Layer 2	12,5	1057	Medium
	Layer 3	--	1233	Medium
Line 7	Layer 1	3,8	735	Easy
	Layer 2	12,5	1111	Medium
	Layer 3	--	1233	Medium
Line 8	Layer 1	3,8	756	Easy
	Layer 2	12,5	1088	Medium
	Layer 3	--	1238	Medium
Line 9	Layer 1	3,8	756	Easy
	Layer 2	6,3	1087	Medium
	Layer 3	--	1214	Medium
Line 10	Layer 1	3,8	786	Easy
	Layer 2	9,2	1095	Medium
	Layer 3	--	1198	Medium

b. Seismic S Wave (Slip or Shear Wave (V_s))

During the propagation of shear waves, deformations in the elements (i.e. changes in angles) are observed. This is because the direction of vibration of the particles in wave propagation is perpendicular to the direction of wave propagation. Inherently, shear wave velocities occur when the material has a resistance against deformation or torsion. The reason for the S wave velocity being 0 in water is that the water has no resistance to torsion and deformation and can be sheared. Normally, the P wave and the S wave tend to increase and decrease together, but the value of the P wave in water is approximately 1500 m/s, while the value for S wave velocity is 0. As the water does not have compressive properties, the P wave velocity is high. The reason for the S wave velocity being 0 in water is that the water has no resistance to torsion, deformation and can be sheared.

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Local Soil Class	Soil Type	(Vs)30 m/sec.	(N60)30 [pulse /30 cm]	(Cu) 30 [kPa]
ZA	Solid, hard rock	> 1500	-	-
ZB	Slightly weathered, medium solid rocks	760 – 1500	-	-
ZC	Very firm sand, gravel and hard clay layers or weathered, very cracked weak rocks	360 – 760	> 50	> 250
ZD	Medium firm-firm layers of sand, gravel or very stiff clay	180 – 360	15-50	70-250
ZE	Profiles with layers of loose sand, gravel or soft - stiff clay or a layer of soft clay (cu < 25 kPa) with a total thickness of more than 3 meters, meeting the conditions of PI > 20 and w > 40%	> 180	> 15	> 70
ZF	Soils requiring site-specific research and evaluation: 1) Soils with the risk of subsidence and potential collapse under earthquake effect (liquefiable soils, highly sensitive clays, collapsible weak cement soils, etc.), 2) Peat with a total thickness of more than 3 meters and/or clays with a high organic content, 3) High-plasticity (PI >50) clays with a total thickness of more than 8 meters, 4) Very thick (> 35 m) soft or medium stiff clays.			

***Table 12**: Classification of rocks and soils according to S (slip or shear) wave velocities (AFAD, 2018. According to Turkey Building Earthquake Regulation)*

The S wave velocities of the 10 lines obtained in the field, and the soil group of the soils for each layer are as follows.

LINES	LAYERS	THICKNESS	S WAVE VELOCITY
LINE 1	LAYER 1	3.8	227
	LAYER 2	6.3	330
	LAYER 3	--	376
LINE 2	LAYER 1	3.8	236
	LAYER 2	8.7	366
	LAYER 3	--	355
LINE 3	LAYER 1	3.8	212
	LAYER 2	12.5	331
	LAYER 3	--	357
LINE 4	LAYER 1	3.8	240
	LAYER 2	12.5	324
	LAYER 3	--	358
LINE 5	LAYER 1	3.8	240
	LAYER 2	6.3	331

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	LAYER 3	--	356
LINE 6	LAYER 1	3.8	238
	LAYER 2	12.5	357
	LAYER 3	--	375
LINE 7	LAYER 1	3.8	258
	LAYER 2	12.5	349
	LAYER 3	--	370
LINE 8	LAYER 1	3.8	248
	LAYER 2	12.5	329
	LAYER 3	--	357
LINE 9	LAYER 1	3.8	253
	LAYER 2	6.3	333
	LAYER 3	--	354
LINE 10	LAYER 1	3.8	246
	LAYER 2	9.2	313
	LAYER 3	--	349

a. Density: ρ (gr/cm^3)

The density according to the longitudinal wave velocity is calculated empirically from the formula below, given by Gardner (1974).

$\rho = d=0.31*V_p^{0.25}$ (gr/cm^3) (Gardner, 1974)

Density: ρ (gr/cm^3)	**Definition**
<1.20	Very low
1.20-1.40	Low
1.40-1.90	**Average**
1.90-2.20	High
>2.20	Very High

Table 13: *Density classification of soil units (Keçeli, 1990)*

Density definition properties for each layer of the soils belonging to the 10 lines obtained in the field are as follows.

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LINES	LAYERS	THICKNESS	DENSITY	DEFINITION
Line 1	Layer 1	3,8	1,490	Medium
	Layer 2	6,3	1,680	Medium
	Layer 3	--	1,780	Medium
Line 2	Layer 1	3,8	1,560	Medium
	Layer 2	8,7	1,720	Medium
	Layer 3	--	1,790	Medium
Line 3	Layer 1	3,8	1,550	Medium
	Layer 2	12,5	1,700	Medium
	Layer 3	--	1,810	Medium
Line 4	Layer 1	3,8	1,620	Medium
	Layer 2	12,5	1,760	Medium
	Layer 3	--	1,830	Medium
Line 5	Layer 1	3,8	1,630	Medium
	Layer 2	6,3	1,760	Medium
	Layer 3	--	1,810	Medium
Line 6	Layer 1	3,8	1,630	Medium
	Layer 2	12,5	1,770	Medium
	Layer 3	--	1,840	Medium
Line 7	Layer 1	3,8	1,610	Medium
	Layer 2	12,5	1,790	Medium
	Layer 3	--	1,840	Medium
Line 8	Layer 1	3,8	1,630	Medium
	Layer 2	12,5	1,780	Medium
	Layer 3	--	1,840	Medium
Line 9	Layer 1	3,8	1,630	Medium
	Layer 2	6,3	1,780	Medium
	Layer 3	--	1,830	Medium
Line 10	Layer 1	3,8	1,640	Medium
	Layer 2	9,2	1,780	Medium
	Layer 3	--	1,820	Medium

b. Poisson's Ratio;(σ)

It is defined as the ratio of the change per unit width to the change per unit length. In engineering geophysics, the Poisson's ratio is important in terms of finding out the degree of saturation of the soil and rock in the study area. V_p and V_s are found with the help of wave velocities. The Poisson's may not exceed 0.5. As this ratio approaches 0.5, water saturation increases. This ratio varies between 0-0.25 in non-porous media, between 0.25-0.35 in moderately porous media, and between 0.35-0.50 in porous media. Poisson's ratio expresses the hardness of the units, i.e., their porosity. It is unitless.

$P= (V_p^2-2*V_s^2)/ (2* V_p^2-2*V_s^2)$ (Bowles, 1988)

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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Poisson's Ratio; (σ)	Firmness	V_p/V_s
0.5	Soft-Liquid	∞
0.4-0.49	**Very Loose**	∞**-2.49**
0.3-0.39	**Loose**	**2.49-1.87**
0.20-0.29	Tight Stiff	1.87-1.71
0.1-0.19	Stiff	1.71-1.5
0-0.09	Solid Rock	1.5-1.41

Table 14: *Firmness of soil/rock environments according to Poisson ratio and vp/vs ratio (Ercan, 2001)*

The Poisson's ratios of 10 lines obtained in the field, and the density properties of the soils for each layer are as follows.

LINES	LAYERS	THICKNESS	POISSON'S RATIO	FIRMNESS
Line 1	Layer 1	3,8	0,390	Loose
	Layer 2	6,3	0,410	Very Loose
	Layer 3	--	0,430	Very Loose
Line 2	Layer 1	3,8	0,420	Very Loose
	Layer 2	8,7	0,410	Very Loose
	Layer 3	--	0,440	Very Loose
Line 3	Layer 1	3,8	0,430	Very Loose
	Layer 2	12,5	0,420	Very Loose
	Layer 3	--	0,450	Very Loose
Line 4	Layer 1	3,8	0,440	Very Loose
	Layer 2	12,5	0,450	Very Loose
	Layer 3	--	0,450	Very Loose
Line 5	Layer 1	3,8	0,440	Very Loose
	Layer 2	6,3	0,440	Very Loose
	Layer 3	--	0,450	Very Loose
Line 6	Layer 1	3,8	0,440	Very Loose
	Layer 2	12,5	0,440	Very Loose
	Layer 3	--	0,450	Very Loose
Line 7	Layer 1	3,8	0,430	Very Loose
	Layer 2	12,5	0,450	Very Loose
	Layer 3	--	0,450	Very Loose
Line 8	Layer 1	3,8	0,440	Very Loose
	Layer 2	12,5	0,450	Very Loose
	Layer 3	--	0,450	Very Loose
Line 9	Layer 1	3,8	0,440	Very Loose
	Layer 2	6,3	0,450	Very Loose
	Layer 3	--	0,450	Very Loose
Line 10	Layer 1	3,8	0,450	Very Loose
	Layer 2	9,2	0,460	Very Loose
	Layer 3	--	0,450	Very Loose

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c. Shear Modulus (μ, kg/cm^2)

The shear modulus of the object's resistance to deformation is found with the help of S wave velocity and density. The shear modulus is one of the parameters required to be found in the elastic modulus. Its unit is kg/cm^2. The shear modulus is an important parameter that should be known for the stability and safety of the structures in the regions under the influence of the effects of high vibrations resulting from the work of large machines, as well as blasting and earthquake, in the calculation of the downhill active force especially in landslide areas.

It shows the resistance of the formation against shear stresses, i.e., horizontal forces. Since liquids have no resistance to shear, this parameter is zero. The higher the shear modulus, the greater the resistance of the formation to shear stresses, i.e., to horizontal forces (horizontal earthquake load).

$$\mu = (d*V_s^2)/100 \text{ (kg/cm}^2\text{)} \qquad \text{(Kramer, 1996)}$$

According to the above model, the Shear Modulus is calculated as follows.

Shear Modulus (μ, kg/cm^2)	Strength
<400	Very weak
400–1500	**Weak**
1500–3000	**Average**
3000–10000	Solid
>10000	Very solid

Table 15: *Strength of soil or rocks according to shear modulus values (Keçeli, 1990)*

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The shear modulus of the 10 lines obtained in the field as well as the strengths of the soils for each layer are as follows.

LINES	LAYERS	THICKNESS	SHEAR MODULUS	STRENGTH
Line 1	Layer 1	3,8	768	Weak
	Layer 2	6,3	1830	Medium
	Layer 3	--	2516	Medium
Line 2	Layer 1	3,8	869	Weak
	Layer 2	8,7	2304	Medium
	Layer 3	--	2256	Medium
Line 3	Layer 1	3,8	697	Weak
	Layer 2	12,5	1863	Medium
	Layer 3	--	2307	Medium
Line 4	Layer 1	3,8	933	Weak
	Layer 2	12,5	1848	Medium
	Layer 3	--	2345	Medium
Line 5	Layer 1	3,8	939	Weak
	Layer 2	6,3	1928	Medium
	Layer 3	--	2294	Medium
Line 6	Layer 1	3,8	923	Weak
	Layer 2	12,5	2256	Medium
	Layer 3	--	2588	Medium
Line 7	Layer 1	3,8	1072	Weak
	Layer 2	12,5	2180	Medium
	Layer 3	--	2519	Medium
Line 8	Layer 1	3,8	1003	Weak
	Layer 2	12,5	1927	Medium
	Layer 3	--	2345	Medium
Line 9	Layer 1	3,8	1043	Weak
	Layer 2	6,3	1974	Medium
	Layer 3	--	2293	Medium
Line 10	Layer 1	3,8	992	Weak
	Layer 2	9,2	1744	Medium
	Layer 3	--	2217	Medium

d. Elasticity Modulus (E, kg/cm^2)

When a force is applied to a material, the elongation in the material is proportional to the stresses within elastic limits. This is called Hook's Law. The amount of longitudinal elongation of the stress that occurs when a force is applied to the object is called Young's Modulus (Elasticity Modulus). In other words, it defines the vertical deflection of the ground in the direction of the vertical pressure applied. In Engineering Geophysics, the dynamic elasticity modulus can be found by knowing the density as well as the velocity of the P-S waves. The unit of this modulus is kg/cm^2.

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E= 2μ(1+σ) kg/cm^2 (Bowles, 1988)

(μ= Shear Modulus, σ= Poisson's Rate)

Elasticity Modulus – E- kg/cm^2	**STRENGTH**
<1000	Very weak
1000–5000	**Weak**
5000–10000	**Average**
10000–30000	Solid
>30000	Very Solid

Table 16: *Strength of soil or rocks according to elasticity modulus values (Keçeli, 1990)*

If we solve the Elasticity Modulus for each layer according to the Model above,

E= G*(3*V_p^2-4*V_s^2)/(V_p^2-V_s^2) (G: Shear modulus)

The elasticity modulus of the 10 lines obtained in the field as well as the strengths of the soils for each layer are as follows.

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LINES	LAYERS	THICKNESS	ELASTICITY MODULUS	STRENGTH
Line 1	Layer 1	3,8	2136	Weak
	Layer 2	6,3	77	Very Weak
	Layer 3	--	7206	Medium
Line 2	Layer 1	3,8	2473	Weak
	Layer 2	8,7	6498	Medium
	Layer 3	--	6513	Medium
Line 3	Layer 1	3,8	1999	Weak
	Layer 2	12,5	5298	Medium
	Layer 3	--	6675	Medium
Line 4	Layer 1	3,8	2692	Weak
	Layer 2	12,5	5346	Medium
	Layer 3	--	6814	Medium
Line 5	Layer 1	3,8	2713	Weak
	Layer 2	6,3	5569	Medium
	Layer 3	--	6643	Medium
Line 6	Layer 1	3,8	2668	Weak
	Layer 2	12,5	6477	Medium
	Layer 3	--	7499	Medium
Line 7	Layer 1	3,8	3064	Weak
	Layer 2	12,5	6302	Medium
	Layer 3	--	7308	Medium
Line 8	Layer 1	3,8	2887	Weak
	Layer 2	12,5	5586	Medium
	Layer 3	--	6822	Medium
Line 9	Layer 1	3,8	2998	Weak
	Layer 2	6,3	5117	Medium
	Layer 3	--	6667	Medium
Line 10	Layer 1	3,8	2870	Weak
	Layer 2	9,2	5076	Medium
	Layer 3	--	6445	Medium

e. Bulk Modulus - (K kg/cm^2)

The Bulk Modulus is a measure of compaction under surrounding pressure. Bulk modulus obtained from wave theory.

K=(E/3(1-2σ) kg/cm^2 (Bowles, 1988)

K=((d(V$_p$^{2}-4/3V$_s$^{2})/100) kg/cm^2

Bulk Modulus (μ, kg/cm^2)	Compression
<400	Very Low
400–10000	**Low**
10000–40000	**Average**
40000–100000	High
>1000000	Very High

Table 17: *Strength of soil or rocks according to bulk modulus values (Keçeli, 1990)*

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The Bulk modulus of the 10 lines obtained in the field as well as the compression characteristics of the soils for each layer are as follows.

LINES	LAYERS	THICKNESS	BULK MODULUS	COMPRESSION
Line 1	Layer 1	3,8	3273	Low
	Layer 2	6,3	10131	Medium
	Layer 3	--	17599	Medium
Line 2	Layer 1	3,8	5352	Low
	Layer 2	8,7	12061	Medium
	Layer 3	--	19246	Medium
Line 3	Layer 1	3,8	5126	Low
	Layer 2	12,5	11348	Medium
	Layer 3	--	20945	Medium
Line 4	Layer 1	3,8	2692	Low
	Layer 2	12,5	5346	Low
	Layer 3	--	6814	Low
Line 5	Layer 1	3,8	8163	Low
	Layer 2	6,3	16612	Medium
	Layer 3	--	21297	Medium
Line 6	Layer 1	3,8	8085	Low
	Layer 2	12,5	16768	Medium
	Layer 3	--	24523	Medium
Line 7	Layer 1	3,8	7269	Low
	Layer 2	12,5	19187	Medium
	Layer 3	--	24615	Medium
Line 8	Layer 1	3,8	7979	Low
	Layer 2	12,5	18502	Medium
	Layer 3	--	25074	Medium
Line 9	Layer 1	3,8	7925	Low
	Layer 2	6,3	18400	Medium
	Layer 3	--	23913	Medium
Line 10	Layer 1	3,8	8809	Low
	Layer 2	9,2	19018	Medium
	Layer 3	--	23165	Medium

f. Soil Dominant Vibration Period (T_0, sec)

It is the period during which the soil naturally vibrates. The period is the ground vibrations resulting from natural or artificial factors, with a period of 0.05 to 2 seconds. In a certain area, the number of repeats of a certain period corresponds to the maximum value. The period with the maximum repetition is defined as the dominant period.

$T_0 = \Sigma 4H_i/V_{si}$ (sec) (Kanai, 1983)

and

$T_a = 0{,}67T_0$ and **$T_b = 1{,}5T_0$** (Aytun, 2001)

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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Soil Dominant Vibration Periods of the 10 lines obtained in the field are as follows.

LINES	Soil Dominant Vibration Periods
LINE 1	0.57
LINE 2	0.58
LINE 3	0.60
LINE 4	0.59
LINE 5	0.59
LINE 6	0.56
LINE 7	0.57
LINE 8	0.59
LINE 9	0.59
LINE 10	0.60

Depending on the ground dominant vibration period, it is calculated from the lower vibration period formula $T_0 1=0.67\ T_0$ and the upper vibration period formula $T_0 2=1.5T_0$. In this case, the resonance state is;
Soil Dominant Vibration Period: 0.60

g. Soil Amplification (SA)

With the seismic MASW method, the value of the average shear wave velocity **(Vs30)** at a depth of 30 meters is found to be within the range of **329.6-357.3** m/sec.

It is calculated from the equation $SA = 68 / (Vs30^{0,6})$ **(**Midorikawa, 1987) using the average shear wave velocity at 30 m. The amplifications are dimensionless.

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The soil amplification values calculated in each seismic profile are as follows.

Network Number	Vs30	Soil Amplification (SA)
MASW-1	352.7	2.01
MASW-2	356.5	2.00
MASW-3	329.6	2.10
MASW-4	338.6	2.06
MASW-5	343.8	2.05
MASW-6	357.3	2.00
MASW-7	352.8	2.01
MASW-8	349.3	2.03
MASW-9	356.5	2.00
MASW-10	345.1	2.04

The soil amplification value calculated from the surface wave analysis (MASW) records taken on the field was found to be in the range of **2.00-2.06**.

g. Safe Bearing Capacity – q_a (kg/cm^2)

It shows the ultimate bearing capacity of 1 cm^2 of ground.

$q_a = 0.024 \cdot \gamma \; V_s . s_v . \alpha \leq 30.6 \gamma$ (Tezcan, Keçeli, Özdemir, 2006)

q_a = Safe bearing capacity of sub-foundation soil (KN/m^2)

γ = Unit weight (KN/m^3)

V_s = Shear wave velocity (m/sec)

s_v = Reduction factor for solid soil (m/sec)

α = Reduction factor (m) for the width of the foundation (B)

B = Width of foundation (m)

If V_s is $\leq$ 500 m/sec $s_V = 1$

If V_s is > 500 m/sec $s_V = 1 - 3 \cdot 10^{-6} (V_s - 500)^{1.6}$

Determination of α for foundation foot width B,

0. < B <1.20 m so $\alpha = 1$ m.

1.2 $\leq$ B $\leq$ 3.0 m so $\alpha = 1.13 - 0.11$ B

3.0 $\leq$ B $\leq$ 12 m. so $\alpha = 0.83 - 0.01$ B.

(1 kN/m^2 = 1 kPa = 10.197 10^{-3} kgf/cm^2)

The safe bearing capacity of 10 lines obtained in the field are as follows.

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LINES	LAYERS	DEPTH	Ground Bearing Capacity
LINE 1	LAYER 1	3.8	3.380
	LAYER 2	6.3	5.540
	LAYER 3	--	6.690
LINE 2	LAYER 1	3.8	3.680
	LAYER 2	8.7	6.300
	LAYER 3	--	6.350
LINE 3	LAYER 1	3.8	3.290
	LAYER 2	12.5	5.630
	LAYER 3	--	6.460
LINE 4	LAYER 1	3.8	3.890
	LAYER 2	12.5	5.700
	LAYER 3	--	6.550
LINE 5	LAYER 1	3.8	3.910
	LAYER 2	6.3	5.830
	LAYER 3	--	6.440
LINE 6	LAYER 1	3.8	3.880
	LAYER 2	12.5	6.320
	LAYER 3	--	6.900
LINE 7	LAYER 1	3.8	4.150
	LAYER 2	12.5	6.250
	LAYER 3	--	6.810
LINE 8	LAYER 1	3.8	4.040
	LAYER 2	12.5	5.860
	LAYER 3	--	6.570
LINE 9	LAYER 1	3.8	4.120
	LAYER 2	6.3	5.930
	LAYER 3	--	6.480
LINE 10	LAYER 1	3.8	4.030
	LAYER 2	9.2	5.570
	LAYER 3	--	6.350

h. Ground Bearing Coefficient - K_0

Bulk modulus is used to calculate the bearing coefficient. The bearing coefficient is calculated from the formula below. Bearing coefficient values are attached.

$$K_0 = 2.49 * \left(\frac{1}{(1/K)*100}\right)^{1.26} * 7 \quad \text{ton/m}^3$$

(K: Bulk modulus)

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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LINES	LAYERS	DEPTH	Bearing Coefficient
LINE 1	LAYER 1	3.8	1352
	LAYER 2	6.3	2216
	LAYER 3	--	2676
LINE 2	LAYER 1	3.8	1472
	LAYER 2	8.7	2520
	LAYER 3	--	2540
LINE 3	LAYER 1	3.8	1316
	LAYER 2	12.5	2252
	LAYER 3	--	2584
LINE 4	LAYER 1	3.8	1556
	LAYER 2	12.5	2280
	LAYER 3	--	2620
LINE 5	LAYER 1	3.8	1564
	LAYER 2	6.3	2332
	LAYER 3	--	2576
LINE 6	LAYER 1	3.8	1552
	LAYER 2	12.5	2528
	LAYER 3	--	2760
LINE 7	LAYER 1	3.8	1660
	LAYER 2	12.5	2500
	LAYER 3	--	2724
LINE 8	LAYER 1	3.8	1616
	LAYER 2	12.5	2344
	LAYER 3	--	2628
LINE 9	LAYER 1	3.8	1648
	LAYER 2	6.3	2372
	LAYER 3	--	2592
LINE 10	LAYER 1	3.8	1612
	LAYER 2	9.2	2228
	LAYER 3	--	2540

- Average shear wave velocities at a depth of 30 meters using the seismic MASW method;

Seismic Profiles	(Vs30) m/sec	Local Soil Class
Masw-Refraction-1	352.7	ZD
Masw-Refraction-2	329.6	ZD
Masw-Refraction-3	338.6	ZD
Masw-Refraction-4	343.8	ZD

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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Masw-Refraction-5	345.1	ZD
Masw-Refraction-6	349.3	ZD
Masw-Refraction-7	352.8	ZD
Masw-Refraction-8	356.5	ZD
Masw-Refraction-9	356.5	ZD
Masw-Refraction-10	357.3	ZD

MEASURE NO.	SOIL LAYERS	VP	VS	h	DENSITY	POISSON'S RATIO	SHEAR MODULUS	ELASTICITY MODULUS	BULK MODULUS	DOMINANT VIB. PERIOD
S-1	Layer 1	537	227	3.8	1.490	0.390	768	2136	3273	0.57
	Layer 2	865	330	6.3	1.680	0.410	1830	5177	10131	
	Layer 3	1085	376	--	1.780	0.430	2516	7206	17599	
S-2	Layer 1	646	236	3.8	1.560	0.420	869	2473	5352	0.58
	Layer 2	938	366	8.7	1.720	0.410	2304	6498	12061	
	Layer 3	1115	355	--	1.790	0.440	2256	6513	19246	
S-3	Layer 1	625	212	3.8	1.550	0.430	697	1999	5126	0.60
	Layer 2	902	331	12.5	1.700	0.420	1863	5298	11348	
	Layer 3	1152	357	--	1.810	0.450	2307	6675	20945	
S-4	Layer 1	747	240	3.8	1.620	0.440	933	2692	7796	0.59
	Layer 2	1044	324	12.5	1.760	0.450	1848	5346	16719	
	Layer 3	1216	358	--	1.830	0.450	2345	6814	23932	
S-5	Layer 1	760	240	3.8	1.630	0.440	1928	2713	8163	0.59
	Layer 2	1044	331	6.3	1.760	0.440	2294	5569	16612	
	Layer 3	1160	356	--	1.810	0.450	2713	6643	21297	
S-6	Layer 1	756	238	3.8	1.630	0.440	923	2668	8085	0.56
	Layer 2	1057	357	12.5	1.770	0.440	2256	6477	16768	
	Layer 3	1233	375	--	1.840	0.450	2588	7499	24523	
S-7	Layer 1	735	258	3.8	1.610	0.430	1072	3064	7269	0.57
	Layer 2	1111	349	12.5	1.790	0.450	2180	6302	19187	
	Layer 3	1233	370	--	1.840	0.450	2519	7308	24615	
S-8	Layer 1	756	248	3.8	1.630	0.440	1003	2887	7979	0.59
	Layer 2	1088	329	12.5	1.780	0.450	1927	5586	18502	
	Layer 3	1238	357	--	1.840	0.450	2345	6822	25074	

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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S-9	Layer 1	756	253	3.8	1.630	0.440	1043	2998	7925	0.59
	Layer 2	1087	333	6.3	1.780	0.450	1974	5717	18400	
	Layer 3	1214	354	--	1.830	0.450	2293	6667	23913	
S-10	Layer 1	786	246	3.8	1.640	0.450	992	2870	8809	0.60
	Layer 2	1095	313	9.2	1.780	0.460	1744	5076	19018	
	Layer 3	1198	349	--	1.820	0.450	2217	6445	23165	

Table 18: *Collective Result of Seismic Velocities and Elastic Parameters*

3.1.2. Microtremor Method

Within the scope of the studies carried out in the study area, 10 Microtremor (MT) measurements were taken. SR04S3-10-SARA Microtremor device was used during the measurements. At the measurement point, a 30-minute three-component (Vertical (z), N-S and D-W) recording was taken with the Seismowin program, and the recordings were evaluated with the Geopsy program. As a result of the evaluation; dominant frequency, dominant period and H/V ratios were obtained, and a soil classification was made according to the Turkish Earthquake Code.

