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Final Event of the European Project TRITON

Geotechnical surveys in the coastal zone of the gulf of Patras

N. Sabatakakis, N. Depountis

Project co-funded by European Union, European Regional Development Funds (E.R.D.F.) and by National Funds of Greece and Italy

RESEARCH TEAM OF THE LAB OF ENGINEERING GEOLOGY

- Nikolaos Sabatakakis, Project Manager, Professor of Engineering Geology
- Nikolaos Depountis, Deputy project Manager, Assistant professor of Engineering Geology
- Aikaterini Kavoura, Post Doc Researcher
- Vasileios Bouboulis, PhD Candidate

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ENGAGED ACTIVITIES

Equipment installation performed by the Region of Western Greece

- one wave data buoy system for wave intensity measurements
- two tide gauges (marigraphs) for sea rise level and tidal measurements
- two weather stations for real time atmospheric measurements

Surveys and studies performed by the University of Patras

- Geotechnical surveys and engineering geological plans
- Satellite, aerial photo imaging, UAV and USV surveys
- Marine surveys and digital bathymetric plans
- Environmental monitoring in the protected areas
- Numerical study of waves, currents and sediment transport

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GEOTECHNICAL SURVEYS

In the frame of the TRITON project an extensive geotechnical investigation program was performed along the shoreline of the gulf of Patras, comprising of:
(a) Borehole drilling and core sampling
(b) in-situ and lab tests
(c) sediment analysis

The purpose of this program was to identify the soil's stratigraphy and its geotechnical properties for specific coastal applications

Google-Earth map representing the geotechnical operations performed along the shoreline of the gulf of Patras (borehole drilling: ΓΝ, CPT tests and sampling points for sediment analysis: S)

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Borehole drilling and core sampling

- Six (6) boreholes were drilled along the shoreline of the gulf of Patras with a total length of 86,53m and the relevant soil core sampling, in-situ (SPT: Standard Penetration Tests) and laboratory tests were performed.
- Standard soil penetration (SPT) tests, according to ASTM D 1586–08a standards, were also performed, in the soil penetrated formations.
- All soil core samples, after on-site macroscopic examination and recording, were placed in special log boxes, photographed, and transported in the lab for testing.

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Standard Penetrometer Tests (SPT)

Execution of Standard Penetration Tests (SPT) in boreholes at intervals of 1.5 m depth in each of them
The test uses a thick-walled sample tube **(2)**, which is driven into the ground at the bottom of the borehole by blows from a slide hammer with a mass of 63.5 kg **(1)** falling through a distance of 760 mm. The sample tube is driven 150 mm into the ground **(3)** by three penetrations and the sum of the number of blows required for the second and third penetration up to a depth of 300 mm is termed the "standard penetration resistance" or the "N-value". The blow count provides an indication of the density of the ground, and a semi-disturbed sample is received **(4)**