Device name	Frequency range	Waiting time
SR04S3-10-SARA	0.02–50 Hz	30 min.



Figure 8: Sara-Doremia Microtremor Device and Equipment

Microtremor Data processing and remarks

The windowed data of the measurements taken, the amplitude spectrum obtained from each window and the dominant frequency H/V ratio are given below. As

a result of the evaluation, it was divided into a maximum of 70 windows with a window length of 25 seconds, and the average dominant frequency, average dominant period and average H/V ratio were obtained at this point.
When the results are examined, it is observed from the Spectra obtained from 8 points that it is a Soil medium. It is observed that the dominant vibration period is within the range of 0.45-0.49 sec. These values represent the ZD soil class according to the Turkish Earthquake Code.

Point name	COORDINATES (UTM 3° ITRF96)		Recording Time	Number of Windows
	Latitude	Longitude		
MT-1	41.283152°	27.837687°	30	20
MT-2	41.280837°	27.834344°	30	20
MT-3	41.277495°	27.828892°	30	23
MT-4	41.277576°	27.830550°	30	22
MT-5	41.278315°	27.832063°	30	22

Table 19: Coordinates of microtremor measurements.

The T0 value is directly related to the geometry of the geological units with different S-wave velocities. It is known that the H/V horizontal – vertical amplitude amplification values vary depending on the S-wave velocity contrast between the upper young geological units and the lower high velocity geological units. If the velocity contrast is low, the horizontal-vertical amplification will be small, and if the velocity contrast is high, the horizontal-vertical amplification will be large. If the units having values close to each other reach deep in thick layers, flat or nearly flat curves are obtained in some cases. In these cases, the H/V ratio obtained may be around 1 and sometimes even below this value. In this study, there are measurements that exemplify this situation. This means that there is no amplification, or that the amplification is very small.

The dominant frequency, horizontal/vertical amplitude ratio (H/V) and dominant period (T0=1/fo) values for the measurement point are given below. The frequency value corresponding to the highest H/V spectral ratio represents the dominant frequency of the soil of the study area. The dominant periods (T0) of the area were determined from the above-mentioned equation as well. Graphs for Horizontal/Vertical (H/V) Spectral Ratio Curves of the MT point are given in the appendices.
To obtain the lower and upper vibration periods of the soil Ta and Tb from the soil dominant vibration period

Ta = 0.67 x To

Tb = 1.50 x To equations are used. (Aytun, 2001)

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Measure Point	Fo (Hz)	T_0 (sec)	Ta (sec)	Tb (sec)	A0 (%)	Formation
MT-1	2.06	0.49	0.33	0.73	1.01	Ergene Formation (Mie)
MT-2	2.14	0.47	0.31	0.70	1.05	Ergene Formation (Mie)
MT-3	2.09	0.48	0.32	0.72	0.89	Ergene Formation (Mie)
MT-4	2.20	0.45	0.30	0.68	1.11	Ergene Formation (Mie)
MT-5	2.21	0.45	0.30	0.68	1.24	Ergene Formation (Mie)

Table 20: Values Obtained from Microtremor Data.

3.2. Test Pit

No test pit was opened in the study area.

3.3. Bores

In order to define the soil and determine the soil parameters, 21 boreholes were drilled at a depth of 20.00-50.00 meters in accordance with TSE standards, and the relevant sections are given in the annex. The coordinates of the bore sites, the type of boring, the name and surname of the borer, the dates of execution etc. are included in the Boring Log Annex (ANNEX-2).

The boring works were carried out with the truck-mounted Mobile Drill, Acker type machine, using core drilling method, in accordance with (TS-1900) and ASTM standards.

DATE	GWL (m)	DEPTH	LITHOLOGY
BH-1	**5.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 16.00	Medium plasticity silt: SİM
		16.00 – 18.00	Low plasticity silt: SiL
		18.00 – 20.00	Silty sand: SiSA
		20.00 – 22.00	Medium plasticity silt: SİM
		22.00 – 25.00	High plasticity silt: SiH
BH-2	**6.50**	**0.00 – 1.00**	Vegetable Soil.
		1.50 – 4.50	Medium plasticity silt: SİM
		4.50 – 8.50	Silty sand: SiSA
		8.50 – 12.50	Medium plasticity silt: SİM
		12.50 – 14.00	Low plasticity silt: SiL
		14.00 – 20.00	Silty sand: SiSA
		20.00 – 23.00	Low plasticity silt: SiL
		23.00 – 25.00	Medium plasticity clay: CIM
BH-3	**6.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.00	Medium plasticity clay: CIM

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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		4.00 – 7.50	Medium plasticity silt: SİM
		7.50 – 10.50	Silty sand: SiSA
		10.50 – 16.50	Medium plasticity silt: SİM
		16.50 – 18.00	Low plasticity silt: SiL
		18.00 – 19.00	Silty sand: SiSA
		19.00 – 25.00	Medium plasticity silt: SİM
		25.00 – 27.00	High plasticity silt: SiH
		27.00 – 33.00	Medium plasticity silt: SİM
		33.00 – 40.00	Well graded sand: SAW
		40.00 – 42.00	Medium plasticity silt: SİM
		42.00 – 50.00	Silty sand: SiSA
BH-4	**3.80**	**0.00 – 1.50**	Vegetable Soil.
		1.50 – 3.00	Silty sand: SiSA
		3.00 – 8.00	Medium plasticity silt: SİM
		8.00 – 10.00	Silty sand: SiSA
		10.00 – 12.00	Medium plasticity silt: SİM
		12.00 – 13.00	Silty sand: SiSA
		13.00 – 18.50	Medium plasticity silt: SİM
		18.50 – 20.00	Silty sand: SiSA
		20.00 – 22.00	Medium plasticity silt: SİM
		22.00 – 25.00	High plasticity silt: SiH
BH-5	**4.50**	**0.00 – 1.50**	Vegetable Soil.
		1.50 – 4.00	Medium plasticity clay: CIM
		4.00 – 13.00	Medium plasticity silt: SİM
		13.00 – 16.50	Silty sand: SiSA
		16.50 – 20.00	Medium plasticity silt: SİM
		20.00 – 25.00	High plasticity silt: SiH
BH-6	**5.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Silty sand: SiSA
		3.00 – 7.00	Medium plasticity silt: SİM
		7.00 – 8.50	Silty sand: SiSA
		8.50 – 10.00	Clay sand: CLSA
		10.00 – 16.00	Medium plasticity silt: SİM
		16.00 – 25.00	Silty sand: SiSA
BH-7	**8.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 5.00	Medium plasticity silt: SİM
		5.00 – 7.00	Silty sand: SiSA
		7.00 – 13.00	Medium plasticity silt: SİM

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		13.00 – 22.00	Silty sand: SiSA
		22.00 – 24.00	Medium plasticity silt: SİM
		24.00 – 25.00	High plasticity silt: SiH
		25.00 – 27.00	Low plasticity silt: SiL
		27.00 – 28.00	Medium plasticity silt: SİM
		28.00 – 33.00	High plasticity silt: SiH
		33.00 – 46.00	Silty sand: SiSA
		46.00 – 48.00	Low plasticity silt: SiL
		48.00 – 50.00	Silty sand: SiSA
BH-8	**10.00**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.00	Medium plasticity clay: CIM
		4.00 – 5.50	Medium plasticity silt: SİM
		5.50 – 8.50	Silty sand: SiSA
		8.50 – 10.50	Medium plasticity silt: SİM
		10.50 – 16.00	Silty sand: SiSA
		16.00 – 25.00	High plasticity silt: SiH
BH-9	**6.00**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 13.00	Medium plasticity silt: SİM
		13.00 – 16.00	Silty sand: SiSA
		16.00 – 20.00	High plasticity silt: SiH
BH-10	**5.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.00	Medium plasticity silt: SİM
		4.00 – 6.00	Silty sand: SiSA
		6.00 – 13.00	Medium plasticity silt: SİM
		13.00 – 14.00	Silty sand: SiSA
		14.00 – 16.00	Clay sand: CLSA
		16.00 – 18.00	Silty sand: SiSA
		18.00 – 19.00	Clay sand: CLSA
		19.00 – 20.00	Silty sand: SiSA
BH-11	**3.70**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 2.50	Medium plasticity clay: CIM
		2.50 – 5.00	Silty sand: SiSA
		5.00 – 7.00	Medium plasticity silt: SİM
		7.00 – 9.50	Silty sand: SiSA
		9.50 – 13.00	Medium plasticity silt: SİM
		13.00 – 16.00	Silty sand: SiSA
		16.00 – 20.00	High plasticity silt: SiH
BH-12	**4.00**	**0.00 – 1.00**	Vegetable Soil.

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

		1.00 – 3.00	Medium plasticity silt: SİM
		3.00 – 5.00	Silty sand: SiSA
		5.00 – 7.00	Medium plasticity silt: SİM
		7.00 – 11.00	Silty sand: SiSA
		11.00 – 12.50	Medium plasticity silt: SİM
		12.50 – 14.00	Silty sand: SiSA
		14.00 – 17.00	Low plasticity silt: SiL
		17.00 – 21.00	Medium plasticity silt: SİM
		21.00 – 31.00	High plasticity silt: SiH
		31.00 – 35.00	Medium plasticity silt: SİM
BH-13	**3.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Medium plasticity clay: CIM
		3.00 – 5.00	High plasticity silt: SiH
		5.00 – 8.00	Medium plasticity silt: SİM
		8.00 – 8.50	Sand.
		8.50 – 20.00	Medium plasticity silt: SİM
BH-14	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Medium plasticity clay: CIM
		3.00 – 8.50	Medium plasticity silt: SİM
		8.50 – 10.00	Silty sand: SiSA
		10.00 – 12.00	High plasticity silt: SiH
		12.00 – 13.00	Silty sand: SiSA
		13.00 – 20.00	Medium plasticity silt: SİM
BH-15	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 2.50	Medium plasticity silt: SİM
		2.50 – 5.00	Silty sand: SiSA
		5.00 – 8.50	Medium plasticity silt: SİM
		8.50 – 14.00	Silty sand: SiSA
		14.00 – 18.00	Medium plasticity silt: SİM
		18.00 – 20.00	Silty sand: SiSA
BH-16	**3.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 2.50	Medium plasticity clay: CIM
		2.50 – 4.50	Silty sand: SiSA
		4.50 – 7.00	Medium plasticity silt: SİM
		7.00 – 8.00	Silty sand: SiSA
		8.00 – 10.00	Low plasticity silt: SiL
		10.00 – 11.00	Medium plasticity silt: SİM
		11.00 – 13.00	High plasticity silt: SiH

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

		13.00 – 20.00	Medium plasticity silt: SİM
		20.00 – 31.00	High plasticity silt: SiH
		31.00 – 32.00	Silty sand: SiSA
		32.00 – 35.00	High plasticity silt: SiH
BH-17	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.00	Medium plasticity silt: SİM
		4.00 – 8.00	Silty sand: SiSA
		8.00 – 17.00	Medium plasticity silt: SİM
		17.00 – 20.00	Silty sand: SiSA
BH-18	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 9.00	Medium plasticity silt: SİM
		9.00 – 10.00	Low plasticity silt: SiL
		10.00 – 11.00	Silty sand: SiSA
		11.00 – 13.00	High plasticity silt: SiH
		13.00 – 16.00	Low plasticity silt: SiL
		16.00 – 21.00	Medium plasticity silt: SİM
		21.00 – 22.00	Silty sand: SiSA
		22.00 – 35.00	High plasticity silt: SiH
BH-AR01	**3.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 8.00	Medium plasticity silt: SİM
		8.00 – 11.00	Silty sand: SiSA
		11.00 – 17.50	Medium plasticity silt: SİM
		17.50 – 20.00	Silty sand: SiSA
		20.00 – 25.00	High plasticity silt: SiH
BH-AR02	**3.70**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.50	Medium plasticity clay: CIM
		4.50 – 5.50	Clay sand: CLSA
		5.50 – 11.00	Medium plasticity silt: SİM
		11.00 – 13.00	High plasticity silt: SiH
		13.00 – 16.50	Medium plasticity silt: SİM
		16.50 – 19.00	High plasticity silt: SiH
		19.00 – 20.50	Medium plasticity silt: SİM
		20.50 – 23.00	High plasticity silt: SiH
		23.00 – 25.00	Medium plasticity silt: SİM
		25.00 – 27.00	Silty sand: SiSA
		27.00 – 33.00	Well graded sand: SAW
		33.00 – 40.00	Silty sand: SiSA
BH-AR03	**10.00**	**0.00 – 1.00**	Vegetable Soil.

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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		1.00 – 3.00	Silty sand: SiSA
		3.00 – 7.00	Medium plasticity clay: CIM
		7.00 – 11.00	Medium plasticity silt: SİM
		11.00 – 15.50	Silty sand: SiSA
		15.50 – 17.00	Medium plasticity silt: SİM
		17.00 – 19.00	Clay sand: CLSA
		19.00 – 21.00	Silty sand: SiSA
		21.00 – 22.00	High plasticity silt: SiH
		22.00 – 24.00	Medium plasticity clay: CIM
		24.00 – 25.00	Medium plasticity silt: SİM

Table 21: Soil units and depths encountered in the study area.

3.4. Field Tests

3.4.1. SPT Tests

In the study area, 21 foundation boreholes with a depth of 20.00-50.00 meters were drilled. Standard penetration testing (SPT) was performed at appropriate levels during boring. The log of the boring performed in the survey area is attached. The variation of SPT N_{30} values obtained during boring with depth is also shown graphically in the annex. Standard Penetration Tests (SPT) performed during drilling are performed to determine the in-situ strength parameters of existing soils at the construction site.

The standard penetration test is an in-situ dynamic shear test. This test is based on the principle of determining the resistance that occurs when a special sampling pipe made of steel is driven into the ground by impact using standard energy, referred to as penetrometry. The standard slit pipe with an outer diameter of 50.0 mm and an inner diameter of 34.9 mm is dropped freely from a height of 76.2 cm with a 63.5 kg hammer, and the number of blows required to be performed to achieve 3 penetrations of 15 cm each (=45 cm) into the soil is determined. The sum of the number of blows for the last two 15 cm penetrations is shown as N_{30} or SPT-N.

The findings of the Standard Penetration values are generally used to determine the relative density and bearing capacity of granular soils. There is a correlative relationship between the standard penetration test results obtained in cohesive soils and the consistency.

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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BORE NO.	DEPTH (m)	NUMBER OF BLOWS	SPT N30	LITHOLOGY
BH-1	1.50 - 1.95	6/7/9	16	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	9/10/13	23	
	4.50 - 4.95	12/18/20	38	
	6.00 - 6.45	17/36/44	80	
	7.50 - 7.95	18/22/25	47	
	9.00 - 9.45	19/27/39	66	
	10.50 - 10.95	21/30/39	69	
	12.00 - 12.45	24/34/40	74	
	13.50 - 13.95	27/35/46	81	
	15.00 - 15.45	36/39/44	83	
	16.50 - 16.95	37/40/48	88	
	18.00 - 18.45	38/46/50/12	--	
	19.50 - 19.95	40/50//50/5	--	
	21.00 - 21.45	41/50/6/-	--	
	22.50 - 22.95	40/48/50/4	--	
	24.00 - 24.45	44/50/4/-	--	
BH-2	1.50 - 1.95	4/7/9	16	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	8/8/16	24	
	4.50 - 4.95	10/12/21	33	
	6.00 - 6.45	20/20/22	42	
	7.50 - 7.95	19/21/24	45	
	9.00 - 9.45	24/26/32	58	
	10.50 - 10.95	18/24/33	57	
	12.00 - 12.45	28/33/40	73	
	13.50 - 13.95	44/50/13/-	--	
	15.00 - 15.45	30/38/50/11	--	
	16.50 - 16.95	32/41/50/11	--	
	18.00 - 18.45	38/46/50/4	--	
	21.00 - 21.45	33/42/50/5	--	
	22.50 - 22.95	40/50/8/-	--	
	24.00 - 24.45	44/50/5/-	--	
BH-3	1.50 - 1.95	5/8/10	18	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	12/13/15	28	
	4.50 - 4.95	11/14/16	30	
	6.00 - 6.45	10/13/23	36	

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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	7.50 - 7.95	12/16/24	40	
	9.00 - 9.45	15/19/29	48	
	10.50 - 10.95	20/28/32	60	
	12.00 - 12.45	42/50/12/-	--	
	13.50 - 13.95	20/24/33	57	
	15.00 - 15.45	22/27/39	--	
	16.50 - 16.95	26/36/50/14	--	
	18.00 - 18.45	28/41/50/8	--	
	19.50 - 19.95	33/42/50/7	--	
	21.00 - 21.45	38/50/12/-	--	
	22.50 - 22.95	16/18/22	40	
	24.00 - 24.45	16/19/24	43	
	25.50 - 25.95	17/20/28	48	
	27.00 - 27.45	17/21/29	50	
	28.50 - 28.95	18/22/30	52	
	30.00 - 30.45	19/27/32	59	
	31.50 - 31.95	22/31/38	69	
	33.00 - 33.45	30/36/50	86	
	34.50 - 34.95	35/40/50/8	--	
	36.00 - 36.45	39/42/50/6	--	
BH-4	1.50 - 1.95	4/5/5	10	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	5/5/6	11	
	4.50 - 4.95	10/12/16	28	
	6.00 - 6.45	16/20/27	47	
	7.50 - 7.95	18/21/27	48	
	9.00 - 9.45	22/22/32	54	
	10.50 - 10.95	22/24/33	57	
	12.00 - 12.45	25/26/40	66	
	13.50 - 13.95	17/17/20	37	
	15.00 - 15.45	15/17/25	42	
	16.50 - 16.95	18/23/30	53	
	18.00 - 18.45	25/32/50	82	
	19.50 - 19.95	30/35/50	85	
	21.00 - 21.45	39/44/50/10	--	
	22.50 - 22.95	13/15/20	35	
	24.00 - 24.45	14/18/22	40	
	25.50 - 25.95	17/21/25	46	

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BH-5	1.50 - 1.95	10/13/15	28	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	11/16/18	34	
	4.50 - 4.95	8/11/14	25	
	6.00 - 6.45	7/8/12	20	
	7.50 - 7.95	12/14/19	33	
	9.00 - 9.45	13/21/24	45	
	10.50 - 10.95	13/21/25	46	
	12.00 - 12.45	14/22/26	48	
	13.50 - 13.95	18/24/31	55	
	15.00 - 15.45	24/36/41	77	
	16.50 - 16.95	15/17/20	37	
	18.00 - 18.45	17/24/26	50	
	19.50 - 19.95	16/22/24	46	
	21.00 - 21.45	16/22/24	46	
	22.50 - 22.95	17/20/23	43	
	24.00 - 24.45	18/21/24	45	
BH-6	1.50 - 1.95	6/8/10	18	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	10/18/21	39	
	4.50 - 4.95	11/14/16	30	
	6.00 - 6.45	6/8/11	19	
	7.50 - 7.95	7/7/13	20	
	9.00 - 9.45	11/24/36	60	
	10.50 - 10.95	16/28/38	66	
	12.00 - 12.45	21/26/34	60	
	13.50 - 13.95	24/28/34	62	
	15.00 - 15.45	26/34/38	72	
	16.50 - 16.95	30/36/40	76	
	18.00 - 18.45	$26/50/50_{/5}$	--	
	19.50 - 19.95	$33/50_{/4}/-$	--	
	21.00 - 21.45	$36/50_{/7}/-$	--	
	22.50 - 22.95	$40/50_{/5}$	---	
	24.00 - 24.45	$50_{/8}/-/-$	--	
BH-7	1.50 - 1.95	5/5/6	11	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	6/7/11	18	
	4.50 - 4.95	8/11/14	25	
	6.00 - 6.45	12/17/19	36	
	7.50 - 7.95	16/21/24	45	

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	9.00 - 9.45	18/26/32	58	
	10.50 - 10.95	10/12/16	28	
	12.00 - 12.45	11/15/20	35	
	13.50 - 13.95	21/29/35	64	
	15.00 - 15.45	32/50/10/-	--	
	16.50 - 16.95	35/50/13/-	--	
	18.00 - 18.45	42/50/4/-	--	
	19.50 - 19.95	46/50/3/-	--	
	21.00 - 21.45	42/50/5/-	--	
	22.50 - 22.95	40/50/8/-	--	
	24.00 - 24.45	50/8/-/-	--	
	25.50-25.95	50/11/-/-	--	
	27.00-27.45	30/39/40	79	
	30.00-30,445	20/28/35	63	
	31.50-31.95	24/32/40	72	
	33.00-33.45	45/50/6/-	--	
	36.00-36.45	50/50/4/-	--	
BH-8	1.50 - 1.95	6/7/7	14	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	8/10/13	23	
	4.50 - 4.95	7/11/14	25	
	6.00 - 6.45	7/13/16	29	
	7.50 - 7.95	8/13/17	30	
	9.00 - 9.45	10/14/19	33	
	10.50 - 10.95	15/18/25	43	
	12.00 - 12.45	21/24/34	48	
	13.50 - 13.95	17/20/27	47	
	15.00 - 15.45	18/26/32	48	
	16.50 - 16.95	19/27/33	60	
	18.00 - 18.45	22/29/36	65	
	19.50 - 19.95	24/30/39	69	
	21.00 - 21.45	26/34/46	80	
	22.50 - 22.95	20/30/32	62	
	24.00 - 24.45	16/21/23	44	
BH-9	1.50 - 1.95	6/9/10	19	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	6/10/12	22	
	4.50 - 4.95	8/12/14	26	
	6.00 - 6.45	11/16/21	27	

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ÇERKEZKÖY/TEKİRDAĞ
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	7.50 - 7.95	12/16/20	36	
	9.00 - 9.45	14/19/24	43	
	10.50 - 10.95	20/26/32	58	
	12.00 - 12.45	13/20/26	46	
	13.50 - 13.95	16/22/30	52	
	15.00 - 15.45	18/24/26	50	
	16.50 - 16.95	24/34/36	70	
	18.00 - 18.45	34/46/50/10	--	
	19.50 - 19.95	44/50/8/-	--	
BH-10	1.50 - 1.95	10/13/16	29	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	8/14/18	32	
	4.50 - 4.95	15/9/16	25	
	6.00 - 6.45	9/14/17	31	
	7.50 - 7.95	15/21/24	45	
	9.00 - 9.45	13/21/21	42	
	10.50 - 10.95	20/26/30	56	
	12.00 - 12.45	15/21/22	43	
	13.50 - 13.95	19/25/32	57	
	15.00 - 15.45	38/50/12/-	--	
	16.50 - 16.95	34/45/50/8	--	
	18.00 - 18.45	24/50/50/6	--	
	19.50 - 19.95	30/50/5/-	--	
BH-11	1.50 - 1.95	6/8/8	16	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	12/15/23	38	
	4.50 - 4.95	13/15/17	32	
	6.00 - 6.45	16/18/18	36	
	7.50 - 7.95	15/18/24	42	
	9.00 - 9.45	15/20/30	50	
	10.50 - 10.95	20/28/32	60	
	12.00 - 12.45	24/21/34	55	
	13.50 - 13.95	35/44/50/12	--	
	15.00 - 15.45	45/50/10/-	--	
	16.50 - 16.95	13/16/21	37	
	18.00 - 18.45	17/17/22	39	
	19.50 - 19.95	18/21/24	45	
BH-12	1.50 - 1.95	5/7/7	14	Sandy, silty, clayey Ergene
	3.00 - 3.45	5/7/9	16	

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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	4.50 - 4.95	6/9/11	20	formation.
	6.00 - 6.45	7/10/12	22	
	7.50 - 7.95	12/15/18	33	
	9.00 - 9.45	16/19/23	42	
	10.50 - 10.95	15/22/25	47	
	12.00 - 12.45	14/24/26	50	
	13.50 - 13.95	14/22/26	48	
	15.00 - 15.45	13/20/26	46	
	16.50 - 16.95	18/24/27	51	
	18.00 - 18.45	20/26/34	60	
	19.50 - 19.95	22/28/37	65	
	21.00 - 21.45	24/31/35	66	
	22.50 - 22.95	26/32/36	68	
	24.00 - 24.45	24/30/38	68	
	27.00 - 27.45	25/32/40	72	
	28.50 - 28.95	27/34/41	75	
	30.00 - 30.45	30/35/42	77	
	31.50 - 31.95	34/37/44	81	
	33.00 - 33.45	38/41/48	89	
	34.50 - 34.95	40/47/50	97	
BH-13	1.50 - 1.95	5/6/8	14	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	5/7/11	18	
	4.50 - 4.95	6/8/12	20	
	6.00 - 6.45	7/12/14	26	
	7.50 - 7.95	11/18/21	39	
	9.00 - 9.45	17/23/27	50	
	10.50 - 10.95	16/24/27	51	
	12.00 - 12.45	15/25/34	59	
	13.50 - 13.95	12/19/24	43	
	15.00 - 15.45	13/21/28	49	
	16.50 - 16.95	18/22/28	50	
	18.00 - 18.45	20/24/33	47	
	19.50 - 19.95	27/27/36	63	
BH-14	1.50 - 1.95	6/6/7	13	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	5/6/8	14	
	4.50 - 4.95	8/10/11	21	
	6.00 - 6.45	9/14/18	32	

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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	7.50 - 7.95	11/17/24	41	
	9.00 - 9.45	24/35/50/12	--	
	10.50 - 10.95	17/20/21	41	
	12.00 - 12.45	20/25/27	52	
	13.50 - 13.95	19/22/30	52	
	15.00 - 15.45	17/21/45	66	
	16.50 - 16.95	19/26/36	62	
	18.00 - 18.45	26/32/41	73	
	19.50 - 19.95	32/39/48	87	
BH-15	1.50 - 1.95	6/7/9	16	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	12/14/16	30	
	4.50 - 4.95	10/11/14	25	
	6.00 - 6.45	8/13/13	26	
	7.50 - 7.95	10/17/21	38	
	9.00 - 9.45	14/20/28	48	
	10.50 - 10.95	15/19/29	58	
	12.00 - 12.45	17/24/32	56	
	13.50 - 13.95	19/27/35	62	
	15.00 - 15.45	20/30/38	68	
	16.50 - 16.95	20/29/40	69	
	18.00 - 18.45	20/25/40	65	
	19.50 - 19.95	27/30/42	72	
BH-16	1.50 - 1.95	6/7/8	15	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	8/12/19	31	
	4.50 - 4.95	10/13/23	36	
	6.00 - 6.45	12/15/26	41	
	7.50 - 7.95	11/12/14	26	
	9.00 - 9.45	10/13/16	29	
	10.50 - 10.95	11/14/18	32	
	12.00 - 12.45	11/14/18	32	
	13.50 - 13.95	11/14/21	35	
	15.00 - 15.45	13/15/23	38	
	16.50 - 16.95	14/16/26	42	
	18.00 - 18.45	18/21/28	49	
	19.50 - 19.95	21/26/34	60	
	21.00 - 21.45	20/25/35	60	
	22.50 - 22.95	20/26/36	62	

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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	24.00 - 24.45	18/21/25	46	
	25.50-25.95	16/24/29	53	
	27.00 - 27.45	17/25/31	56	
	28.50 - 28.95	19/26/34	60	
	30.00 - 30.45	22/28/36	64	
	31.50 - 31.95	25/34/39	73	
	33.00 - 33.45	27/35/40	75	
	34.50 - 34.95	29/36/41	77	
BH-17	1.50 - 1.95	5/6/6	12	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	6/7/8	15	
	4.50 - 4.95	8/10/12	22	
	6.00 - 6.45	19/35/35	70	
	7.50 - 7.95	10/12/15	27	
	9.00 - 9.45	13/13/17	30	
	10.50 - 10.95	15/17/24	41	
	12.00 - 12.45	17/18/28	46	
	13.50 - 13.95	17/18/30	48	
	15.00 - 15.45	17/19/33	52	
	16.50 - 16.95	18/21/34	55	
	18.00 - 18.45	21/32/45	77	
	19.50 - 19.95	30/39/50/14	--	
BH-18	1.50 - 1.95	4/5/6	11	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	5/6/6	12	
	4.50 - 4.95	6/7/8	15	
	6.00 - 6.45	7/8/10	18	
	7.50 - 7.95	9/14/19	33	
	9.00 - 9.45	12/21/29	50	
	10.50 - 10.95	14/21/27	48	
	12.00 - 12.45	16/21/28	49	
	13.50 - 13.95	16/19/24	43	
	15.00 - 15.45	16/18/22	40	
	16.50 - 16.95	17/23/31	54	
	18.00 - 18.45	17/26/39	65	
	19.50 - 19.95	17/24/34	58	
	21.00 - 21.45	18/20/29	49	
	22.50 - 22.95	20/26/32	58	
	24.00 - 24.45	23/32/36	68	

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

	25.50 - 25.95	22/24/28	52	
	27.00 - 27.45	21/26/32	58	
	28.50 - 28.95	23/31/35	66	
	30.00 - 30.45	24/36/38	74	
	31.50 - 31.95	28/35/40	75	
	33.00 - 33.45	31/36/40	76	
	34.50 - 34.95	33/38/42	80	
BH-AR01	1.50 - 1.95	5/5/6	11	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	5/6/6	12	
	4.50 - 4.95	6/8/10	18	
	6.00 - 6.45	7/10/13	23	
	7.50 - 7.95	8/12/17	29	
	9.00 - 9.45	15/32/44	76	
	10.50 - 10.95	16/22/27	49	
	12.00 - 12.45	19/27/30	57	
	13.50 - 13.95	14/19/24	43	
	15.00 - 15.45	14/20/25	45	
	16.50 - 16.95	16/22/30	52	
	18.00 - 18.45	15/30/50/13	--	
	19.50 - 19.95	20/34/50	84	
	21.00 - 21.45	18/24/32	56	
	22.50 - 22.95	19/28/35	63	
	24.00 - 24.45	22/30/39	69	
BH-AR02	1.50 - 1.95	6/7/8	15	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	5/9/9	18	
	4.50 - 4.95	8/11/13	24	
	6.00 - 6.45	15/23/30	53	
	7.50 - 7.95	18/26/36	62	
	9.00 - 9.45	34/43/50/10	--	
	10.50 - 10.95	14/19/26	45	
	12.00 - 12.45	17/25/32	57	
	13.50 - 13.95	10/16/21	37	
	15.00 - 15.45	9/13/21	34	
	16.50 - 16.95	10/16/24	40	
	18.00 - 18.45	11/20/28	48	
	19.50 - 19.95	10/25/32	57	
	21.00 - 21.45	30/42/50/12	--	

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	22.50 - 22.95	19/25/36	1	
	24.00 - 24.45	21/33/42	5	
	25.50 - 25.95	38/43/50/8	--	
	27.00 - 27.45	42/50/14/-	--	
	28.50 - 28.95	45/50/5/-	--	
	31.50-31.95	50/50/4/-	--	
BH-AR03	1.50 - 1.95	4/6/7	13	Sandy, silty, clayey Ergene formation.
	3.00 - 3.45	7/8/9	17	
	4.50 - 4.95	6/8/9	17	
	6.00 - 6.45	6/7/9	16	
	7.50 - 7.95	8/9/12	21	
	9.00 - 9.45	10/11/14	25	
	10.50 - 10.95	15/20/23	43	
	12.00 - 12.45	21/29/34	63	
	13.50 - 13.95	26/31/38	69	
	15.00 - 15.45	34/46/50/12	--	
	16.50 - 16.95	14/20/22	42	
	18.00 - 18.45	24/34/46	80	
	19.50 - 19.95	18/21/25	46	
	21.00 - 21.45	20/26/32	58	
	22.50 - 22.95	19/22/32	54	
	24.00 - 24.45	19/21/34	55	

Table 22: Number of blows and lithology depending on depth in different boreholes.

The correction factors used for the standard penetration resistance N values to be used in geotechnical design are given below.
(N1)E: Corrected number of blows
CE: Energy Correction Factor
CN: Overburden Correction Factor (Liao and Whitman, 1986)
CB: Boring Diameter Correction Factor
CS: Sampler Correction Factor
CR: Rod Length Correction Factor
CBF: Blow Velocity Correction Factor
A value of 1 was used for CB, CS, CR correction factors. (McGregor and Duncan, 1998)
Since an automatic ram is used during SPT, energy correction is not applicable. N60 rod length correction has been performed.

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Variables		Symbols	Correction Factor			
			Skempton* (1986)	Robertson and Wride (1997)	McGregor and Duncan (1998)	Bowles (1996)
Rod Length	> 30 m	C_R	1	< 1.0	1	1
	10 – 30 m		1	1	1	1
	6 – 10 m		0.95	0.95	1	0.95
	4 – 6 m		0.85	0.85	1	0.85
	3 – 4 m		0.75	0.75	1	0.75
	0 – 3 m		0.75	-	0.75	0.75
Pipe	If a non-liner sampler is used					
	Standard pipe (with liner) sampler:	C_S	1.2	1.1 – 1.3	-	1.0
	Loose sand		1	1	-	0.9
	Firm sand and clay		1	1	-	0.8
Borer Diameter	60 – 120 mm	C_B	1	1	-	1
	150 mm		1.05	1.05	-	1.05
	200 mm		1.15	1.15	-	1.15
Blow Impact Speed	Less than 20 and 10-20 impact/min.	C_{BF}	-	-	0.95	-
	More than 20 and 10-20 impact/min		-	-	1.05	-

* Skempton (1986) factors are generally used in practice.

Table 23: Drill diameter, sampler, rod length and blow impact speed correction factors (Aggour and Radding, 2001)

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	16	1,910	0.05	1.0	1.0	0.75	0.7	0.5	0.5	0.4
3.3	23	1,910	0.04	1.0	1.0	0.75	0.7	0.6	0.5	0.4
4.8	38	1,910	0.03	1.0	1.0	0.75	1.0	0.8	0.7	0.61
6.3	80	1,910	0.03	1.0	1.0	0.75	1.7	1.4	1.3	1.1
7.8	47	1,910	0.03	1.0	1.0	0.75	0.9	0.8	0.7	0.6
9.3	66	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
10.8	69	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
12.3	74	1,910	0.02	1.0	1.0	0.75	1.2	0.9	0.9	0.7
13.8	81	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
15.3	83	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
16.8	88	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
18.3	100	1,910	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	100	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
21.3	100	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

Groundwater was encountered at a depth of 5.50 meters in the borehole no. BH-1.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	16	1,920	0.05	1.0	1.0	0.75	0.7	0.5	0.5	0.4
3.3	24	1,920	0.04	1.0	1.0	0.75	0.7	0.6	0.5	0.5
4.8	33	1,920	0.03	1.0	1.0	0.75	0.8	0.7	0.6	0.53
6.3	42	1,920	0.03	1.0	1.0	0.75	0.9	0.7	0.7	0.6
7.8	45	1,920	0.03	1.0	1.0	0.75	0.9	0.7	0.7	0.6
9.3	58	1,920	0.02	1.0	1.0	0.75	1.0	0.9	0.8	0.7
10.8	57	1,920	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.7
12.3	73	1,920	0.02	1.0	1.0	0.75	1.1	0.9	0.9	0.7
13.8	100	1,920	0.02	1.0	1.0	0.75	1.5	1.2	1.1	0.9
15.3	100	1,920	0.02	1.0	1.0	0.75	1.5	1.2	1.1	0.9
16.8	100	1,920	0.02	1.0	1.0	0.75	1.3	1.1	1.0	0.9
18.3	100	1,920	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	100	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
21.3	100	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

Groundwater was encountered at a depth of 6.50 meters in the borehole no. BH-2.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	18	1,910	0.05	1.0	1.0	0.75	0.7	0.6	0.6	0.5
3.3	28	1,910	0.04	1.0	1.0	0.75	0.8	0.7	0.6	0.5
4.8	30	1,910	0.03	1.0	1.0	0.75	0.8	0.6	0.6	0.48
6.3	36	1,910	0.03	1.0	1.0	0.75	0.8	0.6	0.6	0.5
7.8	40	1,910	0.03	1.0	1.0	0.75	0.8	0.6	0.6	0.5
9.3	48	1,910	0.02	1.0	1.0	0.75	0.9	0.7	0.6	0.6
10.8	60	1,910	0.02	1.0	1.0	0.75	1.1	0.9	0.8	0.7
12.3	100	1,910	0.02	1.0	1.0	0.75	1.6	1.3	1.2	1.0
13.8	57	1,910	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
15.3	100	1,910	0.02	1.0	1.0	0.75	1.5	1.2	1.1	0.9
16.8	100	1,910	0.02	1.0	1.0	0.75	1.3	1.1	1.0	0.9
18.3	100	1,910	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	100	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
21.3	100	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

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Groundwater was encountered at a depth of 6.50 meters in the borehole no. BH-3.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	10	1,930	0.05	1.0	1.0	0.75	0.4	0.3	0.3	0.3
3.3	11	1,930	0.04	1.0	1.0	0.75	0.3	0.3	0.2	0.2
4.8	28	1,930	0.03	1.0	1.0	0.75	0.7	0.6	0.5	0.45
6.3	47	1,930	0.03	1.0	1.0	0.75	1.0	0.8	0.8	0.7
7.8	48	1,930	0.03	1.0	1.0	0.75	0.9	0.8	0.7	0.6
9.3	54	1,930	0.02	1.0	1.0	0.75	1.0	0.8	0.7	0.6
10.8	57	1,930	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.7
12.3	66	1,930	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.7
13.8	37	1,930	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
15.3	42	1,930	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
16.8	53	1,930	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
18.3	82	1,930	0.02	1.0	1.0	0.75	1.0	0.9	0.8	0.7
19.8	85	1,930	0.02	1.0	1.0	0.75	1.0	0.9	0.8	0.7
21.3	100	1,930	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

Groundwater was encountered at a depth of 3.80 meters in the borehole no. BH-4.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	28	1,920	0.05	1.0	1.0	0.75	1.1	0.9	0.9	0.7
3.3	34	1,920	0.04	1.0	1.0	0.75	1.0	0.8	0.8	0.7
4.8	25	1,920	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.40
6.3	20	1,920	0.03	1.0	1.0	0.75	0.4	0.4	0.3	0.3
7.8	33	1,920	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.4
9.3	45	1,920	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
10.8	46	1,920	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
12.3	48	1,920	0.02	1.0	1.0	0.75	0.7	0.6	0.6	0.5
13.8	55	1,920	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
15.3	77	1,920	0.02	1.0	1.0	0.75	1.1	0.9	0.8	0.7
16.8	37	1,920	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
18.3	50	1,920	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
19.8	46	1,920	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
21.3	46	1,920	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.4

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Groundwater was encountered at a depth of 4.50 meters in the borehole no. BH-5.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	18	1,920	0.05	1.0	1.0	0.75	0.7	0.6	0.5	0.5
3.3	39	1,920	0.04	1.0	1.0	0.75	1.2	1.0	0.9	0.8
4.8	30	1,920	0.03	1.0	1.0	0.75	0.7	0.6	0.6	0.48
6.3	19	1,920	0.03	1.0	1.0	0.75	0.4	0.3	0.3	0.3
7.8	20	1,920	0.03	1.0	1.0	0.75	0.4	0.3	0.3	0.3
9.3	60	1,920	0.02	1.0	1.0	0.75	1.1	0.9	0.8	0.7
10.8	66	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
12.3	60	1,920	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
13.8	62	1,920	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
15.3	72	1,920	0.02	1.0	1.0	0.75	1.1	0.9	0.8	0.7
16.8	76	1,920	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.7
18.3	100	1,920	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	100	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
21.3	100	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

Groundwater was encountered at a depth of 5.50 meters in the borehole no. BH-6.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	11	1,920	0.05	1.0	1.0	0.75	0.4	0.4	0.3	0.3
3.3	18	1,920	0.04	1.0	1.0	0.75	0.5	0.4	0.4	0.3
4.8	25	1,920	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.40
6.3	36	1,920	0.03	1.0	1.0	0.75	0.8	0.6	0.6	0.5
7.8	45	1,920	0.03	1.0	1.0	0.75	0.9	0.7	0.7	0.6
9.3	58	1,920	0.02	1.0	1.0	0.75	1.0	0.9	0.8	0.7
10.8	28	1,920	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
12.3	35	1,920	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.4
13.8	64	1,920	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
15.3	100	1,920	0.02	1.0	1.0	0.75	1.5	1.2	1.1	0.9
16.8	100	1,920	0.02	1.0	1.0	0.75	1.3	1.1	1.0	0.9
18.3	100	1,920	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	100	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8
21.3	100	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

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Groundwater was encountered at a depth of 8.50 meters in the borehole no. BH-7.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	14	1,900	0.05	1.0	1.0	0.75	0.6	0.5	0.4	0.4
3.3	23	1,900	0.04	1.0	1.0	0.75	0.7	0.6	0.5	0.4
4.8	25	1,900	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.40
6.3	29	1,900	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.4
7.8	30	1,900	0.03	1.0	1.0	0.75	0.6	0.5	0.4	0.4
9.3	33	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
10.8	43	1,900	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
12.3	48	1,900	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
13.8	47	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.4
15.3	48	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
16.8	60	1,900	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
18.3	65	1,900	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
19.8	69	1,900	0.02	1.0	1.0	0.75	0.9	0.7	0.6	0.5
21.3	80	1,900	0.02	1.0	1.0	0.75	1.0	0.8	0.7	0.6

Groundwater was encountered at a depth of 10.00 meters in the borehole no. BH-8.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	19	1,920	0.05	1.0	1.0	0.75	0.8	0.6	0.6	0.5
3.3	22	1,920	0.04	1.0	1.0	0.75	0.7	0.5	0.5	0.4
4.8	26	1,920	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.42
6.3	27	1,920	0.03	1.0	1.0	0.75	0.6	0.5	0.4	0.4
7.8	36	1,920	0.03	1.0	1.0	0.75	0.7	0.6	0.5	0.5
9.3	43	1,920	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
10.8	58	1,920	0.02	1.0	1.0	0.75	1.0	0.9	0.8	0.7
12.3	46	1,920	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
13.8	52	1,920	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
15.3	50	1,920	0.02	1.0	1.0	0.75	0.7	0.6	0.6	0.5
16.8	70	1,920	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
18.3	100	1,920	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	100	1,920	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

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Groundwater was encountered at a depth of 6.00 meters in the borehole no. BH-9.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	29	1,910	0.05	1.0	1.0	0.75	1.2	1.0	0.9	0.8
3.3	32	1,910	0.04	1.0	1.0	0.75	1.0	0.8	0.7	0.6
4.8	25	1,910	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.40
6.3	31	1,910	0.03	1.0	1.0	0.75	0.7	0.6	0.5	0.4
7.8	45	1,910	0.03	1.0	1.0	0.75	0.9	0.7	0.7	0.6
9.3	42	1,910	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
10.8	56	1,910	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.6
12.3	43	1,910	0.02	1.0	1.0	0.75	0.7	0.5	0.5	0.4
13.8	57	1,910	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
15.3	100	1,910	0.02	1.0	1.0	0.75	1.5	1.2	1.1	0.9
16.8	100	1,910	0.02	1.0	1.0	0.75	1.3	1.1	1.0	0.9
18.3	100	1,910	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	100	1,910	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

Groundwater was encountered at a depth of 5.50 meters in the borehole no. BH-10.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	16	1,890	0.05	1.0	1.0	0.75	0.7	0.5	0.5	0.4
3.3	38	1,890	0.04	1.0	1.0	0.75	1.2	0.9	0.9	0.7
4.8	32	1,890	0.03	1.0	1.0	0.75	0.8	0.7	0.6	0.52
6.3	36	1,890	0.03	1.0	1.0	0.75	0.8	0.6	0.6	0.5
7.8	42	1,890	0.03	1.0	1.0	0.75	0.8	0.7	0.6	0.5
9.3	50	1,890	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
10.8	60	1,890	0.02	1.0	1.0	0.75	1.1	0.9	0.8	0.7
12.3	55	1,890	0.02	1.0	1.0	0.75	0.9	0.7	0.6	0.6
13.8	100	1,890	0.02	1.0	1.0	0.75	1.5	1.2	1.1	1.0
15.3	100	1,890	0.02	1.0	1.0	0.75	1.5	1.2	1.1	1.0
16.8	37	1,890	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
18.3	39	1,890	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
19.8	45	1,890	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4

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Groundwater was encountered at a depth of 3.70 meters in the borehole no. BH-11.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	14	1,890	0.05	1.0	1.0	0.75	0.6	0.5	0.4	0.4
3.3	16	1,890	0.04	1.0	1.0	0.75	0.5	0.4	0.4	0.3
4.8	20	1,890	0.03	1.0	1.0	0.75	0.5	0.4	0.4	0.32
6.3	22	1,890	0.03	1.0	1.0	0.75	0.5	0.4	0.4	0.3
7.8	33	1,890	0.03	1.0	1.0	0.75	0.7	0.5	0.5	0.4
9.3	42	1,890	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
10.8	47	1,890	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
12.3	50	1,890	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
13.8	48	1,890	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
15.3	46	1,890	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.4
16.8	51	1,890	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.4
18.3	60	1,890	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
19.8	65	1,890	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
21.3	66	1,890	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5

Groundwater was encountered at a depth of 4.00 meters in the borehole no. BH-12.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	14	1,890	0.05	1.0	1.0	0.75	0.6	0.5	0.4	0.4
3.3	18	1,890	0.04	1.0	1.0	0.75	0.5	0.4	0.4	0.4
4.8	20	1,890	0.03	1.0	1.0	0.75	0.5	0.4	0.4	0.32
6.3	26	1,890	0.03	1.0	1.0	0.75	0.6	0.5	0.4	0.4
7.8	39	1,890	0.03	1.0	1.0	0.75	0.8	0.6	0.6	0.5
9.3	50	1,890	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
10.8	51	1,890	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
12.3	59	1,890	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
13.8	43	1,890	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
15.3	49	1,890	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
16.8	50	1,890	0.02	1.0	1.0	0.75	0.7	0.5	0.5	0.4
18.3	47	1,890	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
19.8	63	1,890	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5

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Groundwater was encountered at a depth of 3.50 meters in the borehole no. BH-13.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	13	1,890	0.05	1.0	1.0	0.75	0.5	0.4	0.4	0.3
3.3	14	1,890	0.04	1.0	1.0	0.75	0.4	0.3	0.3	0.3
4.8	21	1,890	0.03	1.0	1.0	0.75	0.5	0.4	0.4	0.34
6.3	32	1,890	0.03	1.0	1.0	0.75	0.7	0.6	0.5	0.5
7.8	41	1,890	0.03	1.0	1.0	0.75	0.8	0.7	0.6	0.5
9.3	100	1,890	0.02	1.0	1.0	0.75	1.8	1.5	1.4	1.2
10.8	41	1,890	0.02	1.0	1.0	0.75	0.7	0.6	0.6	0.5
12.3	52	1,890	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
13.8	52	1,890	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
15.3	66	1,890	0.02	1.0	1.0	0.75	1.0	0.8	0.7	0.6
16.8	62	1,890	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
18.3	73	1,890	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
19.8	87	1,890	0.02	1.0	1.0	0.75	1.1	0.9	0.8	0.7

Groundwater was encountered at a depth of 3.20 meters in the borehole no. BH-14.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	16	1,900	0.05	1.0	1.0	0.75	0.7	0.5	0.5	0.4
3.3	30	1,900	0.04	1.0	1.0	0.75	0.9	0.7	0.7	0.6
4.8	25	1,900	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.40
6.3	26	1,900	0.03	1.0	1.0	0.75	0.6	0.5	0.4	0.4
7.8	38	1,900	0.03	1.0	1.0	0.75	0.7	0.6	0.6	0.5
9.3	48	1,900	0.02	1.0	1.0	0.75	0.9	0.7	0.6	0.6
10.8	58	1,900	0.02	1.0	1.0	0.75	1.0	0.9	0.8	0.7
12.3	56	1,900	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
13.8	62	1,900	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
15.3	68	1,900	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.6
16.8	69	1,900	0.02	1.0	1.0	0.75	0.9	0.8	0.7	0.6
18.3	65	1,900	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
19.8	72	1,900	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6

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Groundwater was encountered at a depth of 3.20 meters in the borehole no. BH-15.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	15	1,900	0.05	1.0	1.0	0.75	0.6	0.5	0.5	0.4
3.3	31	1,900	0.04	1.0	1.0	0.75	0.9	0.8	0.7	0.6
4.8	36	1,900	0.03	1.0	1.0	0.75	0.9	0.7	0.7	0.58
6.3	41	1,900	0.03	1.0	1.0	0.75	0.9	0.7	0.7	0.6
7.8	26	1,900	0.03	1.0	1.0	0.75	0.5	0.4	0.4	0.3
9.3	29	1,900	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
10.8	32	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
12.3	32	1,900	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
13.8	35	1,900	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
15.3	38	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
16.8	42	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
18.3	49	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
19.8	60	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.6	0.5
21.3	60	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5

Groundwater was encountered at a depth of 3.50 meters in the borehole no. BH-16.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	12	1,900	0.05	1.0	1.0	0.75	0.5	0.4	0.4	0.3
3.3	15	1,900	0.04	1.0	1.0	0.75	0.5	0.4	0.3	0.3
4.8	22	1,900	0.03	1.0	1.0	0.75	0.6	0.5	0.4	0.35
6.3	70	1,900	0.03	1.0	1.0	0.75	1.5	1.3	1.1	1.0
7.8	27	1,900	0.03	1.0	1.0	0.75	0.5	0.4	0.4	0.3
9.3	30	1,900	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
10.8	41	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.6	0.5
12.3	46	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
13.8	48	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
15.3	52	1,900	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
16.8	55	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.6	0.5
18.3	77	1,900	0.02	1.0	1.0	0.75	1.0	0.8	0.7	0.6
	100	1,900	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

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Groundwater was encountered at a depth of 3.20 meters in the borehole no. BH-17.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	11	1,900	0.05	1.0	1.0	0.75	0.5	0.4	0.3	0.3
3.3	12	1,900	0.04	1.0	1.0	0.75	0.4	0.3	0.3	0.2
4.8	15	1,900	0.03	1.0	1.0	0.75	0.4	0.3	0.3	0.24
6.3	18	1,900	0.03	1.0	1.0	0.75	0.4	0.3	0.3	0.3
7.8	33	1,900	0.03	1.0	1.0	0.75	0.6	0.5	0.5	0.4
9.3	50	1,900	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
10.8	48	1,900	0.02	1.0	1.0	0.75	0.9	0.7	0.6	0.6
12.3	49	1,900	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
13.8	43	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
15.3	40	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
16.8	54	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
18.3	65	1,900	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
19.8	58	1,900	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.5
21.3	49	1,900	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4

Groundwater was encountered at a depth of 3.70 meters in the borehole no. BH-18.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	11	1,920	0.05	1.0	1.0	0.75	0.4	0.4	0.3	0.3
3.3	12	1,920	0.04	1.0	1.0	0.75	0.4	0.3	0.3	0.2
4.8	18	1,920	0.03	1.0	1.0	0.75	0.4	0.4	0.3	0.29
6.3	23	1,920	0.03	1.0	1.0	0.75	0.5	0.4	0.4	0.3
7.8	29	1,920	0.03	1.0	1.0	0.75	0.6	0.5	0.4	0.4
9.3	76	1,920	0.02	1.0	1.0	0.75	1.4	1.1	1.0	0.9
10.8	49	1,920	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
12.3	57	1,920	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
13.8	43	1,920	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
15.3	45	1,920	0.02	1.0	1.0	0.75	0.7	0.5	0.5	0.4
16.8	52	1,920	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.4
18.3	100	1,920	0.02	1.0	1.0	0.75	1.3	1.0	1.0	0.8
19.8	84	1,920	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.7
21.3	56	1,920	0.02	1.0	1.0	0.75	0.7	0.5	0.5	0.4

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Groundwater was encountered at a depth of 3.50 meters in the borehole no. BH-AR01.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	15	1,930	0.05	1.0	1.0	0.75	0.6	0.5	0.5	0.4
3.3	18	1,930	0.04	1.0	1.0	0.75	0.5	0.4	0.4	0.3
4.8	24	1,930	0.03	1.0	1.0	0.75	0.6	0.5	0.4	0.38
6.3	53	1,930	0.03	1.0	1.0	0.75	1.2	0.9	0.9	0.7
7.8	62	1,930	0.03	1.0	1.0	0.75	1.2	1.0	0.9	0.8
9.3	100	1,930	0.02	1.0	1.0	0.75	1.8	1.5	1.3	1.1
10.8	45	1,930	0.02	1.0	1.0	0.75	0.8	0.7	0.6	0.5
12.3	57	1,930	0.02	1.0	1.0	0.75	0.9	0.7	0.7	0.6
13.8	37	1,930	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
15.3	34	1,930	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
16.8	40	1,930	0.02	1.0	1.0	0.75	0.5	0.4	0.4	0.3
18.3	48	1,930	0.02	1.0	1.0	0.75	0.6	0.5	0.5	0.4
19.8	57	1,930	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.4
21.3	100	1,930	0.02	1.0	1.0	0.75	1.2	1.0	0.9	0.8

Groundwater was encountered at a depth of 3.70 meters in the borehole no. BH-AR02.