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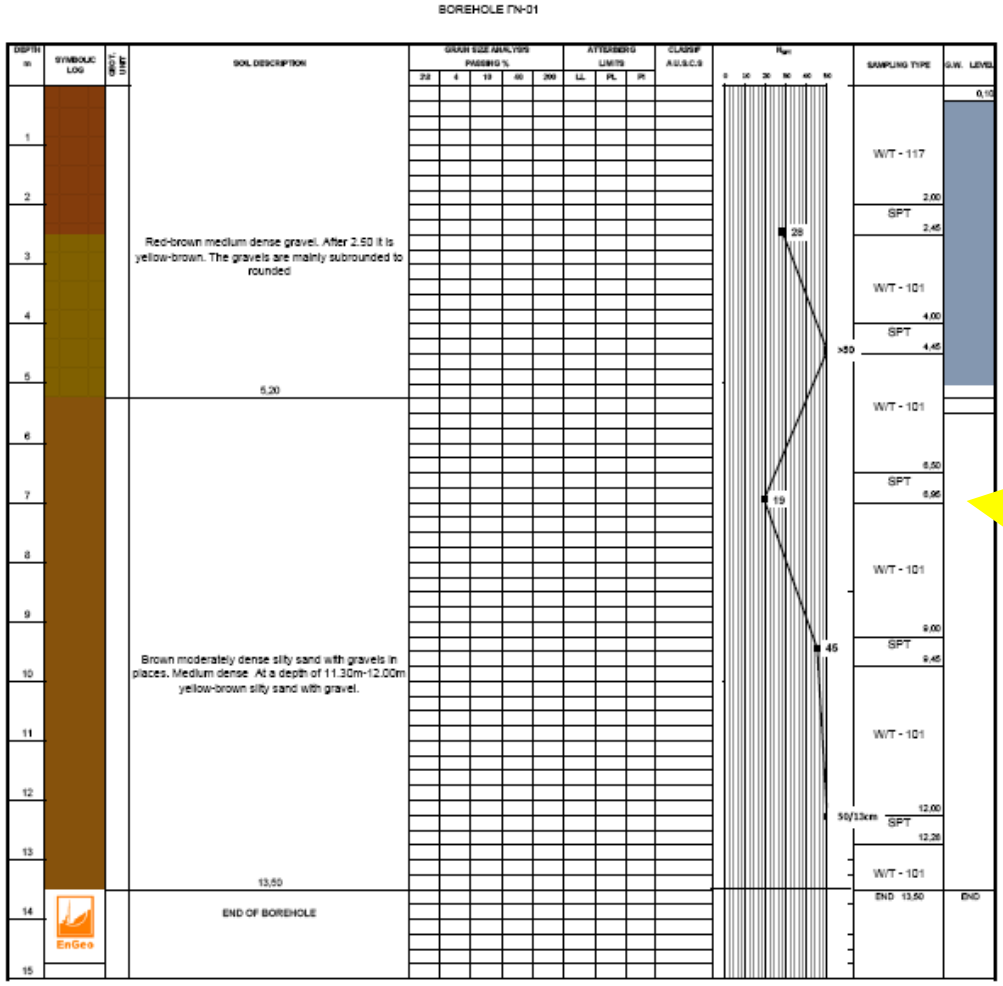
Borehole logs



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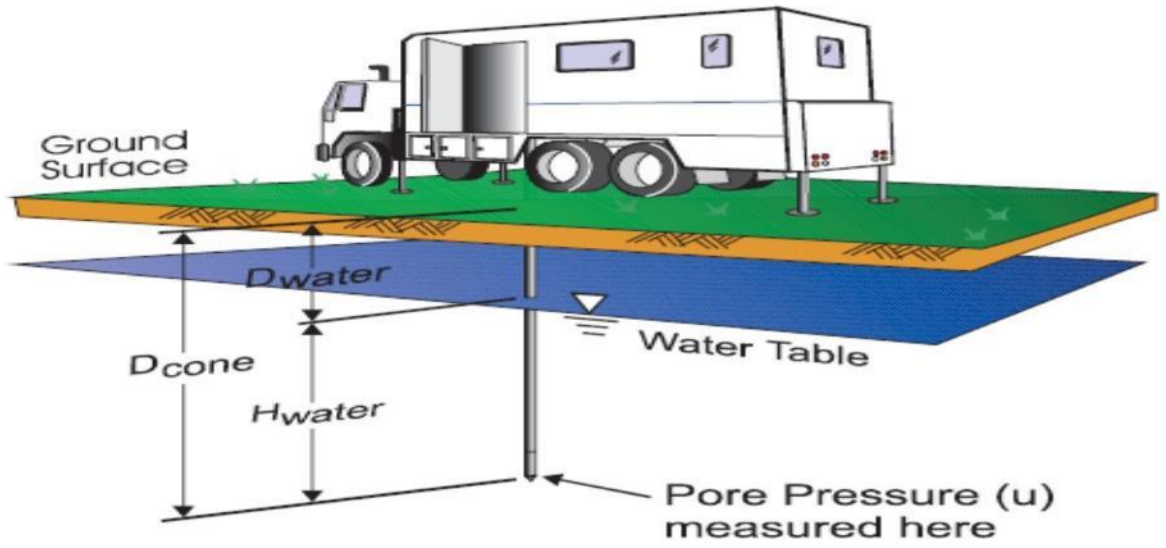
Cone Penetrometer Tests (CPT)



Execution of Cone Penetrometer Tests (CPT) on land, in different areas, where soft saturated sediments exist along the shoreline. The cone penetrometer test (CPT) is a method used to determine the engineering geological properties of soils, pore water pressure as well as soil stratigraphy

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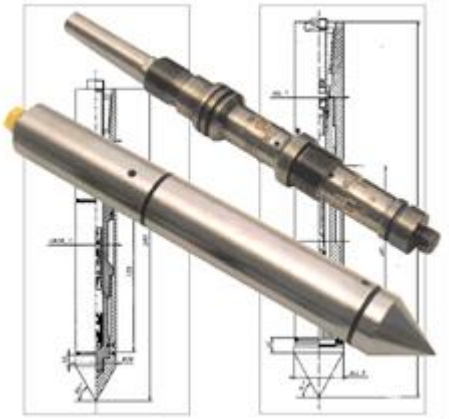
Cone Penetrometer Test (CPT) Equipment



Subtraction Cones

The 10 cm^2 and 15 cm^2 subtraction cones (GS) come with the following channels:
Cone resistance (C), local friction (F), inclination (I) and pore pressure (P).

Compression Cones

The 10 cm^2 compression cones come with the following channels: Cone resistance (C), local friction (F), inclination (I: deviation, II: biaxial) and pore pressure (P). The available measurement ranges are listed below but other ranges can be provided upon request. Pore pressure is measured behind the shoulder of the tip (u2 position).

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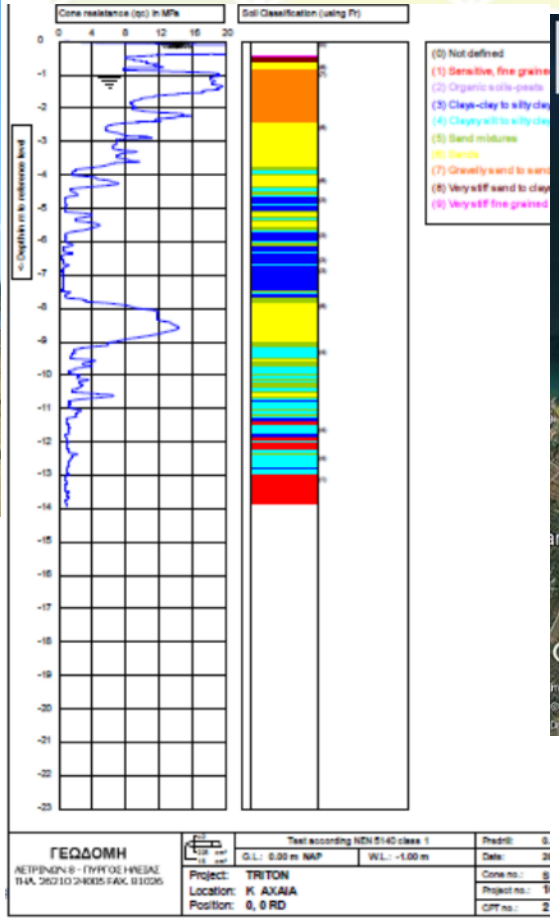
Cone Penetrometer Tests in the area of intervention



Google-Earth map representing the penetration tests performed along the shoreline of the gulf of Patras, in the areas of Kato Achaia and Alykes fishery port

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Sediment sampling and grain size analysis

Shoreline for sediment sampling for coastal engineering purposes and sediment mapping

Sediment sampling in 102 different positions along the shoreline of the gulf of Patras
Execution of laboratory identification and classification tests on the received soil samples with an emphasis given in grain size analysis and other physical properties.
This procedure identifies the origin of the deposited sediments in the coastal zone, which is very important in the subsequent analyses of sediment transport