AD	SPT (Field)	γ (gr/cm3)	CN	CB	CS	CR	SPT (flat)	N55	N1(60)	N (X)
1.8	13	1,920	0.05	1.0	1.0	0.75	0.5	0.4	0.4	0.3
3.3	17	1,920	0.04	1.0	1.0	0.75	0.5	0.4	0.4	0.3
4.8	17	1,920	0.03	1.0	1.0	0.75	0.4	0.3	0.3	0.27
6.3	16	1,920	0.03	1.0	1.0	0.75	0.3	0.3	0.3	0.2
7.8	21	1,920	0.03	1.0	1.0	0.75	0.4	0.3	0.3	0.3
9.3	25	1,920	0.02	1.0	1.0	0.75	0.4	0.4	0.3	0.3
10.8	43	1,920	0.02	1.0	1.0	0.75	0.8	0.6	0.6	0.5
12.3	63	1,920	0.02	1.0	1.0	0.75	1.0	0.8	0.7	0.6
13.8	69	1,920	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.7
15.3	100	1,920	0.02	1.0	1.0	0.75	1.5	1.2	1.1	0.9
16.8	42	1,920	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
18.3	80	1,920	0.02	1.0	1.0	0.75	1.0	0.8	0.8	0.7
19.8	46	1,920	0.02	1.0	1.0	0.75	0.6	0.5	0.4	0.4
21.3	58	1,920	0.02	1.0	1.0	0.75	0.7	0.6	0.5	0.4

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Groundwater was encountered at a depth of 10.00 meters in the borehole no. BH-AR03.

SPT-N (N/30 cm)	Safe Bearing Capacity (qu) (kg/cm^2)	CONSISTENCY
> 2	> 0.25	Very soft
2 – 4	0.25 – 0.50	Soft
4 – 8	0.50 – 1.00	Average
8 – 15	1.00 – 2.00	Stiff
15 – 30	2.00 – 4.00	Very stiff
> 30	> 4.00	Hard

Table 24: The relationship between impact number, bearing capacity and consistency in cohesive soils. (Terzaghi and Peck)

(N) Number of Blows	Relative firmness	Relative density
4>	0.15>	Very loose
4-10	0.15-0.35	Loose
10-30	0.35-0.65	Average
30-50	0.65-0.85	Tight
50<	0.85>	Very tight

Table 25: The relationship between the number of impacts and the relative density in cohesionless soils. (Terzaghi and Peck)

3.4.2. Pressuremeter Test

It is performed to determine the strength parameters of the soil and as a result, to determine the bearing capacity of the soil, the amount of settlement that will occur under the foundation as well as different settlements, and to calculate the safety stress of the foundation-soil by using MENARD formulations. It is applied on gravelly, sandy, clayey, silty alluvial soils and weathered rocks and soft rock foundations. The soil is deformed using compressed air or nitrogen gas in the drilled boreholes. Pressuremeter test data is filled in a table and Menard1 formulations are used in the calculations. The depth of the tests as well as the frequency of construction are determined according to the project characteristics and soil conditions.
Results are presented in the form of tables and graphs.

As a result of the tests performed;

1-Pressuremeter; for foundation soil surveys,
a- The strength parameters of the soil (Pa, Pf, Pl, E, C, Q, G) are determined.
b- The bearing capacity of the soil and the soil safety stress are determined.
c- If the load to be applied to the soil is known, settlements that may occur on the foundation soil under this load are determined.
2- With the pressuremeter test, the excavation limit is determined in gradients, alluvium, filling and all kinds of pickling works.
3- Slope stability surveys can be performed using a pressuremeter. For this, slip zones are determined and slope analyzes are performed using pressuremeter data.
4- In galleries and tunnels, effective loads can be calculated by determining the relaxation limit occurring around the gallery or tunnel by drilling holes on a section and performing one test at every meter.
5- The injection efficiency coefficient can be calculated by performing tests before and after the injection.
6- After the fillings are compressed, their load bearing capacity can be determined by performing a test.

I - Pressure meter Tester

The test is carried out with a Menard Type pressure meter, which consists of a cylindrical probe that creates circular deformation on the soil by applying circular pressure, and a control panel connected to it. Menard Type pressure meter;

- Surface measuring device
- Probe
- It consists of plastic pipes that transmit the pressure given from the borehole head.

Surface measuring device

It consists of manometers showing the values of pressure applied to the probe lowered into the drilled hole; volume meters showing the volumetric changes at the test level under the applied pressure; and compressed air or NO2 tubes with 200 kg/cm^2 pressure, supplying the pressure. In addition, there are hoods, valves, and sockets for applying the desired pressure with the water supplied to the probe lowered into the borehole. This equipment is enclosed in a protective box.

Probe;

It allows the test to be performed at the desired level. It consists of 3 cells. The bottom and top cells are protective cells, and the middle cell acts as a measuring cell. The protective and measuring cells in a rubber sheath are connected to separate volume meters, and equal amounts of water are supplied into the three cells. The test is completed by supplying air between the rubber sheath and the cells through a separate air duct so that the water returns after the test, to ensure that the probe is not stuck in the borehole and can be easily removed from the borehole.

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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Pipes that supply pressure:

They are plastic pipes that provide the connection of the probe with the above-ground measuring devices.

II - Conducting the pressure meter test

In the standard GB type pressure meter, the effective pressure is 70 kg/cm^2, and the soil and rock deformation modules between 5-10000 kg/cm^2 are measured.

Pressures are supplied through NO2 tubes and plastic pipes; the pressure increase and thus the volume increase in the measuring cell is monitored, while the volume increase is monitored by the rise in the liquid column in the volume meter. By gradually applying 1, 2, 3 kg/cm^2 and increasing circular pressures to the probe placed in the borehole, the volumetric changes occurring in the measuring cell are recorded within 15-30-60 seconds for each pressure level. After the necessary corrections are performed, “Pressure to the x-axis”, “Volume changes to the y-axis in usually 60 seconds” are marked on a graph.

The first segment of rise in the graph indicates that the probe is seated onto the soil and shows the internal pressure P0 of the soil. This phase of the curve, which then becomes linear, is referred to as the “elastic phase”. With the help of graphics, the Menard Elastic Modulus (Em) is determined for each level. After this elastic phase, the curve starts to rise, from which point the “plastic phase” of the unit under test begins.

The pressure limit (PL) is the point where the volumetric increases theoretically reach an infinite value, and this value theoretically corresponds to the “Final bearing capacity” of the section tested.

BOREHOLE NO.	DEPTH	PL	P_L*	E_M
BH-1	5.00	9.69	6.49	178.10
BH-1	10.00	10.14	7.38	241.57
BH-1	15.00	14.47	10.25	295.44
BH-1	20.00	14.54	10.40	314.61
BH-1	25.00	15.52	12.36	345.17
BH-2	5.00	8.37	6.20	163.77
BH-2	10.00	10.72	7.50	223.10
BH-2	15.00	14.54	11.42	320.70
BH-2	20.00	15.67	11.51	351.80
BH-2	25.00	15.81	12.46	369.18
BH-3	5.00	8.54	6.21	152.47
BH-3	10.00	10.59	7.37	218.73
BH-3	15.00	11.69	8.33	242.87

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ÇERKEZKÖY/TEKİRDAĞ
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BH-3	20.00	15.63	12.41	339.93
BH-3	25.00	9.81	7.41	193.71
BH-3	30.00	10.90	7.57	229.24
BH-3	35.00	15.80	12.47	342.24
BH-3	40.00	15.51	12.44	366.35
BH-3	45.00	16.84	13.51	396.94
BH-3	50.00	16.93	13.53	405.96
BH-4	5.00	7.60	5.84	143.25
BH-4	10.00	10.75	7.41	215.36
BH-4	15.00	9.85	6.52	181.95
BH-4	20.00	13.86	10.51	319.00
BH-4	25.00	9.61	7.31	186.09
BH-5	5.00	7.74	5.40	132.87
BH-5	10.00	9.46	7.33	185.09
BH-5	15.00	12.63	9.50	281.67
BH-5	20.00	9.77	7.46	188.77
BH-5	25.00	9.92	7.46	194.39
BH-6	5.00	7.49	5.80	140.80
BH-6	10.00	11.61	8.32	234.72
BH-6	15.00	12.27	9.41	265.53
BH-6	20.00	15.62	12.48	367.41
BH-6	25.00	15.68	12.52	397.24
BH-7	5.00	7.00	5.95	150.46
BH-7	10.00	8.54	6.24	156.43
BH-7	15.00	15.76	13.48	402.87
BH-7	20.00	15.68	12.49	386.07
BH-7	25.00	16.70	13.43	429.74
BH-7	30.00	11.72	8.42	234.06
BH-7	35.00	15.94	12.48	400.92
BH-7	40.00	16.12	13.54	449.28
BH-7	45.00	16.98	13.57	463.51
BH-7	50.00	16.90	13.54	482.57
BH-8	5.00	7.72	5.90	140.84
BH-8	10.00	8.69	6.47	167.77
BH-8	15.00	10.57	7.47	225.18

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-8	20.00	12.25	9.33	266.53
BH-8	25.00	9.73	7.31	192.92
BH-9	5.00	7.09	5.85	151.22
BH-9	10.00	10.81	7.49	203.60
BH-9	15.00	10.59	7.34	198.34
BH-9	20.00	15.81	12.48	396.73
BH-10	5.00	7.64	5.89	143.43
BH-10	10.00	9.36	7.28	188.06
BH-10	15.00	15.60	12.48	384.65
BH-10	20.00	15.66	12.49	405.30
BH-11	5.00	8.53	6.41	165.84
BH-11	10.00	10.46	7.40	215.21
BH-11	15.00	15.73	12.45	384.61
BH-11	20.00	9.69	8.32	195.84
BH-12	5.00	6.83	5.37	124.04
BH-12	10.00	8.72	6.39	154.39
BH-12	15.00	9.51	7.30	185.56
BH-12	20.00	11.63	8.39	229.76
BH-12	25.00	11.84	8.50	231.34
BH-12	30.00	12.24	9.43	263.77
BH-12	35.00	14.57	11.38	341.90
BH-13	5.00	7.92	5.43	135.05
BH-13	10.00	10.83	7.45	213.36
BH-13	15.00	9.91	7.41	198.28
BH-13	20.00	11.96	8.47	247.55
BH-14	5.00	7.74	6.36	136.67
BH-14	10.00	9.94	7.48	201.26
BH-14	15.00	11.96	8.47	247.55
BH-14	20.00	13.92	10.37	299.75
BH-15	5.00	6.76	5.43	140.86
BH-15	10.00	8.50	6.41	167.02
BH-15	15.00	11.54	8.31	247.23
BH-15	20.00	12.39	9.41	272.94
BH-16	5.00	8.99	6.46	169.14
BH-16	10.00	7.50	6.22	149.45

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-16	15.00	8.82	6.51	179.44
BH-16	20.00	10.72	8.42	234.10
BH-16	25.00	10.61	7.43	216.82
BH-16	30.00	11.54	8.33	267.39
BH-16	35.00	12.80	10.49	308.09
BH-17	5.00	7.44	5.87	149.92
BH-17	10.00	8.62	6.33	164.98
BH-17	15.00	10.666	7.44	207.25
BH-17	20.00	15.57	11.45	363.04
BH-18	5.00	6.40	5.21	118.08
BH-18	10.00	10.69	7.49	224.25
BH-18	15.00	8.87	6.56	176.33
BH-18	20.00	10.59	7.33	216.48
BH-18	25.00	10.69	7.42	228.97
BH-18	30.00	13.73	10.50	315.03
BH-18	35.00	12.86	9.33	288.56
BH-AR01	5.00	7.74	5.40	132.87
BH-AR01	10.00	10.71	7.47	202.24
BH-AR01	15.00	11.05	8.30	238.53
BH-AR01	20.00	10.67	8.34	228.13
BH-AR01	25.00	11.05	8.30	238.53
BH-AR02	5.00	8.51	6.24	162.99
BH-AR02	10.00	9.85	7.46	194.67
BH-AR02	15.00	8.46	6.25	157.28
BH-AR02	20.00	12.76	9.44	287.38
BH-AR02	25.00	13.73	10.46	326.18
BH-AR02	30.00	15.65	12.45	393.20
BH-AR02	35.00	15.81	12.41	408.24
BH-AR02	40.00	16.80	13.47	463.60
BH-AR03	5.00	6.56	5.20	107.94
BH-AR03	10.00	7.02	5.91	154.52
BH-AR03	15.00	15.56	12.41	352.47
BH-AR03	20.00	10.60	7.39	215.44
BH-AR03	25.00	11.60	8.30	247.08

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Table 26: Values Obtained from Pressuremeter Test.

4. HYDROGEOLOGY

Due to the effect of surface and groundwater on rocks and soil, it is important to investigate the hydrogeological properties of the region during the selection of area for settlement. Precipitation waters cause groundwater levels to change, surface flooding, partial or complete saturation of slopes and lead to an increase in pore water pressure, resulting in mass movements.

Water increases the unit weight of the soil. It also chemically changes, weather and reduces the resistance of the material or rocks in the soil.

Among the damages caused by earthquakes on engineering structures, the most effective ones are the damages resulting from the liquefaction of water-saturated loose sand layers. When a water-saturated sand layer is subjected to earthquake vibrations, it tends to compress and decrease its volume; if drainage is not possible, the tendency to decrease the volume leads to an increase in pore water pressure. When this increase in pore water pressure reaches a level equal to the average ambient pressure, the effective stresses become zero, the sand layer loses its strength completely, and becomes liquefied.

In fine-grained soils, certain changes are observed depending on the water content. In such soils, as the water content increases, the plasticity of the soil also increases. As the plasticity of the soil increases, the potential for compaction and swelling increases, water permeability decreases, and difficulties are encountered during land excavation and filling operations.

Water was encountered at a depth of 3.20-10.00 meters in the boreholes with a depth of 20.00-50.00 m, which are drilled in the study area and equipped with PVC pipes.

5. LABORATORY TESTS AND ANALYSIS

The strength properties of the units can be found by performing laboratory tests on undisturbed samples (UD) or by performing field tests through correlation.

During the foundation drilling, cores were obtained from the SOIL units to determine the bearing capacity of the soil. The core samples taken from the drills were transferred to the Jeolab Soil Laboratory and subjected to various tests. The physical properties of the soil forming the study area and the laboratory test results of the samples taken from the foundation drilling are given below and detailed in the Annex.

NUMUNE / SAMPLE			SU İÇERİĞİ / Water content	DOĞAL BİRİM HACİM AĞIRLIK / Wet unit weight	ATTERBERG LİMİTLERİ/ATTERBERG LIMITS			ELEK ANALİZİ / Sieve Analysis		HİDROMETRE / HYDROMETRIC ANALYSIS		ZEMİN SINIFI / SOİL CLASS	ODOMETRE/ OEDOMETER	Şişme basıncı Swelling pressure	Şişme yüzdesi Swelling percentage	ÜÇ EKSENLİ BASINÇ DAYANIMI / TRIAXIAL COMPRESSION		KESME KUTUSU /SHEAR TEST	
Sondaj- No Boring No	NUMUNE NO /Sample №	DERİNLİK (m) Depth	w_n	g_n	LL	PL	PI	GRAVEL	SAND	SILT	CLAY					c	Ø	c	Ø
			%	gr/cm³	%	%	%	%	%	%	%			kg/cm²	%	kg/cm²	Degrees	kg/cm²	Degrees
BH-AR01	UD	2,50-3,00	18.88	1.92	46	39	7	0.76	28.24	38.20	32.80	SiM	+	0.05	0.58			0.39	7.53
BH-AR01	SPT	4,50-4,95	20.31		47	41	6	14.71	20.99	64.30		SiM							
BH-AR01	UD	5,50-6,00	16.55	1.92	49	42	7	5.13	28.53	34.65	31.69	SiM	+	0.05	0.56			0.75	7.01
BH-AR01	SPT	7,50-7,95	22.69		45	37	8	1.58	37.09	61.33		SiM							
BH-AR01	SPT	9,00-9,45	16.22		29	22	7	4.75	46.78	48.47		SiSa							
BH-AR01	SPT	10,50-10,95	17.30		27	20	7	3.45	56.41	40.14		SiSa							
BH-AR01	SPT	12,00-12,45	18.33		44	36	8	4.94	31.59	63.46		SiM							
BH-AR01	SPT	13,50-13,95	14.52		47	38	9	2.64	25.82	71.55		SiM							
BH-AR01	SPT	15,00-15,45	19.63		45	37	8	11.19	29.19	59.63		SiM							
BH-AR01	SPT	16,50-16,95	20.34		47	38	9	10.42	35.61	53.97		SiM							
BH-AR01	SPT	18,00-18,45	19.70		27	20	7	10.90	29.06	60.04		SiSa							
BH-AR01	SPT	19,50-19,95	20.33		26	17	9	13.97	53.96	32.07		SiSa							
BH-AR01	SPT	21,00-21,45	25.69		57	41	16	1.27	4.46	94.27		SİH							
BH-AR01	SPT	22,50-22,95	23.66		56	43	13	0.00	7.45	92.55		SİH							
BH-AR01	SPT	24,00-24,45	24.25		55	41	14	0.00	10.72	89.28		SİH							
BH-AR02	SPT	1,50-1,95	20.01		45	22	23	5.13	32.41	62.46		ClM							
BH-AR02	UD	2,50-3,00	20.72	1.94	41	21	20	12.79	36.71	26.40	24.10	ClM				0.68	8.19		
BH-AR02	SPT	4,50-4,95	22.36		26	13	13	6.07	48.65	45.28		ClSa							
BH-AR02	UD	5,50-6,00	26.61	1.93	42	35	7	4.27	26.85	34.94	33.95	SiM				0.64	7.90		
BH-AR02	SPT	7,50-7,95	23.28		45	36	9	2.15	33.68	64.17		SiM							
BH-AR02	SPT	9,00-9,45	21.02		48	42	6	3.41	38.22	58.38		SiM							
BH-AR02	SPT	10,50-10,95	20.90		45	38	7	4.75	34.06	61.19		SiM							
BH-AR02	SPT	12,00-12,45	27.00		56	44	12	2.74	6.03	91.23		SİH							
BH-AR02	UD	14,00-14,50	24.26	1.93	46	39	7	1.41	32.27	34.73	31.60	SiM				0.68	7.87		
BH-AR02	SPT	15,00-15,45	21.03		48	43	5	14.17	26.11	59.72		SiM							
BH-AR02	SPT	16,50-16,95	20.36		58	47	11	1.59	5.64	92.77		SiH							
BH-AR02	SPT	18,00-18,45	25.28		54	42	12	0.64	11.46	87.91		SiH							
BH-AR02	SPT	19,50-19,95	23.02		46	39	7	4.78	31.61	63.61		SiM							
BH-AR02	SPT	21,00-21,45	20.09		57	44	13	3.11	6.60	90.28		SiH							
BH-AR02	SPT	22,50-22,95	20.38		46	38	8	5.53	2.29	92.18		SiH							
BH-AR02	SPT	24,00-24,45	18.28		47	40	7	10.03	13.87	76.11		SiM							
BH-AR02	SPT	25,50-25,95	15.39		25	20	5	6.46	56.29	37.25		SiSa							
BH-AR02	SPT	27,00-27,45	15.18		NP	NP	NP	3.36	89.61	7.02		SaW							
BH-AR02	SPT	28,50-28,95	13.14		NP	NP	NP	14.09	76.81	9.10		SaW							

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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BH-AR02	CR	31,00-31,50	15.24		NP	NP	NP	10.44	86.30	3.26		SaW							
BH-AR02	CR	33,00-33,50	16.30		NP	NP	NP	12.01	83.48	4.50		SaW							
BH-AR02	CR	35,00-35,50	16.35		26	21	5	6.49	56.54	36.97		SiSa							
BH-AR02	CR	38,00-38,50	17.80		27	19	8	5.36	47.43	47.20		SiSa							
BH-AR02	CR	40,00-40,50	20.11		26	20	6	6.43	48.06	45.51		SiSa							
BH-AR03	UD	2,50-3,00	21.69	1.94	27	20	7	3.90	46.34	26.81	22.95	SiSa	+	0.06	0.57	0.68	8.78		
BH-AR03	SPT	4,50-4,95	26.27		47	21	26	10.17	20.29	69.54		CIM							
BH-AR03	UD	5,50-6,00	23.70	1.92	45	22	23	1.49	28.44	31.27	38.80	CIM	+	0.06	0.53			0.79	6.53
BH-AR03	SPT	7,50-7,95	21.07		43	38	5	5.62	29.86	64.53		SiM							
BH-AR03	UD	8,50-9,00	20.52	1.92	43	39	4	5.68	26.46	36.56	31.30	SiM	+	0.06	0.54			0.73	7.15
BH-AR03	SPT	10,50-10,95	22.00		27	21	6	1.66	23.47	74.87		SiM							
BH-AR03	SPT	12,00-12,45	18.58		25	19	6	3.43	47.94	48.63		SiSa							
BH-AR03	SPT	13,50-13,95	15.25		27	19	8	4.78	52.77	42.45		SiSa							
BH-AR03	SPT	15,00-15,45	20.39		27	20	7	5.68	52.60	41.72		SiSa							
BH-AR03	SPT	16,50-16,95	22.36		47	39	8	0.82	29.02	70.16		SiM							
BH-AR03	SPT	18,00-18,45	18.11		28	17	11	4.98	46.67	48.35		CISa							
BH-AR03	SPT	19,50-19,95	26.36		24	17	7	3.52	50.25	46.23		SiSa							
BH-AR03	SPT	21,00-21,45	23.25		58	43	15	1.60	6.83	91.57		SiH							
BH-AR03	SPT	22,50-22,95	22.52		46	24	22	4.89	26.89	68.23		CIM							
BH-AR03	SPT	24,00-24,45	20.87		45	38	7	3.86	30.30	65.83		SiM							
BH-1	UD	2,50-3,00	23.45	1.92	47	38	9	4.70	26.75	35.90	32.65	SiM	+	0.05	0.55	0.71	7.84		
BH-1	SPT	4,50-4,95	22.11		48	43	5	3.00	21.22	75.78		SiM							
BH-1	UD	5,50-6,00	25.55	1.91	43	34	9	4.91	27.67	35.28	32.15	SiM	+	0.05	0.58	0.76	7.90		
BH-1	SPT	7,50-7,95	20.35		47	39	8	0.59	35.50	63.91		SiM							
BH-1	UD	8,50-9,00	21.48	1.93	45	38	7	5.46	35.37	29.97	29.20	SiM	+	0.06	0.56	0.77	8.23		
BH-1	SPT	10,50-10,95	19.70		42	38	4	10.11	35.23	54.66		SiM							
BH-1	SPT	12,00-12,45	25.67		45	36	9	6.01	23.72	70.27		SiM							
BH-1	SPT	13,50-13,95	21.10		47	39	8	3.74	26.98	69.28		SiM							
BH-1	SPT	15,00-15,45	22.48		46	40	6	5.56	30.95	63.49		SiM							
BH-1	SPT	16,50-16,95	17.48		26	19	7	15.66	24.02	60.32		SiL							
BH-1	SPT	18,00-18,45	15.60		27	19	8	9.62	46.77	43.61		SiSa							
BH-1	SPT	19,50-19,95	18.99		28	20	8	8.77	43.18	48.05		SiSa							
BH-1	SPT	21,00-21,45	20.39		47	40	7	3.74	29.21	67.05		SiM							
BH-1	SPT	22,50-22,95	25.67		56	43	13	0.00	10.05	89.95		SiH							
BH-1	SPT	24,00-24,45	27.17		57	45	12	4.85	11.56	83.60		SiH							
BH-2	UD	2,50-3,00	25.28	1.92	45	38	7	6.12	24.82	36.16	32.90	SiM	+	0.06	0.56	0.73	7.50		
BH-2	SPT	4,50-4,95	23.05		28	20	8	13.75	39.23	47.02		SiSa							
BH-2	UD	5,50-6,00	21.46	1.94	25	18	7	5.46	45.25	26.59	22.70	SiSa	+	0.06	0.60	0.71	7.45		
BH-2	SPT	7,50-7,95	20.02		29	23	6	4.96	47.68	47.36		SiSa							
BH-2	UD	8,50-9,00	19.51	1.95	44	38	6	4.91	39.41	28.24	27.45	SiM	+	0.06	0.59	0.70	8.35		
BH-2	SPT	10,50-10,95	25.20		43	38	5	1.58	30.47	67.95		SiM							
BH-2	SPT	12,00-12,45	21.06		48	40	8	5.70	39.81	54.49		SiM							
BH-2	SPT	13,50-13,95	17.12		26	19	7	17.44	29.36	53.20		SiL							
BH-2	SPT	15,00-15,45	23.28		25	19	6	13.88	48.12	38.00		SiSa							
BH-2	SPT	16,50-16,95	20.07		27	22	5	4.05	48.70	47.25		SiSa							
BH-2	SPT	18,00-18,45	23.10		25	20	5	9.62	48.14	42.25		SiSa							
BH-2	SPT	21,00-21,45	18.67		24	18	6	15.31	22.35	62.34		SiL							
BH-2	SPT	22,50-22,95	19.72		25	18	7	22.88	17.23	59.89		SiL							
BH-2	SPT	24,00-24,45	28.70		45	22	23	0.00	23.96	76.04		CIM							
BH-3	UD	2,50-3,00	22.53	1.91	46	24	22	5.45	22.66	35.40	36.49	CIM	+	0.05	0.61	0.72	8.65		
BH-3	SPT	4,50-4,95	21.05		45	35	10	4.75	29.72	65.52		SiM							
BH-3	UD	5,50-6,00	23.40	1.92	42	34	8	4.33	28.04	34.33	33.30	SiM	+	0.05	0.60	0.73	9.72		
BH-3	SPT	7,50-7,95	23.24		27	20	7	7.26	50.37	42.37		SiSa							
BH-3	UD	8,50-9,00	17.59	1.93	25	19	6	5.46	33.44	31.95	29.15	SiSa	+	0.06	0.56			0.35	7.76
BH-3	SPT	10,50-10,95	19.30		27	18	9	4.95	25.77	69.28		SiSa							
BH-3	SPT	12,00-12,45	22.35		47	41	6	7.66	19.07	73.27		SiM							
BH-3	SPT	13,50-13,95	23.17		43	38	5	11.79	24.26	63.95		SiM							
BH-3	SPT	15,00-15,45	24.18		48	39	9	12.73	14.63	72.64		SiM							
BH-3	SPT	16,50-16,95	23.25		26	18	8	13.95	29.26	56.79		SiL							
BH-3	SPT	18,00-18,45	21.06		25	19	6	16.13	47.31	36.56		SiSa							
BH-3	SPT	19,50-19,95	20.08		46	39	7	6.45	26.66	66.89		SiM							
BH-3	SPT	21,00-21,45	25.17		45	37	8	4.46	38.31	57.24		SiM							
BH-3	SPT	22,50-22,95	26.27		48	40	8	16.38	18.90	64.71		SiM							

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-3	SPT	24,00-24,45	23.04		46	37	9	1.76	44.36	53.88		SiM							
BH-3	SPT	25,50-25,95	17.12		57	44	13	4.46	6.29	89.25		SİH							
BH-3	SPT	27,00-27,45	21.90		42	35	7	5.64	39.38	54.98		SiM							
BH-3	SPT	28,50-28,95	22.18		47	40	7	8.34	30.70	60.97		SiM							
BH-3	SPT	30,00-30,45	17.10		45	37	8	7.16	30.74	62.10		SiM							
BH-3	SPT	31,50-31,95	19.72		42	34	8	3.87	27.79	68.35		SiM							
BH-3	SPT	33,00-33,45	16.25		NP	NP	NP	4.63	88.19	7.18		SaW							
BH-3	SPT	34,50-34,95	15.14		NP	NP	NP	3.56	93.41	3.03		SaW							
BH-3	SPT	36,00-36,45	13.18		NP	NP	NP	9.71	83.15	7.13		SaW							
BH-3	CR	39,00-39,50	15.11		NP	NP	NP	7.40	82.66	9.93		SaW							
BH-3	CR	41,00-41,50	19.37		46	39	7	2.59	35.58	61.84		SiM							
BH-3	CR	44,00-44,50	18.57		26	19	7	4.67	45.88	49.45		SiSa							
BH-3	CR	47,00-47,50	31.05		25	21	4	5.38	56.36	38.26		SiSa							
BH-3	CR	50,00-50,50	20.19		24	18	6	22.34	44.33	33.33		SiSa							
BH-4	UD	2,50-3,00	15.63	1.94	28	21	7	8.05	43.50	26.10	22.35	SiSa	+	0.06	0.54			0.75	9.30
BH-4	SPT	4,50-4,95	24.22		45	36	9	2.72	31.18	66.11		SiM							
BH-4	UD	5,50-6,00	22.63	1.93	47	42	5	5.42	38.83	29.14	26.60	SiM	+	0.05	0.60			0.71	8.02
BH-4	SPT	7,50-7,95	21.06		42	36	6	2.77	41.34	55.89		SiM							
BH-4	SPT	9,00-9,45	18.71		27	20	7	10.09	49.94	39.96		SiSa							
BH-4	SPT	10,50-10,95	17.44		46	37	9	7.07	30.46	62.46		SiM							
BH-4	SPT	12,00-12,45	16.17		27	22	5	9.70	50.56	39.74		SiSa							
BH-4	SPT	13,50-13,95	22.39		47	36	11	3.39	25.23	71.39		SiM							
BH-4	UD	14,50-15,00	20.39	1.94	48	41	7	6.30	28.19	34.27	31.25	SiM	+	0.06	0.56			0.71	7.49
BH-4	SPT	16,50-16,95	22.06		42	37	5	1.52	45.16	53.33		SiM							
BH-4	SPT	18,00-18,45	20.17		49	40	9	0.00	22.59	77.41		SiM							
BH-4	SPT	19,50-19,95	16.57		25	20	5	7.24	51.91	40.85		SiSa							
BH-4	SPT	21,00-21,45	24.14		47	39	8	10.90	22.15	66.95		SiM							
BH-4	SPT	22,50-22,95	25.29		57	42	15	0.71	10.77	88.51		SİH							
BH-4	SPT	24,00-24,45	26.18		58	46	12	0.00	5.64	94.36		SİH							
BH-5	SPT	1,50-1,95	26.36		45	23	22	4.29	25.43	70.28		CIM							
BH-5	UD	2,50-3,00	25.49	1.92	47	21	26	3.45	26.80	34.75	35.00	CIM	+	0.05	0.58	0.72	7.92		
BH-5	SPT	4,50-4,95	21.03		46	39	7	11.04	23.26	65.70		SiM							
BH-5	UD	5,50-6,00	21.54	1.92	42	36	6	3.48	26.31	35.62	34.60	SiM	+	0.06	0.58	0.74	7.99		
BH-5	SPT	7,50-7,95	20.09		47	40	7	8.45	22.48	69.07		SiM							
BH-5	SPT	9,00-9,45	19.57		43	38	5	13.26	20.94	65.80		SiM							
BH-5	SPT	10,50-10,95	24.18		47	38	9	7.34	20.67	71.99		SiM							
BH-5	SPT	12,00-12,45	20.10		42	35	7	3.05	34.90	62.05		SiM							
BH-5	SPT	13,50-13,95	17.10		25	20	5	4.39	57.35	38.26		SiSa							
BH-5	SPT	15,00-15,45	19.38		23	16	7	5.19	53.93	40.88		SiSa							
BH-5	SPT	16,50-16,95	17.52		44	38	6	4.75	38.89	56.36		SiM							
BH-5	SPT	18,00-18,45	19.00		47	39	8	5.72	31.83	62.45		SiM							
BH-5	SPT	19,50-19,95	17.53		49	40	9	4.46	23.46	72.08		SiM							
BH-5	SPT	21,00-21,45	26.98		57	44	13	6.18	13.54	80.28		SİH							
BH-5	SPT	22,50-22,95	27.42		55	44	11	0.83	12.30	86.87		SİH							
BH-5	SPT	24,00-24,45	26.19		52	38	14	1.67	13.73	84.60		SİH							
BH-6	UD	2,50-3,00	15.65	1.94	27	20	7	3.76	49.83	25.00	21.40	SiSa	+	0.05	0.56			0.36	8.82
BH-6	SPT	4,50-4,95	23.25		47	38	9	5.45	33.42	61.13		SiM							
BH-6	UD	5,50-6,00	23.17	1.92	45	39	6	8.78	24.75	35.83	30.65	SiM	+	0.05	0.59			0.41	7.76
BH-6	SPT	7,50-7,95	17.15		26	22	4	14.33	37.30	48.37		SiSa							
BH-6	SPT	9,00-9,45	18.67		29	14	15	9.83	40.81	49.37		CISa							
BH-6	SPT	10,50-10,95	20.51		25	18	7	8.73	30.58	60.69		SiM							
BH-6	SPT	12,00-12,45	18.55		27	22	5	4.39	28.06	67.56		SiM							
BH-6	SPT	13,50-13,95	21.35		25	18	7	3.38	20.74	75.88		SiM							
BH-6	SPT	15,00-15,45	19.77		28	21	7	4.25	23.81	71.93		SiM							
BH-6	SPT	16,50-16,95	18.54		26	20	6	5.69	58.74	35.57		SiSa							
BH-6	SPT	18,00-18,45	17.18		23	18	5	4.50	62.86	32.64		SiSa							
BH-6	SPT	19,50-19,95	20.39		27	19	8	15.38	36.82	47.80		SiSa							
BH-6	SPT	21,00-21,45	18.27		25	20	5	0.14	63.64	36.22		SiSa							
BH-6	SPT	22,50-22,95	21.05		26	19	7	4.98	54.72	40.30		SiSa							
BH-6	SPT	24,00-24,45	18.60		27	19	8	10.94	39.95	49.11		SiSa							

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-7	UD	2,50-3,00	24.58	1.92	45	38	7	1.57	25.65	39.28	33.50	SİM	+	0.06	0.51	0.73	7.19		
BH-7	SPT	4,50-4,95	23.25		48	42	6	4.49	25.81	69.69		SİM							
BH-7	UD	5,50-6,00	21.60	1.94	26	18	8	5.16	47.10	25.70	22.05	SiSa	+	0.06	0.56	0.68	8.70		
BH-7	SPT	7,50-7,95	23.70		48	41	7	9.77	23.87	66.36		SİM							
BH-7	UD	8,50-9,00	21.90	1.92	44	38	6	6.84	21.36	37.59	34.20	SİM	+	0.07	0.55	0.74	7.85		
BH-7	SPT	10,50-10,95	26.28		45	39	6	4.19	31.55	64.26		SİM							
BH-7	SPT	12,00-12,45	23.66		47	43	4	7.36	33.45	59.19		SİM							
BH-7	SPT	13,50-13,95	16.70		26	19	7	9.71	54.59	35.70		SiSa							
BH-7	SPT	15,00-15,45	19.68		24	19	5	9.00	47.20	43.79		SiSa							
BH-7	SPT	16,50-16,95	20.57		28	20	8	14.03	37.77	48.20		SiSa							
BH-7	SPT	18,00-18,45	17.55		26	18	8	1.51	52.27	46.21		SiSa							
BH-7	SPT	19,50-19,95	16.28		25	15	10	6.86	48.31	44.83		SiSa							
BH-7	SPT	21,00-21,45	20.08		27	20	7	8.35	44.85	46.80		SiSa							
BH-7	SPT	22,50-22,95	25.25		47	39	8	2.75	21.69	75.56		SİM							
BH-7	SPT	24,00-24,45	26.20		57	44	13	1.58	4.68	93.74		SİH							
BH-7	SPT	25,50-25,95	17.25		27	22	5	22.35	27.48	50.17		SİL							
BH-7	SPT	27,00-27,45	23.30		47	39	8	6.83	19.07	74.10		SİM							
BH-7	SPT	28,50-28,95	26.07		56	43	13	4.62	6.45	88.93		SiH							
BH-7	SPT	30,00-30,45	26.22		55	44	11	4.78	5.69	89.53		SiH							
BH-7	SPT	31,50-31,95	24.29		58	43	15	3.50	5.83	90.67		SiH							
BH-7	SPT	33,00-33,45	21.05		24	17	7	11.08	44.91	44.01		SiSa							
BH-7	SPT	34,50-34,95	20.25		27	20	7	7.67	43.95	48.38		SiSa							
BH-7	SPT	36,00-36,45	24.15		25	19	6	9.12	41.41	49.46		SiSa							
BH-7	CR	38,00-38,50	19.57		24	19	5	8.76	61.33	29.91		SiSa							
BH-7	CR	40,00-40,50	15.24		23	17	6	13.60	43.89	42.51		SiSa							
BH-7	CR	42,00-42,50	18.99		25	18	7	13.22	56.68	30.10		SiSa							
BH-7	CR	44,00-44,50	17.68		23	16	7	10.23	52.50	37.27		SiSa							
BH-7	CR	46,00-46,50	21.03		28	19	9	15.77	32.11	52.12		SiL							
BH-7	CR	48,00-48,50	20.10		25	17	8	4.48	55.66	39.85		SiSa							
BH-7	CR	50,00-50,50	23.28		26	20	6	9.70	53.29	37.01		SiSa							
BH-8	UD	2,50-3,00	24.62	1.90	45	20	25	7.88	25.72	32.70	33.70	CIM	+	+	+	0.77	6.37		
BH-8	SPT	4,50-4,95	20.13		42	38	4	6.46	27.80	65.74		SİM							
BH-8	SPT	6,00-6,45	16.46		26	20	6	9.36	66.78	23.86		SiSa							
BH-8	UD	7,00-7,50	17.32	1.93	30	22	8	5.31	48.49	24.20	22.00	SiSa	+	+	+			0.71	9.10
BH-8	SPT	9,00-9,45	21.81		43	34	9	6.36	32.14	61.50		SİM							
BH-8	SPT	10,50-10,95	16.94		25	20	5	8.60	53.10	38.29		SiSa							
BH-8	SPT	12,00-12,45	17.20		28	21	7	24.03	41.83	34.14		SiSa							
BH-8	SPT	13,50-13,95	17.38		26	18	8	13.89	46.93	39.19		SiSa							
BH-8	SPT	15,00-15,45	16.12		29	22	7	8.86	57.76	33.38		SiSa							
BH-8	SPT	16,50-16,95	23.32		55	40	15	3.98	12.52	83.50		SİH							
BH-8	SPT	18,00-18,45	22.19		58	45	13	5.01	10.01	84.98		SİH							
BH-8	SPT	19,50-19,95	24.31		57	39	18	2.73	10.97	86.31		SİH							
BH-8	SPT	21,00-21,45	22.56		59	45	14	1.41	16.75	81.84		SİH							
BH-8	SPT	22,50-22,95	25.12		60	48	12	0.00	9.83	90.17		SİH							
BH-8	SPT	24,00-24,45	23.10		56	45	11	0.00	17.72	82.28		SİH							
BH-9	UD	2,50-3,00	21.76	1.94	47	40	7	6.61	47.03	24.26	22.10	SİM	+	0.05	0.53	0.71	7.45		
BH-9	SPT	4,50-4,95	24.69		43	38	5	3.99	32.78	63.23		SİM							
BH-9	UD	5,50-6,00	17.46	1.92	47	39	8	9.66	30.55	30.34	29.45	SİM	+	0.06	0.60	0.74	7.38		
BH-9	SPT	7,50-7,95	20.36		45	38	7	6.13	41.84	52.03		SİM							
BH-9	SPT	8,50-8,95	19.80		44	36	8	5.32	35.28	59.40		SİM							
BH-9	SPT	10,50-10,95	19.89		48	39	9	12.39	11.83	75.78		SİM							
BH-9	SPT	12,00-12,45	20.64		45	38	7	2.65	39.21	58.14		SİM							
BH-9	SPT	13,50-13,95	21.05		25	20	5	4.38	52.89	42.73		SiSa							
BH-9	SPT	15,00-15,45	19.77		24	15	9	6.86	47.74	45.39		SiSa							
BH-9	SPT	16,50-16,95	26.39		57	44	13	3.71	8.18	88.12		SiH							
BH-9	SPT	18,00-18,45	27.18		56	45	11	4.76	13.26	81.98		SiH							
BH-9	SPT	19,50-19,95	28.10		58	46	12	1.64	7.43	90.92		SiH							

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-10	SPT	1,50-1,95	25.28		48	41	7	4.98	18.71	76.31		SİM						
BH-10	UD	2,50-3,00	21.59	1.91	46	37	9	3.02	23.49	38.44	35.05	SİM	+	0.06	0.56	0.75	6.20	
BH-10	SPT	4,50-4,95	18.57		26	19	7	4.26	51.35	44.39		SİSa						
BH-10	UD	5,50-6,00	21.66	1.94	25	18	7	3.21	47.42	26.62	22.75	SİSa	+	0.06	0.56	0.72	8.25	
BH-10	SPT	7,50-7,95	21.25		47	39	8	6.96	24.98	68.06		SİM						
BH-10	SPT	9,00-9,45	25.25		47	38	9	0.55	30.36	69.09		SİM						
BH-10	SPT	10,50-10,95	23.25		45	40	5	14.09	31.63	54.27		SİM						
BH-10	SPT	12,00-12,45	27.10		42	35	7	18.31	22.41	59.28		SİM						
BH-10	SPT	13,50-13,95	18.57		26	17	9	0.32	62.61	37.07		SİSa						
BH-10	SPT	15,00-15,45	15.28		28	16	12	5.61	45.51	48.88		CISa						
BH-10	SPT	16,50-16,95	17.54		27	22	5	8.08	41.99	49.93		SİSa						
BH-10	SPT	18,00-18,45	25.23		27	16	11	2.27	54.59	43.14		CISa						
BH-10	SPT	19,50-19,95	19.30		25	19	6	11.03	40.89	48.09		SİSa						
BH-11	SPT	1,50-1,95	24.80		43	23	20	6.04	24.76	69.20		CIM						
BH-11	UD	2,50-3,00	19.26	1.94	28	21	7	8.58	47.81	43.61		SİSa						0.57	9.34
BH-11	SPT	4,50-4,95	17.36		26	18	8	5.46	57.09	37.45		SİSa						
BH-11	UD	5,50-6,00	21.05	1.89	43	35	8	7.18	37.82	29.61	25.30	SİM	+	+	+			0.54	7.53
BH-11	SPT	7,50-7,95	17.88		29	20	9	8.68	54.94	36.38		SİSa						
BH-11	SPT	9,00-9,45	16.49		27	20	7	6.18	64.00	29.82		SİSa						
BH-11	SPT	10,50-10,95	20.21		42	36	6	7.82	26.74	65.43		SİM						
BH-11	SPT	12,00-12,45	21.13		43	35	8	8.33	23.81	67.87		SİM						
BH-11	SPT	13,50-13,95	17.52		28	21	7	8.16	47.94	43.90		SİSa						
BH-11	SPT	15,00-15,45	18.05		30	22	8	5.90	52.89	41.22		SİSa						
BH-11	SPT	16,50-16,95	24.51		57	42	15	4.14	8.28	87.58		SİH						
BH-11	SPT	18,00-18,45	23.97		59	45	14	2.28	8.25	89.47		SİH						
BH-11	SPT	19,50-19,95	24.32		56	39	17	0.00	9.64	90.36		SİH						
BH-12	UD	2,50-3,00	21.47	1.89	42	35	7	7.12	39.17	28.16	25.55	SİM	+	+	+	0.76	7.26		
BH-12	SPT	4,50-4,95	18.21		28	19	9	8.96	51.11	39.93		SİSa							
BH-12	UD	5,50-6,00	21.70	1.89	44	37	7	6.12	37.37	30.51	26.00	SİM	+	+	+	0.74	6.83		
BH-12	SPT	7,50-7,95	17.95		26	18	8	7.25	47.97	44.78		SİSa							
BH-12	UD	8,50-9,00	16.67	1.93	29	21	8	6.99	62.82	16.29	13.90	SİSa	+	+	+			0.55	9.26
BH-12	SPT	10,50-10,95	20.02		27	20	7	6.10	54.80	39.10		SİSa							
BH-12	SPT	12,00-12,45	17.08		41	35	6	5.33	40.74	53.93		SİM							
BH-12	SPT	13,50-13,95	16.66		28	20	8	9.20	58.27	32.52		SİSa							
BH-12	SPT	15,00-15,45	19.72		26	22	4	20.71	21.16	58.13		SİL							
BH-12	SPT	16,50-16,95	19.11		28	25	3	24.24	23.30	52.46		SİL							
BH-12	SPT	18,00-18,45	21.13		44	35	9	7.91	25.94	66.15		SİM							
BH-12	SPT	19,50-19,95	20.05		42	35	7	9.04	23.26	67.70		SİM							
BH-12	SPT	21,00-21,45	23.60		58	43	15	4.24	10.78	84.98		SİH							
BH-12	SPT	22,50-22,95	24.12		56	38	18	2.73	10.79	86.48		SİH							
BH-12	SPT	24,00-24,45	23.52		59	43	16	2.14	8.91	88.95		SİH							
BH-12	SPT	25,50-25,95	23.99		55	36	19	4.27	11.10	84.63		SİH							
BH-12	SPT	27,00-27,45	24.55		57	40	17	3.58	6.57	89.85		SİH							
BH-12	SPT	28,50-28,95	23.68		58	42	16	2.18	14.90	82.92		SİH							
BH-12	SPT	30,00-30,45	24.02		56	37	19	4.44	10.95	84.61		SİH							
BH-12	SPT	31,50-31,95	20.39		46	38	8	5.38	20.61	74.01		SİM							
BH-12	SPT	33,00-33,45	20.77		43	34	9	4.51	17.30	78.20		SİM							
BH-12	SPT	34,50-34,95	21.16		45	37	8	6.18	22.97	70.86		SİM							
BH-13	UD	2,50-3,00	32.71	1.90	42	20	22	6.87	36.59	25.14	31.40	CIM	+	+	+	0.59	7.58		
BH-13	SPT	4,50-4,95	24.58		58	42	16	3.92	7.72	88.36		SİH							
BH-13	UD	5,50-6,00	20.11	1.90	43	35	8	8.35	24.02	37.63	30.00	SİM	+	+	+	0.64	6.60		
BH-13	SPT	7,50-7,95	22.03		45	36	9	6.80	22.09	71.11		SİM							
BH-13	UD	8,50-9,00	21.27	1.89	42	33	8	8.19	29.01	33.90	28.90	SİM	+	+	+	0.77	6.49		
BH-13	SPT	10,50-10,95	20.19		45	38	7	6.99	31.38	61.63		SİM							
BH-13	SPT	12,00-12,45	20.62		44	38	6	5.74	30.90	63.36		SİM							
BH-13	SPT	13,50-13,95	21.14		46	37	9	7.75	20.53	71.73		SİM							
BH-13	SPT	15,00-15,45	20.96		42	34	8	6.64	22.95	70.41		SİM							
BH-13	SPT	16,50-16,95	20.84		43	36	7	6.21	20.39	73.40		SİM							
BH-13	SPT	18,00-18,45	20.32		40	31	9	8.22	23.14	68.64		SİM							
BH-13	SPT	19,50-19,95	19.93		44	38	6	7.28	29.23	63.49		SİM							