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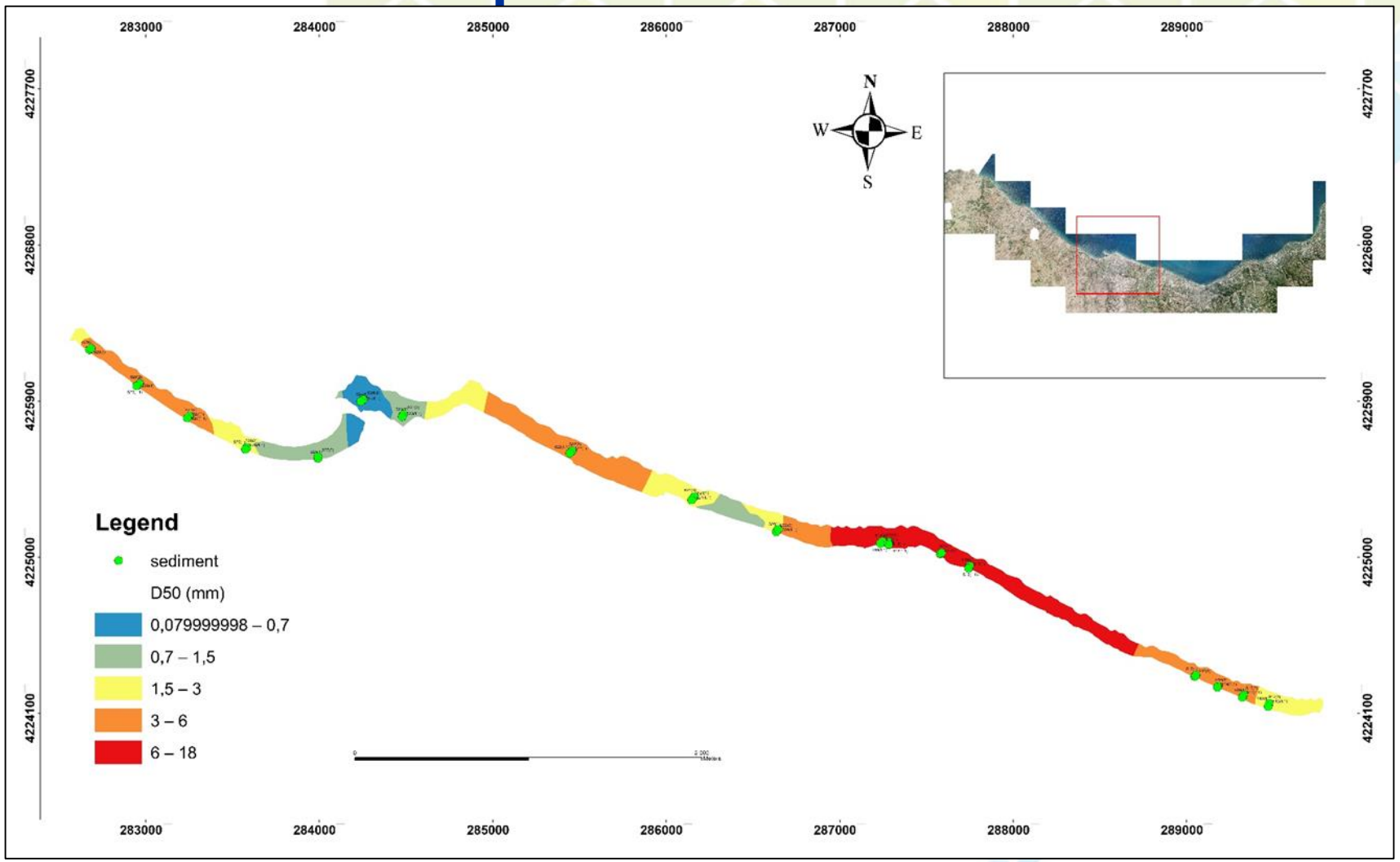
Sediment maps in the area of intervention



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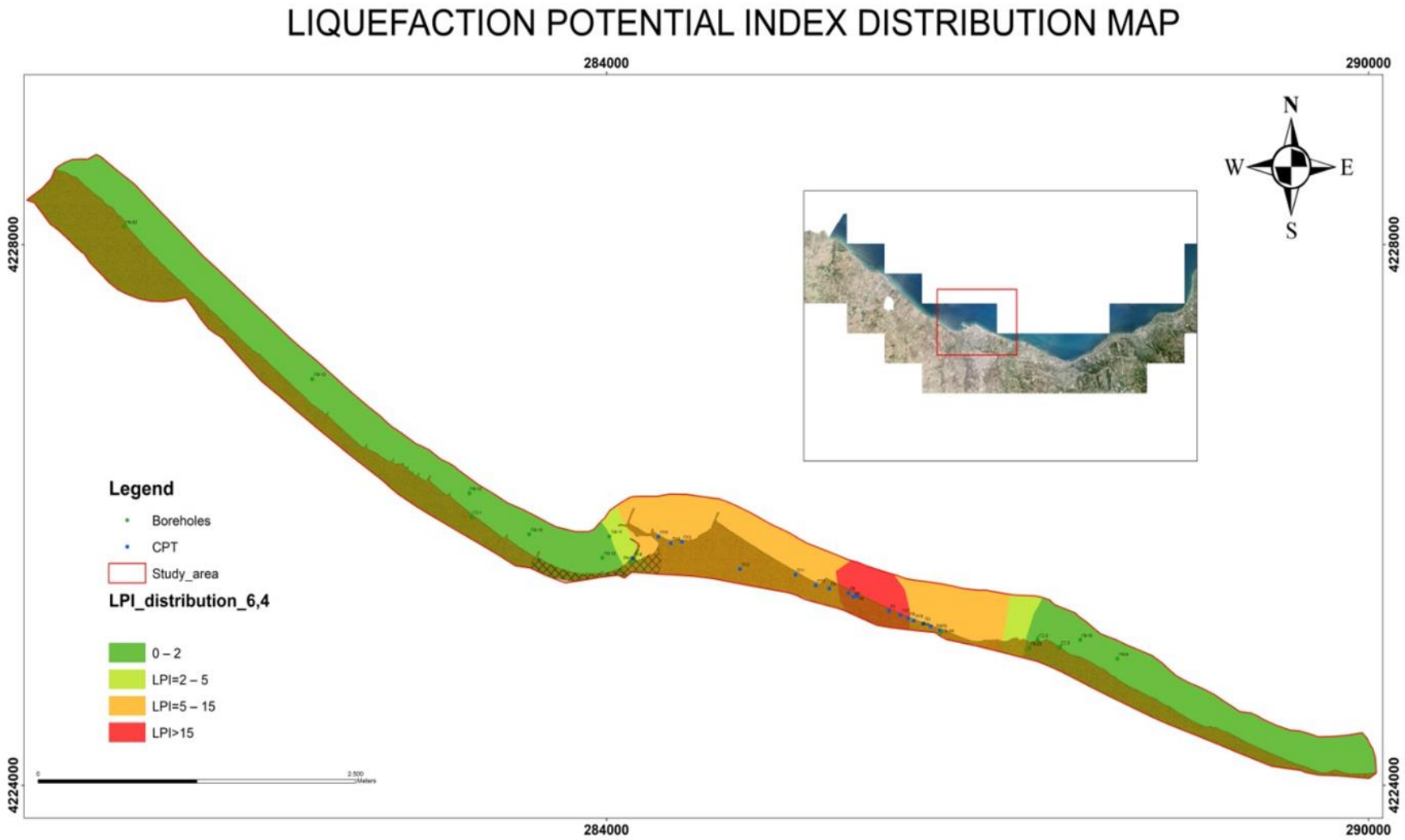
Liquefaction Potential Index (LPI) map in the area of intervention