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BH-14	UD	2,50-3,00	23.66	1.91	43	23	20	7.64	26.10	31.56	34.70	CIM	+	+	+	0.62	6.87		
BH-14	SPT	4,50-4,95	20.13		40	33	7	8.91	20.76	70.33		SİM							
BH-14	UD	5,50-6,00	19.52	1.89	44	35	9	5.90	27.15	37.20	29.75	SİM	+	+	+	0.59	6.91		
BH-14	SPT	7,50-7,95	20.88		41	34	7	7.28	32.91	59.82		SİM							
BH-14	SPT	9,00-9,45	16.34		27	19	8	9.06	49.13	41.81		SiSa							
BH-14	SPT	10,50-10,95	24.58		58	42	16	2.27	9.58	88.15		SİH							
BH-14	SPT	12,00-12,45	17.12		25	17	8	6.64	58.27	35.09		SiSa							
BH-14	SPT	13,50-13,95	20.62		42	33	9	8.64	37.50	53.86		SİM							
BH-14	SPT	15,00-15,45	21.66		44	37	7	6.94	28.01	65.06		SİM							
BH-14	SPT	16,50-16,95	20.28		41	32	9	6.10	25.74	68.16		SİM							
BH-14	SPT	18,00-18,45	19.85		45	37	8	5.25	22.88	71.87		SİM							
BH-14	SPT	19,50-19,95	19.37		43	35	8	6.43	21.44	72.12		SİM							
BH-15	SPT	1,50-1,95	21.82		41	34	7	5.24	24.33	70.43		SİM							
BH-15	UD	2,50-3,00	16.36	1.93	28	20	8	7.33	54.03	20.24	18.40	SiSa						0.61	9.54
BH-15	SPT	4,50-4,95	20.79		44	35	9	5.95	32.30	61.75		SİM							
BH-15	UD	5,50-6,00	20.41	1.90	42	35	7	8.90	36.67	29.38	25.05	SİM	+	+	+	0.60	7.06		
BH-15	SPT	7,50-7,95	19.77		41	32	9	6.81	34.17	59.02		SİM							
BH-15	SPT	9,00-9,45	17.08		30	22	8	9.69	55.50	34.82		SiSa							
BH-15	SPT	10,50-10,95	16.94		27	20	7	6.30	58.24	35.45		SiSa							
BH-15	SPT	12,00-12,45	17.11		26	19	7	5.34	66.58	28.08		SiSa							
BH-15	SPT	13,50-13,95	17.34		29	20	9	6.52	50.80	42.68		SiSa							
BH-15	SPT	15,00-15,45	20.23		43	35	8	5.35	40.11	54.54		SİM							
BH-15	SPT	16,50-16,95	21.78		45	37	8	7.38	34.92	57.70		SİM							
BH-15	SPT	18,00-18,45	17.29		28	19	9	5.44	51.98	42.58		SiSa							
BH-15	SPT	19,50-19,95	18.02		29	22	7	6.26	56.83	36.91		SiSa							
BH-16	SPT	1,50-1,95	24.37		44	22	22	5.88	23.12	70.99		CIM							
BH-16	UD	2,50-3,00	17.22	1.93	28	20	8	5.28	47.83	46.89		SiSa						0.54	9.77
BH-16	SPT	4,50-4,95	20.43		42	35	7	8.74	25.81	65.45		SİM							
BH-16	UD	5,50-6,00	20.66	1.91	43	34	9	6.01	34.58	34.57	24.85	SİM	+	+	+	0.70	6.93		
BH-16	SPT	7,50-7,95	17.04		28	21	7	10.80	55.61	33.58		SiSa							
BH-16	UD	8,50-9,00	18.25	1.92	26	23	3	9.15	27.45	34.25	29.15	SİL	+	+	+			0.58	8.20
BH-16	SPT	10,50-10,95	16.89		45	37	8	6.96	25.07	67.97		SİM							
BH-16	SPT	12,00-12,45	24.72		58	43	15	3.80	14.60	81.60		SİH							
BH-16	UD	13,00-13,50	21.42	1.90	42	33	9	5.57	19.58	40.40	34.45	SİM	+	+	+	0.72	6.82		
BH-16	SPT	15,00-15,45	19.89		45	38	7	7.01	24.52	68.48		SİM							
BH-16	SPT	16,50-16,95	20.06		43	35	8	7.80	27.44	64.76		SİM							
BH-16	SPT	18,00-18,45	21.09		40	32	8	6.10	26.07	67.84		SİM							
BH-16	SPT	19,50-19,95	20.72		43	34	9	5.76	22.97	71.27		SİM							
BH-16	SPT	21,00-21,45	24.55		57	40	17	4.21	10.86	84.93		SİH							
BH-16	SPT	22,50-22,95	25.81		58	43	15	2.73	8.05	89.22		SİH							
BH-16	SPT	24,00-24,45	24.94		55	36	19	0.00	9.70	90.30		SİH							
BH-16	SPT	25,50-25,95	25.08		59	44	15	0.00	17.50	82.50		SİH							
BH-16	SPT	27,00-27,45	24.72		57	41	16	1.37	12.40	86.23		SİH							
BH-16	SPT	28,50-28,95	24.37		56	38	18	3.09	13.47	83.44		SİH							
BH-16	SPT	30,00-30,45	25.05		58	41	17	4.49	10.18	85.33		SİH							
BH-16	SPT	31,50-31,95	17.63		29	21	8	5.35	48.91	45.74		SiSa							
BH-16	SPT	33,00-33,45	24.55		59	43	16	3.83	14.81	81.36		SİH							
BH-16	SPT	34,50-34,95	24.76		56	37	19	2.23	11.83	85.94		SİH							
BH-17	UD	2,50-3,00	21.45	1.92	43	35	8	5.97	42.22	51.82		SİM	+	+	+	0.60	7.95		
BH-17	SPT	4,50-4,95	17.26		27	21	6	6.11	54.00	39.90		SiSa							
BH-17	UD	5,50-6,00	16.44	1.93	25	18	7	7.98	46.73	24.44	20.85	SiSa						0.58	8.96
BH-17	SPT	7,50-7,95	18.77		28	19	9	5.32	51.37	43.31		SiSa							
BH-17	UD	8,50-9,00	21.53	1.90	42	35	7	6.59	41.32	28.14	23.95	SİM	+	+	+	0.73	7.42		
BH-17	SPT	10,50-10,95	22.64		41	33	8	8.17	30.10	61.73		SİM							
BH-17	SPT	12,00-12,45	20.08		45	39	6	6.90	26.89	66.21		SİM							
BH-17	SPT	13,50-13,95	21.81		43	35	8	5.62	24.45	69.93		SİM							
BH-17	SPT	15,00-15,45	20.39		40	31	9	8.03	32.31	59.66		SİM							
BH-17	SPT	16,50-16,95	19.98		41	34	7	9.30	36.33	54.37		SİM							
BH-17	SPT	18,00-18,45	17.11		30	24	6	8.07	54.68	37.25		SiSa							
BH-17	SPT	19,50-19,95	17.76		26	18	8	8.72	58.17	33.11		SiSa							

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BH-18	UD	2,50-3,00	21.31	1.90	43	34	9	6.56	20.11	40.78	32.55	SİM	+	+	+	0.78	6.87		
BH-18	SPT	4,50-4,95	20.85		42	35	7	8.70	23.74	67.56		SİM							
BH-18	UD	5,50-6,00	22.57	1.91	45	37	8	7.42	31.67	32.91	28.00	SİM				0.72	7.11		
BH-18	SPT	7,50-7,95	21.62		41	33	8	8.84	32.26	58.89		SİM	+	+	+				
BH-18	SPT	9,00-9,45	19.67		25	22	3	21.11	24.34	54.55		SİL							
BH-18	SPT	10,50-10,95	17.16		30	21	9	9.15	54.19	36.66		SiSa							
BH-18	SPT	12,00-12,45	19.85		56	40	16	2.70	7.45	89.86		SİH							
BH-18	SPT	13,50-13,95	20.02		28	23	5	10.91	38.86	50.23		SİL							
BH-18	SPT	15,00-15,45	23.32		26	24	2	14.79	27.44	57.77		SİL							
BH-18	SPT	16,50-16,95	21.86		44	36	8	7.30	32.62	60.08		SİM							
BH-18	SPT	18,00-18,45	22.04		40	31	9	5.99	28.77	65.23		SİM							
BH-18	SPT	19,50-19,95	20.96		43	37	6	8.64	29.20	62.17		SİM							
BH-18	SPT	21,00-21,45	16.69		29	22	7	7.11	49.02	43.87		SiSa							
BH-18	SPT	22,50-22,95	25.10		58	41	17	0.71	4.14	95.15		SİH							
BH-18	SPT	24,00-24,45	26.82		55	36	19	0.00	3.78	96.22		SİH							
BH-18	SPT	25,50-25,95	26.44		59	43	16	0.00	3.67	96.33		SİH							
BH-18	SPT	27,00-27,45	25.92		56	38	18	0.00	6.22	93.78		SİH							
BH-18	SPT	28,50-28,95	24.67		58	41	17	0.83	10.73	88.44		SİH							
BH-18	SPT	30,00-30,45	25.05		55	39	16	0.00	10.32	89.68		SİH							
BH-18	SPT	31,50-31,95	25.42		59	40	19	0.00	8.76	91.24		SİH							
BH-18	SPT	33,00-33,45	26.14		57	42	15	0.00	5.57	94.43		SİH							
BH-18	SPT	34,50-34,95	24.98		56	39	17	0.00	4.16	95.84		SİH							

Table 27: Laboratory Results.

5.1. Determination of Index/Physical Properties of Soils

Samples taken from soils at different depths were subjected to various analyses by Jeolab Soil Laboratory. As a result of the investigation, MAST Shear test, Triaxial Compression test, Water content, Natural-Dry Unit Volume Weight, Oedometer test, Swelling Pressure, Swelling Percentage, Atterberg Limits and Sieve Analysis tests were performed to obtain a general opinion about the bearing capacity, settlement amount and liquefaction risk of the soil. In addition, the soil safety stress coefficient, soil group and type, which will form the basis of static calculations, have been determined.

BORE NO.	**DEPTH (m)**	**WATER CONTENT (Wn)**	**NATURAL UNIT V. WEIGHT** g_n (g/cm^3)	**SOIL CLASS** (USCS)
BH-AR01	2.50-3.00	18.88	1.92	SiM
BH-AR01	4.50-4.95	20.31		SiM
BH-AR01	5.50-6.00	16.55	1.92	SiM
BH-AR01	7.50-7.95	22.69		SiM
BH-AR01	9.00-9.45	16.22		SiSa
BH-AR01	10.50-10.95	17.30		SiSa
BH-AR01	12.00-12.45	18.33		SiM
BH-AR01	13.50-13.95	14.52		SiM

BH-AR01	15.00-15.45	19.63		SiM
BH-AR01	16.50-16.95	20.34		SiM
BH-AR01	18.00-18.45	19.70		SiSa
BH-AR01	19.50-19.95	20.33		SiSa
BH-AR01	21.00-21.45	25.69		SiH
BH-AR01	22.50-22.95	23.66		SiH
BH-AR01	24.00-24.45	24.25		SiH
BH-AR02	1.50-1.95	20.01		CIM
BH-AR02	2.50-3.00	20.72	1.94	CIM
BH-AR02	4.50-4.95	22.36		CISa
BH-AR02	5.50-6.00	26.61	1.93	SiM
BH-AR02	7.50-7.95	23.28		SiM
BH-AR02	9.00-9.45	21.02		SiM
BH-AR02	10.50-10.95	20.90		SiM
BH-AR02	12.00-12.45	27.00		SiH
BH-AR02	14.00-14.50	24.26	1.93	SiM
BH-AR02	15.00-15.45	21.03		SiM
BH-AR02	16.50-16.95	20.36		SiH
BH-AR02	18.00-18.45	25.28		SiH
BH-AR02	19.50-19.95	23.02		SiM
BH-AR02	21.00-21.45	20.09		SiH
BH-AR02	22.50-22.95	20.38		SiH
BH-AR02	24.00-24.45	18.28		SiM
BH-AR02	25.50-25.95	15.39		SiSa
BH-AR02	27.00-27.45	15.18		SaW
BH-AR02	28.50-28.95	13.14		SaW
BH-AR02	31.00-31.50	15.24		SaW
BH-AR02	33.00-33.50	16.30		SaW
BH-AR02	35.00-35.50	16.35		SiSa
BH-AR02	38.00-38.50	17.80		SiSa
BH-AR02	40.00-40.50	20.11		SiSa
BH-AR03	2.50-3.00	21.69	1.94	SiSa
BH-AR03	4.50-4.95	26.27		CIM
BH-AR03	5.50-6.00	23.70	1.92	CIM
BH-AR03	7.50-7.95	21.07		SiM
BH-AR03	8.50-9.00	20.52	1.92	SiM

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BH-AR03	10.50-10.95	22.00		SiM
BH-AR03	12.00-12.45	18.58		SiSa
BH-AR03	13.50-13.95	15.25		SiSa
BH-AR03	15.00-15.45	20.39		SiSa
BH-AR03	16.50-16.95	22.36		SiM
BH-AR03	18.00-18.45	18.11		CISa
BH-AR03	19.50-19.95	26.36		SiSa
BH-AR03	21.00-21.45	23.25		SiH
BH-AR03	22.50-22.95	22.52		CIM
BH-AR03	24.00-24.45	20.87		SiM
BH-1	2.50-3.00	23.45	1.92	SiM
BH-1	4.50-4.95	22.11		SiM
BH-1	5.50-6.00	25.55	1.91	SiM
BH-1	7.50-7.95	20.35		SiM
BH-1	8.50-9.00	21.48	1.93	SiM
BH-1	10.50-10.95	19.70		SiM
BH-1	12.00-12.45	25.67		SiM
BH-1	13.50-13.95	21.10		SiM
BH-1	15.00-15.45	22.48		SiM
BH-1	16.50-16.95	17.48		SiL
BH-1	18.00-18.45	15.60		SiSa
BH-1	19.50-19.95	18.99		SiSa
BH-1	21.00-21.45	20.39		SiM
BH-1	22.50-22.95	25.67		SiH
BH-1	24.00-24.45	27.17		SiH
BH-2	2.50-3.00	25.28	1.92	SiM
BH-2	4.50-4.95	23.05		SiSa
BH-2	5.50-6.00	21.46	1.94	SiSa
BH-2	7.50-7.95	20.02		SiSa
BH-2	8.50-9.00	19.51	1.95	SiM
BH-2	10.50-10.95	25.20		SiM
BH-2	12.00-12.45	21.06		SiM
BH-2	13.50-13.95	17.12		SiL
BH-2	15.00-15.45	23.28		SiSa
BH-2	16.50-16.95	20.07		SiSa
BH-2	18.00-18.45	23.10		SiSa

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-2	21.00-21.45	18.67		SiL
BH-2	22.50-22.95	19.72		SiL
BH-2	24.00-24.45	28.70		CIM
BH-3	2.50-3.00	22.53	1.91	CIM
BH-3	4.50-4.95	21.05		SiM
BH-3	5.50-6.00	23.40	1.92	SiM
BH-3	7.50-7.95	23.24		SiSa
BH-3	8.50-9.00	17.59	1.93	SiSa
BH-3	10.50-10.95	19.30		SiSa
BH-3	12.00-12.45	22.35		SiM
BH-3	13.50-13.95	23.17		SiM
BH-3	15.00-15.45	24.18		SiM
BH-3	16.50-16.95	23.25		SiL
BH-3	18.00-18.45	21.06		SiSa
BH-3	19.50-19.95	20.08		SiM
BH-3	21.00-21.45	25.17		SiM
BH-3	22.50-22.95	26.27		SiM
BH-3	24.00-24.45	23.04		SiM
BH-3	25.50-25.95	17.12		SiH
BH-3	27.00-27.45	21.90		SiM
BH-3	28.50-28.95	22.18		SiM
BH-3	30.00-30.45	17.10		SiM
BH-3	31.50-31.95	19.72		SiM
BH-3	33.00-33.45	16.25		SaW
BH-3	34.50-34.95	15.14		SaW
BH-3	36.00-36.45	13.18		SaW
BH-3	39.00-39.50	15.11		SaW
BH-3	41.00-41.50	19.37		SiM
BH-3	44.00-44.50	18.57		SiSa
BH-3	47.00-47.50	31.05		SiSa
BH-3	50.00-50.50	20.19		SiSa
BH-4	2.50-3.00	15.63	1.94	SiSa
BH-4	4.50-4.95	24.22		SiM
BH-4	5.50-6.00	22.63	1.93	SiM
BH-4	7.50-7.95	21.06		SiM
BH-4	9.00-9.45	18.71		SiSa

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-4	10.50-10.95	17.44		SiM
BH-4	12.00-12.45	16.17		SiSa
BH-4	13.50-13.95	22.39		SiM
BH-4	14.50-15.00	20.39	1.94	SiM
BH-4	16.50-16.95	22.06		SiM
BH-4	18.00-18.45	20.17		SiM
BH-4	19.50-19.95	16.57		SiSa
BH-4	21.00-21.45	24.14		SiM
BH-4	22.50-22.95	25.29		SiH
BH-4	24.00-24.45	26.18		SiH
BH-5	1.50-1.95	26.36		CIM
BH-5	2.50-3.00	25.49	1.92	CIM
BH-5	4.50-4.95	21.03		SiM
BH-5	5.50-6.00	21.54	1.92	SiM
BH-5	7.50-7.95	20.09		SiM
BH-5	9.00-9.45	19.57		SiM
BH-5	10.50-10.95	24.18		SiM
BH-5	12.00-12.45	20.10		SiM
BH-5	13.50-13.95	17.10		SiSa
BH-5	15.00-15.45	19.38		SiSa
BH-5	16.50-16.95	17.52		SiM
BH-5	18.00-18.45	19.00		SiM
BH-5	19.50-19.95	17.53		SiM
BH-5	21.00-21.45	26.98		SiH
BH-5	22.50-22.95	27.42		SiH
BH-5	24.00-24.45	26.19		SiH
BH-6	2.50-3.00	15.65	1.94	SiSa
BH-6	4.50-4.95	23.25		SiM
BH-6	5.50-6.00	23.17	1.92	SiM
BH-6	7.50-7.95	17.15		SiSa
BH-6	9.00-9.45	18.67		CISa
BH-6	10.50-10.95	20.51		SiM
BH-6	12.00-12.45	18.55		SiM
BH-6	13.50-13.95	21.35		SiM
BH-6	15.00-15.45	19.77		SiM
BH-6	16.50-16.95	18.54		SiSa

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-6	18.00-18.45	17.18		SiSa
BH-6	19.50-19.95	20.39		SiSa
BH-6	21.00-21.45	18.27		SiSa
BH-6	22.50-22.95	21.05		SiSa
BH-6	24.00-24.45	18.60		SiSa
BH-7	2.50-3.00	24.58	1.92	SiM
BH-7	4.50-4.95	23.25		SiM
BH-7	5.50-6.00	21.60	1.94	SiSa
BH-7	7.50-7.95	23.70		SİM
BH-7	8.50-9.00	21.90	1.92	SİM
BH-7	10.50-10.95	26.28		SİM
BH-7	12.00-12.45	23.66		SİM
BH-7	13.50-13.95	16.70		SiSa
BH-7	15.00-15.45	19.68		SiSa
BH-7	16.50-16.95	20.57		SiSa
BH-7	18.00-18.45	17.55		SiSa
BH-7	19.50-19.95	16.28		SiSa
BH-7	21.00-21.45	20.08		SiSa
BH-7	22.50-22.95	25.25		SiM
BH-7	24.00-24.45	26.20		SiH
BH-7	25.50-25.95	17.25		SiL
BH-7	27.00-27.45	23.30		SİM
BH-7	28.50-28.95	26.07		SiH
BH-7	30.00-30.45	26.22		SiH
BH-7	31.50-31.95	24.29		SiH
BH-7	33.00-33.45	21.05		SiSa
BH-7	34.50-34.95	20.25		SiSa
BH-7	36.00-36.45	24.15		SiSa
BH-7	38.00-38.50	19.57		SiSa
BH-7	40.00-40.50	15.24		SiSa
BH-7	42.00-42.50	18.99		SiSa
BH-7	44.00-44.50	17.68		SiSa
BH-7	46.00-46.50	21.03		SiL
BH-7	48.00-48.50	20.10		SiSa
BH-7	50.00-50.50	23.28		SiSa
BH-8	2.50-3.00	24.62	1.90	CIM

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ÇERKEZKÖY/TEKİRDAĞ
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BH-8	4.50-4.95	20.13		SİM
BH-8	6.00-6.45	16.46		SiSa
BH-8	7.00-7.50	17.32	1.93	SiSa
BH-8	9.00-9.45	21.81		SİM
BH-8	10.50-10.95	16.94		SiSa
BH-8	12.00-12.45	17.20		SiSa
BH-8	13.50-13.95	17.38		SiSa
BH-8	15.00-15.45	16.12		SiSa
BH-8	16.50-16.95	23.32		SiH
BH-8	18.00-18.45	22.19		SiH
BH-8	19.50-19.95	24.31		SiH
BH-8	21.00-21.45	22.56		SiH
BH-8	22.50-22.95	25.12		SiH
BH-8	24.00-24.45	23.10		SiH
BH-9	2.50-3.00	21.76	1.94	SiM
BH-9	4.50-4.95	24.69		SiM
BH-9	5.50-6.00	17.46	1.92	SiM
BH-9	7.50-7.95	20.36		SiM
BH-9	8.50-8.95	19.80		SiM
BH-9	10.50-10.95	19.89		SiM
BH-9	12.00-12.45	20.64		SiM
BH-9	13.50-13.95	21.05		SiSa
BH-9	15.00-15.45	19.77		SiSa
BH-9	16.50-16.95	26.39		SiH
BH-9	18.00-18.45	27.18		SiH
BH-9	19.50-19.95	28.10		SiH
BH-10	1.50-1.95	25.28		SiM
BH-10	2.50-3.00	21.59	1.91	SiM
BH-10	4.50-4.95	18.57		SiSa
BH-10	5.50-6.00	21.66	1.94	SiSa
BH-10	7.50-7.95	21.25		SiM
BH-10	9.00-9.45	25.25		SiM
BH-10	10.50-10.95	23.25		SiM
BH-10	12.00-12.45	27.10		SiM
BH-10	13.50-13.95	18.57		SiSa
BH-10	15.00-15.45	15.28		CISa

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-10	16.50-16.95	17.54		SiSa
BH-10	18.00-18.45	25.23		CISa
BH-10	19.50-19.95	19.30		SiSa
BH-11	1.50-1.95	24.80		CIM
BH-11	2.50-3.00	19.26	1.94	SiSa
BH-11	4.50-4.95	17.36		SiSa
BH-11	5.50-6.00	21.05	1.89	SİM
BH-11	7.50-7.95	17.88		SiSa
BH-11	9.00-9.45	16.49		SiSa
BH-11	10.50-10.95	20.21		SİM
BH-11	12.00-12.45	21.13		SİM
BH-11	13.50-13.95	17.52		SiSa
BH-11	15.00-15.45	18.05		SiSa
BH-11	16.50-16.95	24.51		SiH
BH-11	18.00-18.45	23.97		SiH
BH-11	19.50-19.95	24.32		SiH
BH-12	2.50-3.00	21.47	1.89	SİM
BH-12	4.50-4.95	18.21		SiSa
BH-12	5.50-6.00	21.70	1.89	SİM
BH-12	7.50-7.95	17.95		SiSa
BH-12	8.50-9.00	16.67	1.93	SiSa
BH-12	10.50-10.95	20.02		SiSa
BH-12	12.00-12.45	17.08		SİM
BH-12	13.50-13.95	16.66		SiSa
BH-12	15.00-15.45	19.72		SiL
BH-12	16.50-16.95	19.11		SiL
BH-12	18.00-18.45	21.13		SİM
BH-12	19.50-19.95	20.05		SİM
BH-12	21.00-21.45	23.60		SiH
BH-12	22.50-22.95	24.12		SiH
BH-12	24.00-24.45	23.52		SiH
BH-12	25.50-25.95	23.99		SiH
BH-12	27.00-27.45	24.55		SiH
BH-12	28.50-28.95	23.68		SiH
BH-12	30.00-30.45	24.02		SiH
BH-12	31.50-31.95	20.39		SİM

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-12	33.00-33.45	20.77		SİM
BH-12	34.50-34.95	21.16		SİM
BH-13	2.50-3.00	32.71	1.90	CIM
BH-13	4.50-4.95	24.58		SiH
BH-13	5.50-6.00	20.11	1.90	SİM
BH-13	7.50-7.95	22.03		SİM
BH-13	8.50-9.00	21.27	1.89	SİM
BH-13	10.50-10.95	20.19		SİM
BH-13	12.00-12.45	20.62		SİM
BH-13	13.50-13.95	21.14		SİM
BH-13	15.00-15.45	20.96		SİM
BH-13	16.50-16.95	20.84		SİM
BH-13	18.00-18.45	20.32		SİM
BH-13	19.50-19.95	19.93		SİM
BH-14	2.50-3.00	23.66	1.91	CIM
BH-14	4.50-4.95	20.13		SİM
BH-14	5.50-6.00	19.52	1.89	SİM
BH-14	7.50-7.95	20.88		SİM
BH-14	9.00-9.45	16.34		SiSa
BH-14	10.50-10.95	24.58		SiH
BH-14	12.00-12.45	17.12		SiSa
BH-14	13.50-13.95	20.62		SİM
BH-14	15.00-15.45	21.66		SİM
BH-14	16.50-16.95	20.28		SİM
BH-14	18.00-18.45	19.85		SİM
BH-14	19.50-19.95	19.37		SİM
BH-15	1.50-1.95	21.82		SİM
BH-15	2.50-3.00	16.36	1.93	SiSa
BH-15	4.50-4.95	20.79		SİM
BH-15	5.50-6.00	20.41	1.90	SİM
BH-15	7.50-7.95	19.77		SİM
BH-15	9.00-9.45	17.08		SiSa
BH-15	10.50-10.95	16.94		SiSa
BH-15	12.00-12.45	17.11		SiSa
BH-15	13.50-13.95	17.34		SiSa
BH-15	15.00-15.45	20.23		SİM