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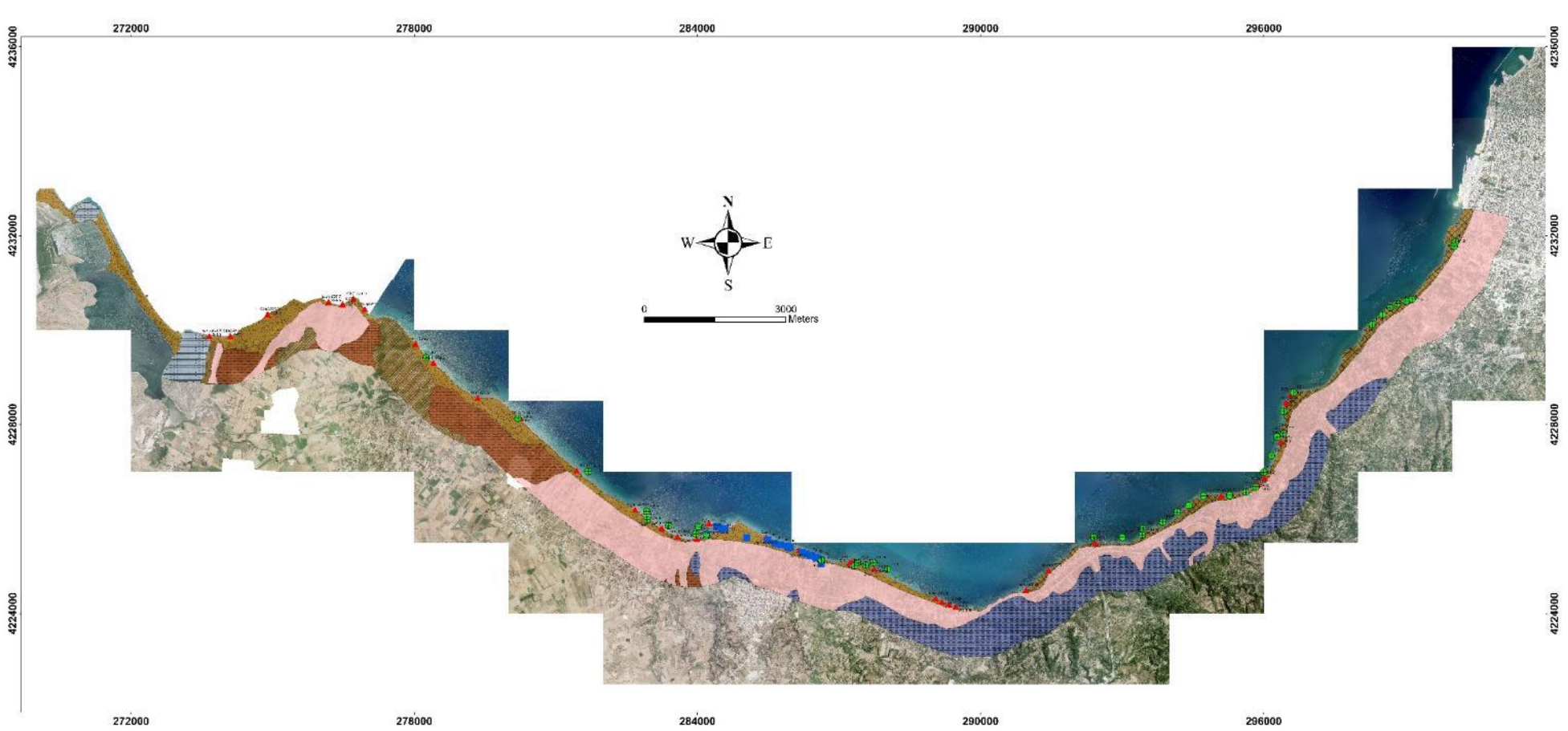
Engineering geological mapping and soil stratigraphy



- Recent embankements 0.5-2 m thick
- Sand, silty sand, gravel and gravelly sands of coastal sediments and river deposits of varying grain size, with D_{50} = 0.67-3.97 mm (SP, SP-SM, SW-SM, GP, GW-GM, GM, GP-GM)
- Lacustrine, lagoonal, coastal, river and aeolian deposits consisted of clay, silt, sand and weatherings of older formations
- Scree of pebbles and gravel of various size with sand and fine grained materials
- Recent deposits or and torrential deposits consisted of clayey silt, silty clay, sand of varying grain size and gravel
- Yellowish to grey clayey marls, sands and sandstones of river, lake and lagoonal deposits with thin layers of conglomerates
- Flysch: Alternations of sandstones, siltstones, clayey marls and conglomerates
- Limestones: Thin to thick – bedded, white – light brown limestone with layers of chert

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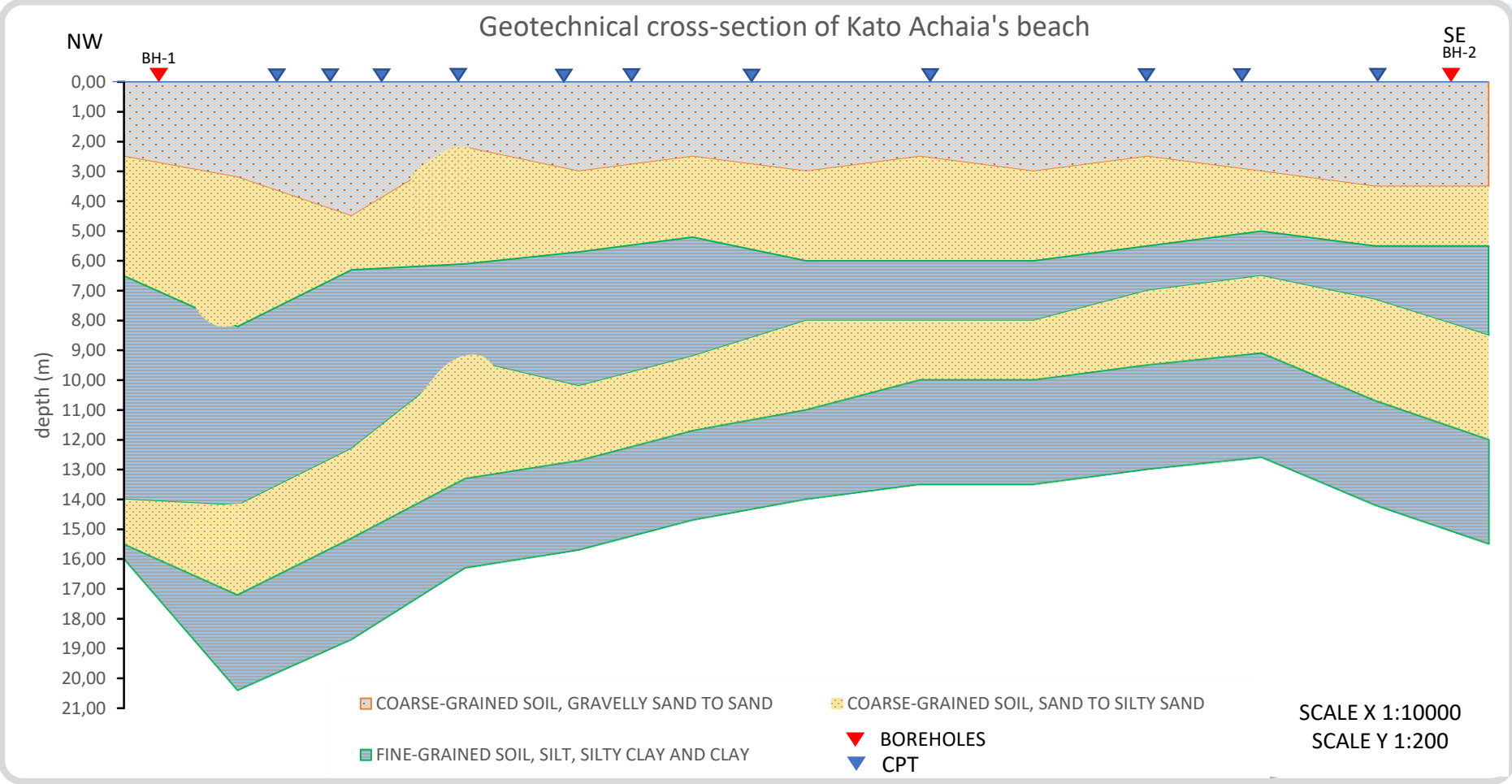
Geotechnical cross-sections



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Geotechnical Implementation in the area of intervention

1) Determination of the Physical and Mechanical properties of the coastal geological formations
2) Determination of the erosion sensitivity of the geological formations and coastal sediments prevailing in the area of intervention
3) Improvement of the coastal vulnerability modelling with the initiation of geotechnical data and graded indexes
4) Assessment of the Liquefaction Potential Index along the coastal zones
5) Design of geotechnical cross-sections for shoreline infrastructures and foundations
6) Use of results, information and data for the production of maps and diagrams in order to detect any potential geological hazards and erosion trend across the shoreline that may affect future construction activities and resendential development

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