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-15	16.50-16.95	21.78		SİM
BH-15	18.00-18.45	17.29		SiSa
BH-15	19.50-19.95	18.02		SiSa
BH-16	1.50-1.95	24.37		CIM
BH-16	2.50-3.00	17.22	1.93	SiSa
BH-16	4.50-4.95	20.43		SİM
BH-16	5.50-6.00	20.66	1.91	SİM
BH-16	7.50-7.95	17.04		SiSa
BH-16	8.50-9.00	18.25	1.92	SiL
BH-16	10.50-10.95	16.89		SİM
BH-16	12.00-12.45	24.72		SiH
BH-16	13.00-13.50	21.42	1.90	SİM
BH-16	15.00-15.45	19.89		SİM
BH-16	16.50-16.95	20.06		SİM
BH-16	18.00-18.45	21.09		SİM
BH-16	19.50-19.95	20.72		SİM
BH-16	21.00-21.45	24.55		SiH
BH-16	22.50-22.95	25.81		SiH
BH-16	24.00-24.45	24.94		SiH
BH-16	25.50-25.95	25.08		SiH
BH-16	27.00-27.45	24.72		SiH
BH-16	28.50-28.95	24.37		SiH
BH-16	30.00-30.45	25.05		SiH
BH-16	31.50-31.95	17.63		SiSa
BH-16	33.00-33.45	24.55		SiH
BH-16	34.50-34.95	24.76		SiH
BH-17	2.50-3.00	21.45	1.92	SİM
BH-17	4.50-4.95	17.26		SiSa
BH-17	5.50-6.00	16.44	1.93	SiSa
BH-17	7.50-7.95	18.77		SiSa
BH-17	8.50-9.00	21.53	1.90	SİM
BH-17	10.50-10.95	22.64		SİM
BH-17	12.00-12.45	20.08		SİM
BH-17	13.50-13.95	21.81		SİM
BH-17	15.00-15.45	20.39		SİM
BH-17	16.50-16.95	19.98		SİM

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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BH-17	18.00-18.45	17.11		SiSa
BH-17	19.50-19.95	17.76		SiSa
BH-18	2.50-3.00	21.31	1.90	SİM
BH-18	4.50-4.95	20.85		SİM
BH-18	5.50-6.00	22.57	1.91	SİM
BH-18	7.50-7.95	21.62		SİM
BH-18	9.00-9.45	19.67		SiL
BH-18	10.50-10.95	17.16		SiSa
BH-18	12.00-12.45	19.85		SiH
BH-18	13.50-13.95	20.02		SiL
BH-18	15.00-15.45	23.32		SiL
BH-18	16.50-16.95	21.86		SİM
BH-18	18.00-18.45	22.04		SİM
BH-18	19.50-19.95	20.96		SİM
BH-18	21.00-21.45	16.69		SiSa
BH-18	22.50-22.95	25.10		SiH
BH-18	24.00-24.45	26.82		SiH
BH-18	25.50-25.95	26.44		SiH
BH-18	27.00-27.45	25.92		SiH
BH-18	28.50-28.95	24.67		SiH
BH-18	30.00-30.45	25.05		SiH
BH-18	31.50-31.95	25.42		SiH
BH-18	33.00-33.45	26.14		SiH
BH-18	34.50-34.95	24.98	1.92	SiH

Table 28: The water content, unit weights, specific gravity and soil classes of the samples taken from the boreholes

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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SAMPLE		ATTERBERG (CONSISTENCY) LIMITS			SIEVE ANALYSIS				SOIL CLASS (USCS)
BORE NO.	DEPTH (m)	LL (%)	PL (%)	PI (%)	Gravel 4 No. (%) (+)	Sand (%)	Silt (%)	Clay (%)	
BH-AR01	2.50-3.00	46	39	7	0.76	28.24	38.20	32.80	SiM
BH-AR01	4.50-4.95	47	41	6	14.71	20.99	64.30		SİM
BH-AR01	5.50-6.00	49	42	7	5.13	28.53	34.65	31.69	SiM
BH-AR01	7.50-7.95	45	37	8	1.58	37.09	61.33		SiM
BH-AR01	9.00-9.45	29	22	7	4.75	46.78	48.47		SiSa
BH-AR01	10.50-10.95	27	20	7	3.45	56.41	40.14		SiSa
BH-AR01	12.00-12.45	44	36	8	4.94	31.59	63.46		SiM
BH-AR01	13.50-13.95	47	38	9	2.64	25.82	71.55		SiM
BH-AR01	15.00-15.45	45	37	8	11.19	29.19	59.63		SiM
BH-AR01	16.50-16.95	47	38	9	10.42	35.61	53.97		SiM
BH-AR01	18.00-18.45	27	20	7	10.90	29.06	60.04		SiSa
BH-AR01	19.50-19.95	26	17	9	13.97	53.96	32.07		SiSa
BH-AR01	21.00-21.45	57	41	16	1.27	4.46	94.27		SiH
BH-AR01	22.50-22.95	56	43	13	0.00	7.45	92.55		SiH
BH-AR01	24.00-24.45	55	41	14	0.00	10.72	89.28		SiH
BH-AR02	1.50-1.95	45	22	23	5.13	32.41	62.46		CIM
BH-AR02	2.50-3.00	41	21	20	12.79	36.71	26.40	24.10	CIM
BH-AR02	4.50-4.95	26	13	13	6.07	48.65	45.28		CLSA
BH-AR02	5.50-6.00	42	35	7	4.27	26.85	34.94	33.95	SiM
BH-AR02	7.50-7.95	45	36	9	2.15	33.68	64.17		SiM
BH-AR02	9.00-9.45	48	42	6	3.41	38.22	58.38		SiM
BH-AR02	10.50-10.95	45	38	7	4.75	34.06	61.19		SiM
BH-AR02	12.00-12.45	56	44	12	2.74	6.03	91.23		SiH
BH-AR02	14.00-14.50	46	39	7	1.41	32.27	34.73	31.60	SiM
BH-AR02	15.00-15.45	48	43	5	14.17	26.11	59.72		SiM
BH-AR02	16.50-16.95	58	47	11	1.59	5.64	92.77		SiH
BH-AR02	18.00-18.45	54	42	12	0.64	11.46	87.91		SiH
BH-AR02	19.50-19.95	46	39	7	4.78	31.61	63.61		SiM
BH-AR02	21.00-21.45	57	44	13	3.11	6.60	90.28		SiH
BH-AR02	22.50-22.95	46	38	8	5.53	2.29	92.18		SiH
BH-AR02	24.00-24.45	47	40	7	10.03	13.87	76.11		SiM
BH-AR02	25.50-25.95	25	20	5	6.46	56.29	37.25		SiSa

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-AR02	27.00-27.45	NP	NP	NP	3.36	89.61	7.02		SaW
BH-AR02	28.50-28.95	NP	NP	NP	14.09	76.81	9.10		SaW
BH-AR02	31.00-31.50	NP	NP	NP	10.44	86.30	3.26		SaW
BH-AR02	33.00-33.50	NP	NP	NP	12.01	83.48	4.50		SaW
BH-AR02	35.00-35.50	26	21	5	6.49	56.54	36.97		SiSa
BH-AR02	38.00-38.50	27	19	8	5.36	47.43	47.20		SiSa
BH-AR02	40.00-40.50	26	20	6	6.43	48.06	45.51		SiSa
BH-AR03	2.50-3.00	27	20	7	3.90	46.34	26.81	22.95	26.81
BH-AR03	4.50-4.95	47	21	26	10.17	20.29	69.54		CIM
BH-AR03	5.50-6.00	45	22	23	1.49	28.44	31.27	38.80	CIM
BH-AR03	7.50-7.95	43	38	5	5.62	29.86	64.53		SİM
BH-AR03	8.50-9.00	43	39	4	5.68	26.46	36.56	31.30	SİM
BH-AR03	10.50-10.95	27	21	6	1.66	23.47	74.87		SiM
BH-AR03	12.00-12.45	25	19	6	3.43	47.94	48.63		SiSa
BH-AR03	13.50-13.95	27	19	8	4.78	52.77	42.45		SiSa
BH-AR03	15.00-15.45	27	20	7	5.68	52.60	41.72		SiSa
BH-AR03	16.50-16.95	47	39	8	0.82	29.02	70.16		SiM
BH-AR03	18.00-18.45	28	17	11	4.98	46.67	48.35		CISa
BH-AR03	19.50-19.95	24	17	7	3.52	50.25	46.23		SiSa
BH-AR03	21.00-21.45	58	43	15	1.60	6.83	91.57		SiH
BH-AR03	22.50-22.95	46	24	22	4.89	26.89	68.23		CIM
BH-AR03	24.00-24.45	45	38	7	3.86	30.30	65.83		SiM
BH-1	2.50-3.00	47	38	9	4.70	26.75	35.90	32.65	SiM
BH-1	4.50-4.95	48	43	5	3.00	21.22	75.78		SiM
BH-1	5.50-6.00	43	34	9	4.91	27.67	35.28	32.15	SiM
BH-1	7.50-7.95	47	39	8	0.59	35.50	63.91		SiM
BH-1	8.50-9.00	45	38	7	5.46	35.37	29.97	29.20	SiM
BH-1	10.50-10.95	42	38	4	10.11	35.23	54.66		SiM
BH-1	12.00-12.45	45	36	9	6.01	23.72	70.27		SiM
BH-1	13.50-13.95	47	39	8	3.74	26.98	69.28		SiM
BH-1	15.00-15.45	46	40	6	5.56	30.95	63.49		SiM
BH-1	16.50-16.95	26	19	7	15.66	24.02	60.32		SiL
BH-1	18.00-18.45	27	19	8	9.62	46.77	43.61		SiSa
BH-1	19.50-19.95	28	20	8	8.77	43.18	48.05		SiSa
BH-1	21.00-21.45	47	40	7	3.74	29.21	67.05		SiM
BH-1	22.50-22.95	56	43	13	0.00	10.05	89.95		SiH

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-1	24.00-24.45	57	45	12	4.85	11.56	83.60		SiH
BH-2	2.50-3.00	45	38	7	6.12	24.82	36.16	32.90	SiM
BH-2	4.50-4.95	28	20	8	13.75	39.23	47.02		SiSa
BH-2	5.50-6.00	25	18	7	5.46	45.25	26.59	22.70	SiSa
BH-2	7.50-7.95	29	23	6	4.96	47.68	47.36		SiSa
BH-2	8.50-9.00	44	38	6	4.91	39.41	28.24	27.45	SiM
BH-2	10.50-10.95	43	38	5	1.58	30.47	67.95		SiM
BH-2	12.00-12.45	48	40	8	5.70	39.81	54.49		SiM
BH-2	13.50-13.95	26	19	7	17.44	29.36	53.20		SiL
BH-2	15.00-15.45	25	19	6	13.88	48.12	38.00		SiSa
BH-2	16.50-16.95	27	22	5	4.05	48.70	47.25		SiSa
BH-2	18.00-18.45	25	20	5	9.62	48.14	42.25		SiSa
BH-2	21.00-21.45	24	18	6	15.31	22.35	62.34		SiL
BH-2	22.50-22.95	25	18	7	22.88	17.23	59.89		SiL
BH-2	24.00-24.45	45	22	23	0.00	23.96	76.04		CIM
BH-3	2.50-3.00	46	24	22	5.45	22.66	35.40	36.49	CIM
BH-3	4.50-4.95	45	35	10	4.75	29.72	65.52		SİM
BH-3	5.50-6.00	42	34	8	4.33	28.04	34.33	33.30	SiM
BH-3	7.50-7.95	27	20	7	7.26	50.37	42.37		SiSA
BH-3	8.50-9.00	25	19	6	5.46	33.44	31.95	29.15	SiSa
BH-3	10.50-10.95	27	18	9	4.95	25.77	69.28		SiSa
BH-3	12.00-12.45	47	41	6	7.66	19.07	73.27		SiM
BH-3	13.50-13.95	43	38	5	11.79	24.26	63.95		SiM
BH-3	15.00-15.45	48	39	9	12.73	14.63	72.64		SiM
BH-3	16.50-16.95	26	18	8	13.95	29.26	56.79		SiL
BH-3	18.00-18.45	25	19	6	16.13	47.31	36.56		SiSa
BH-3	19.50-19.95	46	39	7	6.45	26.66	66.89		SiM
BH-3	21.00-21.45	45	37	8	4.46	38.31	57.24		SiM
BH-3	22.50-22.95	48	40	8	16.38	18.90	64.71		SiM
BH-3	24.00-24.45	46	37	9	1.76	44.36	53.88		SiM
BH-3	25.50-25.95	57	44	13	4.46	6.29	89.25		SiH
BH-3	27.00-27.45	42	35	7	5.64	39.38	54.98		SiM
BH-3	28.50-28.95	47	40	7	8.34	30.70	60.97		SiM
BH-3	30.00-30.45	45	37	8	7.16	30.74	62.10		SiM
BH-3	31.50-31.95	42	34	8	3.87	27.79	68.35		SiM
BH-3	33.00-33.45	NP	NP	NP	4.63	88.19	7.18		SaW

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-3	34.50-34.95	NP	NP	NP	3.56	93.41	3.03		SaW
BH-3	36.00-36.45	NP	NP	NP	9.71	83.15	7.13		SaW
BH-3	39.00-39.50	NP	NP	NP	7.40	82.66	9.93		SaW
BH-3	41.00-41.50	46	39	7	2.59	35.58	61.84		SiM
BH-3	44.00-44.50	26	19	7	4.67	45.88	49.45		SiSa
BH-3	47.00-47.50	25	21	4	5.38	56.36	38.26		SiSa
BH-3	50.00-50.50	24	18	6	22.34	44.33	33.33		SiSa
BH-4	2.50-3.00	28	21	7	8.05	43.50	26.10	22.35	SiSa
BH-4	4.50-4.95	45	36	9	2.72	31.18	66.11		SİM
BH-4	5.50-6.00	47	42	5	5.42	38.83	29.14	26.60	SiM
BH-4	7.50-7.95	42	36	6	2.77	41.34	55.89		SiM
BH-4	9.00-9.45	27	20	7	10.09	49.94	39.96		SiSa
BH-4	10.50-10.95	46	37	9	7.07	30.46	62.46		SiM
BH-4	12.00-12.45	27	22	5	9.70	50.56	39.74		SiSa
BH-4	13.50-13.95	47	36	11	3.39	25.23	71.39		SiM
BH-4	14.50-15.00	48	41	7	6.30	28.19	34.27	31.25	SİM
BH-4	16.50-16.95	42	37	5	1.52	45.16	53.33		SiM
BH-4	18.00-18.45	49	40	9	0.00	22.59	77.41		SiM
BH-4	19.50-19.95	25	20	5	7.24	51.91	40.85		SiSa
BH-4	21.00-21.45	47	39	8	10.90	22.15	66.95		SiM
BH-4	22.50-22.95	57	42	15	0.71	10.77	88.51		SiH
BH-4	24.00-24.45	58	46	12	0.00	5.64	94.36		SiH
BH-5	1.50-1.95	45	23	22	4.29	25.43	70.28		CIM
BH-5	2.50-3.00	47	21	26	3.45	26.80	34.75	35.00	SİM
BH-5	4.50-4.95	46	39	7	11.04	23.26	65.70		SİM
BH-5	5.50-6.00	42	36	6	3.48	26.31	35.62	34.60	SİM
BH-5	7.50-7.95	47	40	7	8.45	22.48	69.07		SiM
BH-5	9.00-9.45	43	38	5	13.26	20.94	65.80		SiM
BH-5	10.50-10.95	47	38	9	7.34	20.67	71.99		SiM
BH-5	12.00-12.45	42	35	7	3.05	34.90	62.05		SiM
BH-5	13.50-13.95	25	20	5	4.39	57.35	38.26		SiSa
BH-5	15.00-15.45	23	16	7	5.19	53.93	40.88		SiSa
BH-5	16.50-16.95	44	38	6	4.75	38.89	56.36		SiM
BH-5	18.00-18.45	47	39	8	5.72	31.83	62.45		SiM
BH-5	19.50-19.95	49	40	9	4.46	23.46	72.08		SiM
BH-5	21.00-21.45	57	44	13	6.18	13.54	80.28		SiH

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-5	22.50-22.95	55	44	11	0.83	12.30	86.87		SiH
BH-5	24.00-24.45	52	38	14	1.67	13.73	84.60		SiH
BH-6	2.50-3.00	27	20	7	3.76	49.83	25.00	21.40	SiSA
BH-6	4.50-4.95	47	38	9	5.45	33.42	61.13		SİM
BH-6	5.50-6.00	45	39	6	8.78	24.75	35.83	30.65	SİM
BH-6	7.50-7.95	26	22	4	14.33	37.30	67.56		SiSa
BH-6	9.00-9.45	29	14	15	9.83	40.81	75.88		CISa
BH-6	10.50-10.95	25	18	7	8.73	30.58	71.93		SiM
BH-6	12.00-12.45	27	22	5	4.39	28.06	35.57		SiM
BH-6	13.50-13.95	25	18	7	3.38	20.74	32.64		SiM
BH-6	15.00-15.45	28	21	7	4.25	23.81	47.80		SiM
BH-6	16.50-16.95	26	20	6	5.69	58.74	36.22		SiSa
BH-6	18.00-18.45	23	18	5	4.50	62.86	40.30		SiSa
BH-6	19.50-19.95	27	19	8	15.38	36.82	49.11		SiSa
BH-6	21.00-21.45	25	20	5	0.14	63.64	48.37		SiSa
BH-6	22.50-22.95	26	19	7	4.98	54.72	49.37		SiSa
BH-6	24.00-24.45	27	19	8	10.94	39.95	60.69		SiSa
BH-7	2.50-3.00	45	38	7	1.57	25.65	39.28	33.50	SİM
BH-7	4.50-4.95	48	42	6	4.49	25.81	69.69		SİM
BH-7	5.50-6.00	26	18	8	5.16	47.10	25.70	22.05	SiSA
BH-7	7.50-7.95	48	41	7	9.77	23.87	66.36		SİM
BH-7	8.50-9.00	44	38	6	6.84	21.36	37.59	34.20	SİM
BH-7	10.50-10.95	45	39	6	4.19	31.55	64.26		SİM
BH-7	12.00-12.45	47	43	4	7.36	33.45	59.19		SİM
BH-7	13.50-13.95	26	19	7	9.71	54.59	35.70		SiSa
BH-7	15.00-15.45	24	19	5	9.00	47.20	43.79		SiSa
BH-7	16.50-16.95	28	20	8	14.03	37.77	48.20		SiSa
BH-7	18.00-18.45	26	18	8	1.51	52.27	46.21		SiSa
BH-7	19.50-19.95	25	15	10	6.86	48.31	44.83		SiSa
BH-7	21.00-21.45	27	20	7	8.35	44.85	46.80		SiSa
BH-7	22.50-22.95	47	39	8	2.75	21.69	75.56		SiM
BH-7	24.00-24.45	57	44	13	1.58	4.68	93.74		SiH
BH-7	25.50-25.95	27	22	5	22.35	27.48	50.17		SiL
BH-7	27.00-27.45	47	39	8	6.83	19.07	74.10		SİM
BH-7	28.50-28.95	56	43	13	4.62	6.45	88.93		SiH
BH-7	30.00-30.45	55	44	11	4.78	5.69	89.53		SiH

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-7	31.50-31.95	58	43	15	3.50	5.83	90.67		SiH
BH-7	33.00-33.45	24	17	7	11.08	44.91	44.01		SiSa
BH-7	34.50-34.95	27	20	7	7.67	43.95	48.38		SiSa
BH-7	36.00-36.45	25	19	6	9.12	41.41	49.46		SiSa
BH-7	38.00-38.50	24	19	5	8.76	61.33	29.91		SiSa
BH-7	40.00-40.50	23	17	6	13.60	43.89	42.51		SiSa
BH-7	42.00-42.50	25	18	7	13.22	56.68	30.10		SiSa
BH-7	44.00-44.50	23	16	7	10.23	52.50	37.27		SiSa
BH-7	46.00-46.50	28	19	9	15.77	32.11	52.12		SiL
BH-7	48.00-48.50	25	17	8	4.48	55.66	39.85		SiSa
BH-7	50.00-50.50	26	20	6	9.70	53.29	37.01		SiSa
BH-8	2.50-3.00	45	20	25	7.88	25.72	32.70	33.70	CIM
BH-8	4.50-4.95	42	38	4	6.46	27.80	65.74		SİM
BH-8	6.00-6.45	26	20	6	9.36	66.78	23.86		SiSA
BH-8	7.00-7.50	30	22	8	5.31	48.49	24.20	22.00	SiSA
BH-8	9.00-9.45	43	34	9	6.36	32.14	61.50		SİM
BH-8	10.50-10.95	25	20	5	8.60	53.10	38.29		SiSa
BH-8	12.00-12.45	28	21	7	24.03	41.83	34.14		SiSa
BH-8	13.50-13.95	26	18	8	13.89	46.93	39.19		SiSa
BH-8	15.00-15.45	29	22	7	8.86	57.76	33.38		SiSa
BH-8	16.50-16.95	55	40	15	3.98	12.52	83.50		SiH
BH-8	18.00-18.45	58	45	13	5.01	10.01	84.98		SiH
BH-8	19.50-19.95	57	39	18	2.73	10.97	86.31		SiH
BH-8	21.00-21.45	59	45	14	1.41	16.75	81.84		SiH
BH-8	22.50-22.95	60	48	12	0.00	9.83	90.17		SiH
BH-8	24.00-24.45	56	45	11	0.00	17.72	82.28		SiH
BH-9	2.50-3.00	47	40	7	6.61	47.03	24.26	22.10	SiM
BH-9	4.50-4.95	43	38	5	3.99	32.78	63.23		SiM
BH-9	5.50-6.00	47	39	8	9.66	30.55	30.34	29.45	SiM
BH-9	7.50-7.95	45	38	7	6.13	41.84	52.03		SiM
BH-9	8.50-8.95	44	36	8	5.32	35.28	59.40		SiM
BH-9	10.50-10.95	48	39	9	12.39	11.83	75.78		SiM
BH-9	12.00-12.45	45	38	7	2.65	39.21	58.14		SiM
BH-9	13.50-13.95	25	20	5	4.38	52.89	42.73		SiSa
BH-9	15.00-15.45	24	15	9	6.86	47.74	45.39		SiSa
BH-9	16.50-16.95	57	44	13	3.71	8.18	88.12		SiH

JEO-BİL Müh. Sondaj Tic. Ltd. Şti.
G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
Tel&Fax: (0282) 725 35 57

BH-9	18.00-18.45	56	45	11	4.76	13.26	81.98		SiH
BH-9	19.50-19.95	58	46	12	1.64	7.43	90.92		SiH
BH-10	1.50-1.95	48	41	7	4.98	18.71	76.31		SiM
BH-10	2.50-3.00	46	37	9	3.02	23.49	38.44	35.05	SİM
BH-10	4.50-4.95	26	19	7	4.26	51.35	44.39		SiSA
BH-10	5.50-6.00	25	18	7	3.21	47.42	26.62	22.75	SiSA
BH-10	7.50-7.95	47	39	8	6.96	24.98	68.06		SiM
BH-10	9.00-9.45	47	38	9	0.55	30.36	69.09		SiM
BH-10	10.50-10.95	45	40	5	14.09	31.63	54.27		SiM
BH-10	12.00-12.45	42	35	7	18.31	22.41	59.28		SiM
BH-10	13.50-13.95	26	17	9	0.32	62.61	37.07		SiSa
BH-10	15.00-15.45	28	16	12	5.61	45.51	48.88		CISa
BH-10	16.50-16.95	27	22	5	8.08	41.99	49.93		SiSa
BH-10	18.00-18.45	27	16	11	2.27	54.59	43.14		CISa
BH-10	19.50-19.95	25	19	6	11.03	40.89	48.09		SiSa
BH-11	1.50-1.95	43	23	20	6.04	24.76	69.20		CIM
BH-11	2.50-3.00	28	21	7	8.58	47.81	43.61		SiSa
BH-11	4.50-4.95	26	18	8	5.46	57.09	37.45		SiSa
BH-11	5.50-6.00	43	35	8	7.18	37.82	29.61	25.30	SİM
BH-11	7.50-7.95	29	20	9	8.68	54.94	36.38		SiSa
BH-11	9.00-9.45	27	20	7	6.18	64.00	29.82		SiSa
BH-11	10.50-10.95	42	36	6	7.82	26.74	65.43		SİM
BH-11	12.00-12.45	43	35	8	8.33	23.81	67.87		SİM
BH-11	13.50-13.95	28	21	7	8.16	47.94	43.90		SiSa
BH-11	15.00-15.45	30	22	8	5.90	52.89	41.22		SiSa
BH-11	16.50-16.95	57	42	15	4.14	8.28	87.58		SiH
BH-11	18.00-18.45	59	45	14	2.28	8.25	89.47		SiH
BH-11	19.50-19.95	56	39	17	0.00	9.64	90.36		SiH
BH-12	2.50-3.00	42	35	7	7.12	39.17	28.16	25.55	SİM
BH-12	4.50-4.95	28	19	9	8.96	51.11	39.93		SiSA
BH-12	5.50-6.00	44	37	7	6.12	37.37	30.51	26.00	SİM
BH-12	7.50-7.95	26	18	8	7.25	47.97	44.78		SiSA
BH-12	8.50-9.00	29	21	8	6.99	62.82	16.29	13.90	SiSA
BH-12	10.50-10.95	27	20	7	6.10	54.80	39.10		SiSa
BH-12	12.00-12.45	41	35	6	5.33	40.74	53.93		SİM
BH-12	13.50-13.95	28	20	8	9.20	58.27	32.52		SiSa

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BH-12	15.00-15.45	26	22	4	20.71	21.16	58.13		SiL
BH-12	16.50-16.95	28	25	3	24.24	23.30	52.46		SiL
BH-12	18.00-18.45	44	35	9	7.91	25.94	66.15		SİM
BH-12	19.50-19.95	42	35	7	9.04	23.26	67.70		SİM
BH-12	21.00-21.45	58	43	15	4.24	10.78	84.98		SiH
BH-12	22.50-22.95	56	38	18	2.73	10.79	86.48		SiH
BH-12	24.00-24.45	59	43	16	2.14	8.91	88.95		SiH
BH-12	25.50-25.95	55	36	19	4.27	11.10	84.63		SiH
BH-12	27.00-27.45	57	40	17	3.58	6.57	89.85		SiH
BH-12	28.50-28.95	58	42	16	2.18	14.90	82.92		SiH
BH-12	30.00-30.45	56	37	19	4.44	10.95	84.61		SiH
BH-12	31.50-31.95	46	38	8	5.38	20.61	74.01		SİM
BH-12	33.00-33.45	43	34	9	4.51	17.30	78.20		SİM
BH-12	34.50-34.95	45	37	8	6.18	22.97	70.86		SİM
BH-13	2.50-3.00	42	20	22	6.87	36.59	25.14	31.40	CIM
BH-13	4.50-4.95	58	42	16	3.92	7.72	88.36		SiH
BH-13	5.50-6.00	43	35	8	8.35	24.02	37.63	30.00	SİM
BH-13	7.50-7.95	45	36	9	6.80	22.09	71.11		SİM
BH-13	8.50-9.00	42	33	8	8.19	29.01	33.90	28.90	SİM
BH-13	10.50-10.95	45	38	7	6.99	31.38	61.63		SİM
BH-13	12.00-12.45	44	38	6	5.74	30.90	63.36		SİM
BH-13	13.50-13.95	46	37	9	7.75	20.53	71.73		SİM
BH-13	15.00-15.45	42	34	8	6.64	22.95	70.41		SİM
BH-13	16.50-16.95	43	36	7	6.21	20.39	73.40		SİM
BH-13	18.00-18.45	40	31	9	8.22	23.14	68.64		SİM
BH-13	19.50-19.95	44	38	6	7.28	29.23	63.49		SİM
BH-14	2.50-3.00	43	23	20	7.64	26.10	31.56	34.70	CIM
BH-14	4.50-4.95	40	33	7	8.91	20.76	70.33		SİM
BH-14	5.50-6.00	44	35	9	5.90	27.15	37.20	29.75	SİM
BH-14	7.50-7.95	41	34	7	7.28	32.91	59.82		SİM
BH-14	9.00-9.45	27	19	8	9.06	49.13	41.81		SiSa
BH-14	10.50-10.95	58	42	16	2.27	9.58	88.15		SiH
BH-14	12.00-12.45	25	17	8	6.64	58.27	35.09		SiSa
BH-14	13.50-13.95	42	33	9	8.64	37.50	53.86		SİM
BH-14	15.00-15.45	44	37	7	6.94	28.01	65.06		SİM
BH-14	16.50-16.95	41	32	9	6.10	25.74	68.16		SİM

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BH-14	18.00-18.45	45	37	8	5.25	22.88	71.87		SİM
BH-14	19.50-19.95	43	35	8	6.43	21.44	72.12		SİM
BH-15	1.50-1.95	41	34	7	5.24	24.33	70.43		SİM
BH-15	2.50-3.00	28	20	8	7.33	54.03	20.24	18.40	SiSa
BH-15	4.50-4.95	44	35	9	5.95	32.30	61.75		SİM
BH-15	5.50-6.00	42	35	7	8.90	36.67	29.38	25.05	SİM
BH-15	7.50-7.95	41	32	9	6.81	34.17	59.02		SİM
BH-15	9.00-9.45	30	22	8	9.69	55.50	34.82		SiSa
BH-15	10.50-10.95	27	20	7	6.30	58.24	35.45		SiSa
BH-15	12.00-12.45	26	19	7	5.34	66.58	28.08		SiSa
BH-15	13.50-13.95	29	20	9	6.52	50.80	42.68		SiSa
BH-15	15.00-15.45	43	35	8	5.35	40.11	54.54		SİM
BH-15	16.50-16.95	45	37	8	7.38	34.92	57.70		SİM
BH-15	18.00-18.45	28	19	9	5.44	51.98	42.58		SiSa
BH-15	19.50-19.95	29	22	7	6.26	56.83	36.91		SiSa
BH-16	1.50-1.95	44	22	22	5.88	23.12	70.99		CIM
BH-16	2.50-3.00	28	20	8	5.28	47.83	46.89		SiSa
BH-16	4.50-4.95	42	35	7	8.74	25.81	65.45		SİM
BH-16	5.50-6.00	43	34	9	6.01	34.58	34.57	24.85	SİM
BH-16	7.50-7.95	28	21	7	10.80	55.61	33.58		SiSA
BH-16	8.50-9.00	26	23	3	9.15	27.45	34.25	29.15	SiL
BH-16	10.50-10.95	45	37	8	6.96	25.07	67.97		SİM
BH-16	12.00-12.45	58	43	15	3.80	14.60	81.60		SiH
BH-16	13.00-13.50	42	33	9	5.57	19.58	40.40	34.45	SİM
BH-16	15.00-15.45	45	38	7	7.01	24.52	68.48		SİM
BH-16	16.50-16.95	43	35	8	7.80	27.44	64.76		SİM
BH-16	18.00-18.45	40	32	8	6.10	26.07	67.84		SİM
BH-16	19.50-19.95	43	34	9	5.76	22.97	71.27		SİM
BH-16	21.00-21.45	57	40	17	4.21	10.86	84.93		SiH
BH-16	22.50-22.95	58	43	15	2.73	8.05	89.22		SiH
BH-16	24.00-24.45	55	36	19	0.00	9.70	90.30		SiH
BH-16	25.50-25.95	59	44	15	0.00	17.50	82.50		SiH
BH-16	27.00-27.45	57	41	16	1.37	12.40	86.23		SiH
BH-16	28.50-28.95	56	38	18	3.09	13.47	83.44		SiH
BH-16	30.00-30.45	58	41	17	4.49	10.18	85.33		SiH
BH-16	31.50-31.95	29	21	8	5.35	48.91	45.74		SiSa

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BH-16	33.00-33.45	59	43	16	3.83	14.81	81.36		SiH
BH-16	34.50-34.95	56	37	19	2.23	11.83	85.94		SiH
BH-17	2.50-3.00	43	35	8	5.97	42.22	51.82		SİM
BH-17	4.50-4.95	27	21	6	6.11	54.00	39.90		SiSa
BH-17	5.50-6.00	25	18	7	7.98	46.73	24.44	20.85	SiSA
BH-17	7.50-7.95	28	19	9	5.32	51.37	43.31		SiSA
BH-17	8.50-9.00	42	35	7	6.59	41.32	28.14	23.95	28.14
BH-17	10.50-10.95	41	33	8	8.17	30.10	61.73		SİM
BH-17	12.00-12.45	45	39	6	6.90	26.89	66.21		SİM
BH-17	13.50-13.95	43	35	8	5.62	24.45	69.93		SİM
BH-17	15.00-15.45	40	31	9	8.03	32.31	59.66		SİM
BH-17	16.50-16.95	41	34	7	9.30	36.33	54.37		SİM
BH-17	18.00-18.45	30	24	6	8.07	54.68	37.25		SiSa
BH-17	19.50-19.95	26	18	8	8.72	58.17	33.11		SiSa
BH-18	2.50-3.00	43	34	9	6.56	20.11	40.78	32.55	SİM
BH-18	4.50-4.95	42	35	7	8.70	23.74	67.56		SİM
BH-18	5.50-6.00	45	37	8	7.42	31.67	32.91	28.00	SİM
BH-18	7.50-7.95	41	33	8	8.84	32.26	58.89		SİM
BH-18	9.00-9.45	25	22	3	21.11	24.34	54.55		SiL
BH-18	10.50-10.95	30	21	9	9.15	54.19	36.66		SiSa
BH-18	12.00-12.45	56	40	16	2.70	7.45	89.86		SiH
BH-18	13.50-13.95	28	23	5	10.91	38.86	50.23		SiL
BH-18	15.00-15.45	26	24	2	14.79	27.44	57.77		SiL
BH-18	16.50-16.95	44	36	8	7.30	32.62	60.08		SİM
BH-18	18.00-18.45	40	31	9	5.99	28.77	65.23		SİM
BH-18	19.50-19.95	43	37	6	8.64	29.20	62.17		SİM
BH-18	21.00-21.45	29	22	7	7.11	49.02	43.87		SiSa
BH-18	22.50-22.95	58	41	17	0.71	4.14	95.15		SiH
BH-18	24.00-24.45	55	36	19	0.00	3.78	96.22		SiH
BH-18	25.50-25.95	59	43	16	0.00	3.67	96.33		SiH
BH-18	27.00-27.45	56	38	18	0.00	6.22	93.78		SiH
BH-18	28.50-28.95	58	41	17	0.83	10.73	88.44		SiH
BH-18	30.00-30.45	55	39	16	0.00	10.32	89.68		SiH
BH-18	31.50-31.95	59	40	19	0.00	8.76	91.24		SiH
BH-18	33.00-33.45	57	42	15	0.00	5.57	94.43		SiH
BH-18	34.50-34.95	56	39	17	0.00	4.16	95.84		SiH

able 29: Sieve and Atterberg results of samples taken from boreholes.

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❖ CONSISTENCY AND CONSISTENCY LIMITS

Plasticity Index; PI (%)	Plasticity Degree	Dry Strength
0 - 5	Non-Plastic	Very Low
5 - 15	Slightly Plastic	Low
15 - 40	Plastic	Average
40	Highly Plastic	High

Table 30: Determination of Plasticity Degree by PI (Leonard, 1962)

According to this table, the plasticity index corresponds to a value of 0.0-37; where the degree of Plasticity at clayey levels is plastic, dry strength is **moderate**, degree of Plasticity at silty levels is "**not plastic/slightly plastic/plastic**"; dry strength is **"very low-low-medium"**, degree of Plasticity at sandy levels is "**not plastic-slightly plastic**", and dry strength is "**very low-low**".

❖ SOIL SWELLING DEGREE

Passing Through Sieve No. 200	LL (%)	Swelling Degree
>95	>60	Very high
60 – 95	40 – 60	High
30 – 60	30 – 40	Average
> 30	> 30	Low

Table 31: Possible Volume Changes in Swelling Clays (Chen, 1975)

According to this table, corresponding to the liquid limit (LL) values of 23-60 and passing through Sieve No. 200 with a rate of 3.03-96.33%; the degree of swelling in clayey soils is **medium-high**, the degree of swelling in silty soils is **medium-high-very high**, and the degree of swelling in sandy soils is **low-medium**. However, since the loads transferred from the structure built in the study area to the soil are higher than the soil load removed from the environment, swelling will not occur.

❖ SOIL COMPRESSION INDEX (Cc)

Definition	Compression Index (Cc)	Liquid Limit (%)
High Compressibility	> 0.40	>51
Medium Compressibility	0.20 – 0.39	31 – 50
Low Compressibility	0 – 0.19	0 – 30

Table 32: Determination of Compression Index according to Liquid Limit values

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From the formula Cc = 0.009 (LL – 10), corresponding to the liquid limit (LL) values of 0.0-60, the soil is medium in clayey levels, low-medium-high in silty levels, and low in sandy levels.

❖ **DEFINITION OF SOIL ACCORDING TO THE AMOUNT OF WATER**

Wn (%)	Soil Definition
0 - 20	Non-weathered - Dry
20 - 40	Slightly Weathered - Slightly Dry
40 - 70	Medium Weathered - Medium Wet
70 - 90	Highly Weathered - Wet
90 - 100	Completely Weathered - Very Wet

Table 33: Identification of Soil Based on Water Content Value

According to the water content tests, as the **Wn = 13.14-32.71%**, the **soil properties are non-weathered – dry / slightly weathered – slightly dry** (Ulusay R. Uygulamalı Jeoteknik Bilgiler, p. 163).

6. ENGINEERING GEOLOGY OF THE STUDY AREA

The base rock of the area of investigation is composed of the sedimentary sequence of Ergene formation, which is made up of white, yellowish, cross-bedded, clay and gravel lens, loosely compacted sands. Ergene formation is observed as unconformable over Danisment formation. Clay lenses between large and small-scale planar and trough cross-bedded gravels and sands present limited dispersal. In the cross beds, the current is generally southward and unidirectional. Cross-bedded gravel and sands, channel deposits, fine sand, silt, and clays can be interpreted as floodplain sediments. Based on some vertebrate fossils found, this unit was associated with Upper Miocene age.

Çebeci and Sinanlı formations, members of Kurtdere, are also distinguished within the Ergene group (Figure 1, Generalized stratigraphic section of the area of investigation).

It has been observed that Thrace formation subsided with angular unconformity on Ergene group located in the investigation.

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7. GEOLOGICAL STATUS

In the study area, from the surface:

DATE	GWL (m)	DEPTH	LITHOLOGY
BH-1	5.50	0.00 – 1.00	Vegetable Soil.
		1.00 – 16.00	Medium plasticity silt: SİM
		16.00 – 18.00	Low plasticity silt: SiL
		18.00 – 20.00	Silty sand: SiSA
		20.00 – 22.00	Medium plasticity silt: SİM
		22.00 – 25.00	High plasticity silt: SiH
BH-2	6.50	0.00 – 1.00	Vegetable Soil.
		1.50 – 4.50	Medium plasticity silt: SİM
		4.50 – 8.50	Silty sand: SiSA
		8.50 – 12.50	Medium plasticity silt: SİM
		12.50 – 14.00	Low plasticity silt: SiL
		14.00 – 20.00	Silty sand: SiSA
		20.00 – 23.00	Low plasticity silt: SiL
		23.00 – 25.00	Medium plasticity clay: CIM
BH-3	6.50	0.00 – 1.00	Vegetable Soil.
		1.00 – 4.00	Medium plasticity clay: CIM
		4.00 – 7.50	Medium plasticity silt: SİM
		7.50 – 10.50	Silty sand: SiSA
		10.50 – 16.50	Medium plasticity silt: SİM
		16.50 – 18.00	Low plasticity silt: SiL
		18.00 – 19.00	Silty sand: SiSA
		19.00 – 25.00	Medium plasticity silt: SİM
		25.00 – 27.00	High plasticity silt: SiH
		27.00 – 33.00	Medium plasticity silt: SİM
		33.00 – 40.00	Well graded sand: SAW
		40.00 – 42.00	Medium plasticity silt: SİM
		42.00 – 50.00	Silty sand: SiSA
BH-4	3.80	0.00 – 1.50	Vegetable Soil.
		1.50 – 3.00	Silty sand: SiSA
		3.00 – 8.00	Medium plasticity silt: SİM
		8.00 – 10.00	Silty sand: SiSA
		10.00 – 12.00	Medium plasticity silt: SİM
		12.00 – 13.00	Silty sand: SiSA
		13.00 – 18.50	Medium plasticity silt: SİM
		18.50 – 20.00	Silty sand: SiSA

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		20.00 – 22.00	Medium plasticity silt: SİM
		22.00 – 25.00	High plasticity silt: SiH
BH-5	**4.50**	**0.00 – 1.50**	Vegetable Soil.
		1.50 – 4.00	Medium plasticity clay: CIM
		4.00 – 13.00	Medium plasticity silt: SİM
		13.00 – 16.50	Silty sand: SiSA
		16.50 – 20.00	Medium plasticity silt: SİM
		20.00 – 25.00	High plasticity silt: SiH
BH-6	**5.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Silty sand: SiSA
		3.00 – 7.00	Medium plasticity silt: SİM
		7.00 – 8.50	Silty sand: SiSA
		8.50 – 10.00	Clay sand: CLSA
		10.00 – 16.00	Medium plasticity silt: SİM
		16.00 – 25.00	Silty sand: SiSA
BH-7	**8.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 5.00	Medium plasticity silt: SİM
		5.00 – 7.00	Silty sand: SiSA
		7.00 – 13.00	Medium plasticity silt: SİM
		13.00 – 22.00	Silty sand: SiSA
		22.00 – 24.00	Medium plasticity silt: SİM
		24.00 – 25.00	High plasticity silt: SiH
		25.00 – 27.00	Low plasticity silt: SiL
		27.00 – 28.00	Medium plasticity silt: SİM
		28.00 – 33.00	High plasticity silt: SiH
		33.00 – 46.00	Silty sand: SiSA
		46.00 – 48.00	Low plasticity silt: SiL
		48.00 – 50.00	Silty sand: SiSA
BH-8	**10.00**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.00	Medium plasticity clay: CIM
		4.00 – 5.50	Medium plasticity silt: SİM
		5.50 – 8.50	Silty sand: SiSA
		8.50 – 10.50	Medium plasticity silt: SİM
		10.50 – 16.00	Silty sand: SiSA
		16.00 – 25.00	High plasticity silt: SiH
BH-9	**6.00**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 13.00	Medium plasticity silt: SİM
		13.00 – 16.00	Silty sand: SiSA

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
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		16.00 – 20.00	High plasticity silt: SiH
BH-10	**5.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.00	Medium plasticity silt: SİM
		4.00 – 6.00	Silty sand: SiSA
		6.00 – 13.00	Medium plasticity silt: SİM
		13.00 – 14.00	Silty sand: SiSA
		14.00 – 16.00	Clay sand: CLSA
		16.00 – 18.00	Silty sand: SiSA
		18.00 – 19.00	Clay sand: CLSA
		19.00 – 20.00	Silty sand: SiSA
BH-11	**3.70**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 2.50	Medium plasticity clay: CIM
		2.50 – 5.00	Silty sand: SiSA
		5.00 – 7.00	Medium plasticity silt: SİM
		7.00 – 9.50	Silty sand: SiSA
		9.50 – 13.00	Medium plasticity silt: SİM
		13.00 – 16.00	Silty sand: SiSA
		16.00 – 20.00	High plasticity silt: SiH
BH-12	**4.00**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Medium plasticity silt: SİM
		3.00 – 5.00	Silty sand: SiSA
		5.00 – 7.00	Medium plasticity silt: SİM
		7.00 – 11.00	Silty sand: SiSA
		11.00 – 12.50	Medium plasticity silt: SİM
		12.50 – 14.00	Silty sand: SiSA
		14.00 – 17.00	Low plasticity silt: SiL
		17.00 – 21.00	Medium plasticity silt: SİM
		21.00 – 31.00	High plasticity silt: SiH
		31.00 – 35.00	Medium plasticity silt: SİM
BH-13	**3.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Medium plasticity clay: CIM
		3.00 – 5.00	High plasticity silt: SiH
		5.00 – 8.00	Medium plasticity silt: SİM
		8.00 – 8.50	Sand.
		8.50 – 20.00	Medium plasticity silt: SİM
BH-14	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Medium plasticity clay: CIM
		3.00 – 8.50	Medium plasticity silt: SİM

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		8.50 – 10.00	Silty sand: SiSA
		10.00 – 12.00	High plasticity silt: SiH
		12.00 – 13.00	Silty sand: SiSA
		13.00 – 20.00	Medium plasticity silt: SİM
BH-15	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 2.50	Medium plasticity silt: SİM
		2.50 – 5.00	Silty sand: SiSA
		5.00 – 8.50	Medium plasticity silt: SİM
		8.50 – 14.00	Silty sand: SiSA
		14.00 – 18.00	Medium plasticity silt: SİM
		18.00 – 20.00	Silty sand: SiSA
BH-16	**3.50**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 2.50	Medium plasticity clay: CIM
		2.50 – 4.50	Silty sand: SiSA
		4.50 – 7.00	Medium plasticity silt: SİM
		7.00 – 8.00	Silty sand: SiSA
		8.00 – 10.00	Low plasticity silt: SiL
		10.00 – 11.00	Medium plasticity silt: SİM
		11.00 – 13.00	High plasticity silt: SiH
		13.00 – 20.00	Medium plasticity silt: SİM
		20.00 – 31.00	High plasticity silt: SiH
		31.00 – 32.00	Silty sand: SiSA
		32.00 – 35.00	High plasticity silt: SiH
BH-17	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.00	Medium plasticity silt: SİM
		4.00 – 8.00	Silty sand: SiSA
		8.00 – 17.00	Medium plasticity silt: SİM
		17.00 – 20.00	Silty sand: SiSA
BH-18	**3.20**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 9.00	Medium plasticity silt: SİM
		9.00 – 10.00	Low plasticity silt: SiL
		10.00 – 11.00	Silty sand: SiSA
		11.00 – 13.00	High plasticity silt: SiH
		13.00 – 16.00	Low plasticity silt: SiL
		16.00 – 21.00	Medium plasticity silt: SİM
		21.00 – 22.00	Silty sand: SiSA
		22.00 – 35.00	High plasticity silt: SiH
BH-AR01	**3.50**	**0.00 – 1.00**	Vegetable Soil.

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G.O.P Mah. Ravalı Sk. No: 11 Kat:1/2
ÇERKEZKÖY/TEKİRDAĞ
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		1.00 – 8.00	Medium plasticity silt: SİM
		8.00 – 11.00	Silty sand: SiSA
		11.00 – 17.50	Medium plasticity silt: SİM
		17.50 – 20.00	Silty sand: SiSA
		20.00 – 25.00	High plasticity silt: SiH
BH-AR02	**3.70**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 4.50	Medium plasticity clay: CIM
		4.50 – 5.50	Clay sand: CLSA
		5.50 – 11.00	Medium plasticity silt: SİM
		11.00 – 13.00	High plasticity silt: SiH
		13.00 – 16.50	Medium plasticity silt: SİM
		16.50 – 19.00	High plasticity silt: SiH
		19.00 – 20.50	Medium plasticity silt: SİM
		20.50 – 23.00	High plasticity silt: SiH
		23.00 – 25.00	Medium plasticity silt: SİM
		25.00 – 27.00	Silty sand: SiSA
		27.00 – 33.00	Well graded sand: SAW
		33.00 – 40.00	Silty sand: SiSA
BH-AR03	**10.00**	**0.00 – 1.00**	Vegetable Soil.
		1.00 – 3.00	Silty sand: SiSA
		3.00 – 7.00	Medium plasticity clay: CIM
		7.00 – 11.00	Medium plasticity silt: SİM
		11.00 – 15.50	Silty sand: SiSA
		15.50 – 17.00	Medium plasticity silt: SİM
		17.00 – 19.00	Clay sand: CLSA
		19.00 – 21.00	Silty sand: SiSA
		21.00 – 22.00	High plasticity silt: SiH
		22.00 – 24.00	Medium plasticity clay: CIM
		24.00 – 25.00	Medium plasticity silt: SİM

- **Evaluation of Karstic Cavities**

No karstic cavities were found in 21 drills performed in the study area at a depth of 20.00-50.00 meters.

- **Evaluation of Units Selected as Foundation Soil**

The units examined in the drillings, corresponding to the soil level, are of medium plasticity clays, low-medium-high plasticity silts and clayey-silty sand and poorly graded sand units belonging to the Ergene formation deposits.

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8. RESULTS AND RECOMMENDATIONS

This report belongs to the Intermodal Terminal Centre construction to be contracted by the Ministry of Transport, and the geological data obtained from the field are given below.

► The study area is within the borders of Tekirdağ province, Çerkezköy district, Ergene district, Karamehmet neighbourhood, where the Intermodal Terminal Centre will be constructed.

►In the study area, 7 work items of 20.00 meters, 8 work items of 25.00 meters, 3 work items of 35.00 meters, 1 work item of 40.00 meters and 2 work items of 50.00 meters, making a total of 585.00 meters of drilling works as well as 10 ea. seismic refraction-MASW and 5 ea. Microtremor studies were carried out.

► In the study area, under the vegetable soil with a thickness of 1.00 m, Miocene aged sediments of the Ergene formation represented by medium plasticity clays, low-medium-high plasticity silts and clayey-silty sand and poorly graded sand units, consisting of repeated layers of sand-silt-clay as the depth increases, are available.

► In boreholes with a depth of 20,00-50,00 meters drilled in the study area, water was found at depths of 3.20-10.00 meters.

► According to the Turkey Earthquake Hazard Maps, the probability of exceeding a magnitude of 7.0 in an earthquake within 50 years is 3.2% (repetition period of 1551 years), and the average ground acceleration of the study area is 0.17, corresponding to a medium hazard class. In the structures to be constructed in the study area, the "**EARTHQUAKE REGULATIONS**" as well as "**THE PRINCIPLES ON BUILDINGS TO BE CONSTRUCTED IN EARTHQUAKE REGIONS**" must be complied with.

► Earthquake Ground Motion Level – 2 class is **DD-2**.

► Based on elastic earthquake loads of the structure to be constructed in the study area, the **local soil class is determined as ZD** (according to AFAD 2018, Turkey Building Earthquake Regulation).

► Map Spectral Acceleration Coefficient for Short Period $\mathbf{S_{DS}}$ **= 0.868**

► Map Spectral Acceleration Coefficient for 1.0 Second Period $\mathbf{S_{D1}}$ **= 0.431**

► Building Utilization Class – (BUC) : 3

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- Building Importance Factor – (I) : 1.0
- Building Height Class – (BHC) : 8
- D.B.H.A. ($\gamma_{n)}$: 1.890-1.950 gr/cm^3
- Water Content (Wn) : 13.14-32.71%
- It is recommended to take necessary drainage measures to prevent damage to the foundation and structure from surface waters in the study area.

- If the depth of the foundation is more than 3.00 meters and the soil is prone to sliding, it is recommended to take necessary measures, such as the construction of a retaining wall, against problems such as ground slips that may occur during foundation excavations and construction.

- "Turkey Building Earthquake Regulation" and "Decision of the Council of Ministers on Turkey Earthquake Hazard Map and Parameter Values" were published in the Official Gazette no. 30364 dated 18 March 2018. The principles of the Building Earthquake Regulation, which entered into force on 1 January 2019, must be followed.

- This report has been prepared for the purpose of investigating the area within the borders of Tekirdağ province, Ergene district, Karamehmet neighbourhood, and cannot be used in any other official procedures without permission.

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