

# 1 SUMMARY

## 1.1 Workflow since project start

The ThermoMap project consists of three basic phases. This reporting period covers mostly the third phase 'Testing the results' that has been officially started within the last reporting period in month 25 (September 2012) and covering two main tasks. Firstly, the improvement of the ThermoMap MapViewer via user seminars and an online survey, and secondly the analysis of soil and soft rock material from all Test Areas with regard to parameters such as soil texture and heat conductivity for the validation of the developed estimation system of the very Shallow Geothermal Potential (vSGP) in Europe throughout the comparison of estimated and measured data. But also the end of the second phase 'Processing, Analysis & Visualisation', is included within this report expressed by the enhancement and improving of the WebGIS-based visualisation tool (working title: ThermoMap MapViewer).

The systematic approach of the three different steps within the project process chain is shown in Figure 1.

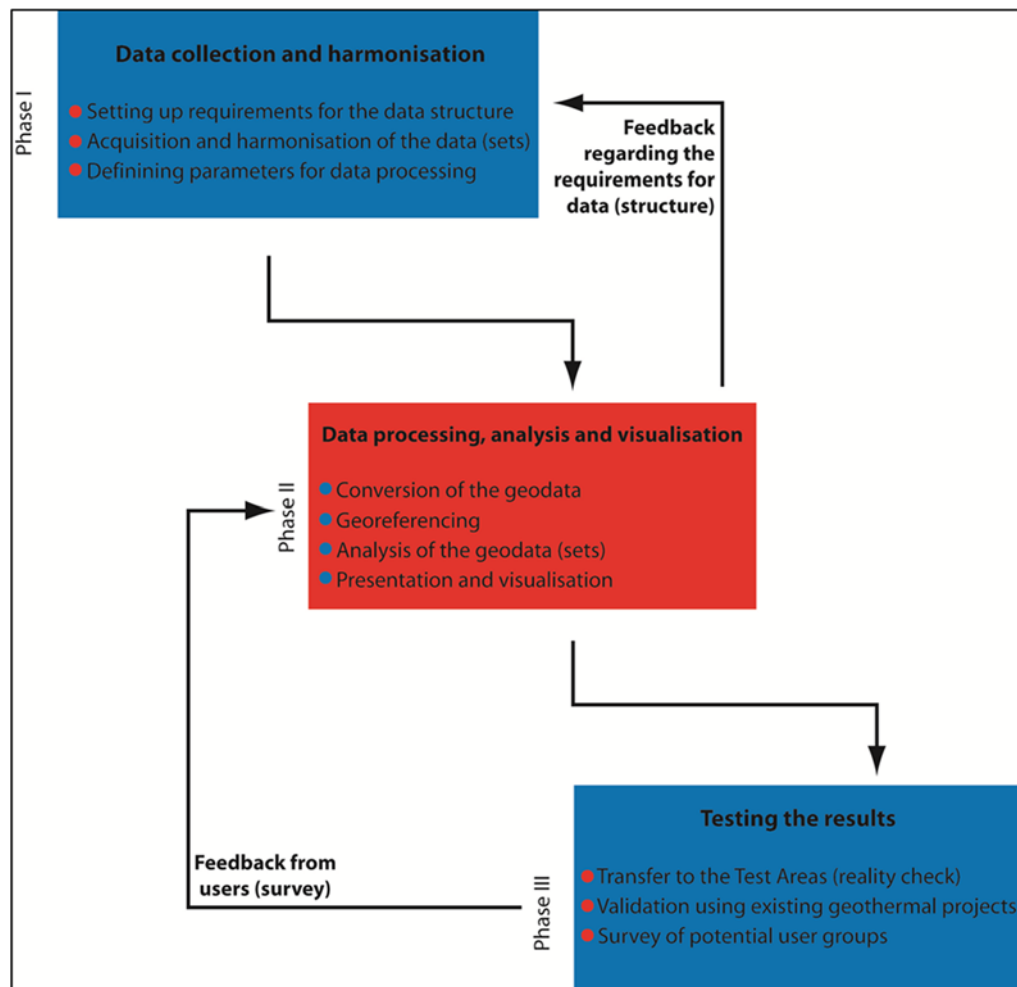


Figure 1: Graphical depiction of the three phases of the ThermoMap-project system chain

In order to filter out adequate data and to harmonise it onto a common basic level within the first project step, two working groups have been set up:

On the one hand the parameter definition group which takes care about the data filtering, on the other hand the standardisation group which should specify the standard for the data harmonisation.

During a comprehensive clarification meeting of both working groups the frame conditions for the setup of the catalogue (D3.1: Catalogue for data requirements, arithmetic instructions and derivation rules) and the required data thereof have been agreed upon.

Subsequently the catalogue has been developed. This catalogue highlights data sets required for the calculation of the estimated very Shallow Geothermal Potential (vSGP) expressed by the parameters thermal heat conductivity and volumetric heat capacity for the Test Area as well as for the European Outline Map (EOM) level. The catalogue has been developed in order to inform the partners about the data, the quality requirements and to support them in the collection of these datasets.

The aim of D3.2 (Standardisation Instruction Manual) was to clearly reflect the standard the collected data is to be harmonised on. Furthermore, it was intended to give support to all data providing partners in the way of standardising the country specific data sets for the calculational estimation of the very Shallow Geothermal Potential (vSGP) at a large to medium scale. Therefore, specific rules and definitions for the standardisation process have been developed.

The first part of D3.2 describes the standardisation procedure for the (meta)data sets and the way of calculating the vSGP for the first 10 meters of the subsoil within the 14 Test Areas at a medium scale level for three depth layers (0-3m / 3-6m / 6-10m). Each data providing partner allocated at least one test site for its country.

In the second part of the manual the way of standardisation of the (meta)data sets for the whole data providing countries is described. The method of calculating the vSGP is shown in detail at a large scale level.

Besides of the data sets' standardisation the manual presents the consolidation of the different parameters and describes their functions and coherences for the calculation of the very Shallow Geothermal Potential (vSGP) values. These types of determination methods are depicted in specific 'cooking recipes' for the scope of the Test Area as well as for the European Outline Map (EOM).

The reason for this division is the fact that in regard to most of the required parameters the data quality and quantity is not yet adequate enough to estimate the geothermal potential comprehensively for all partner countries and all three depth layers with blanket coverage and sufficient accuracy.

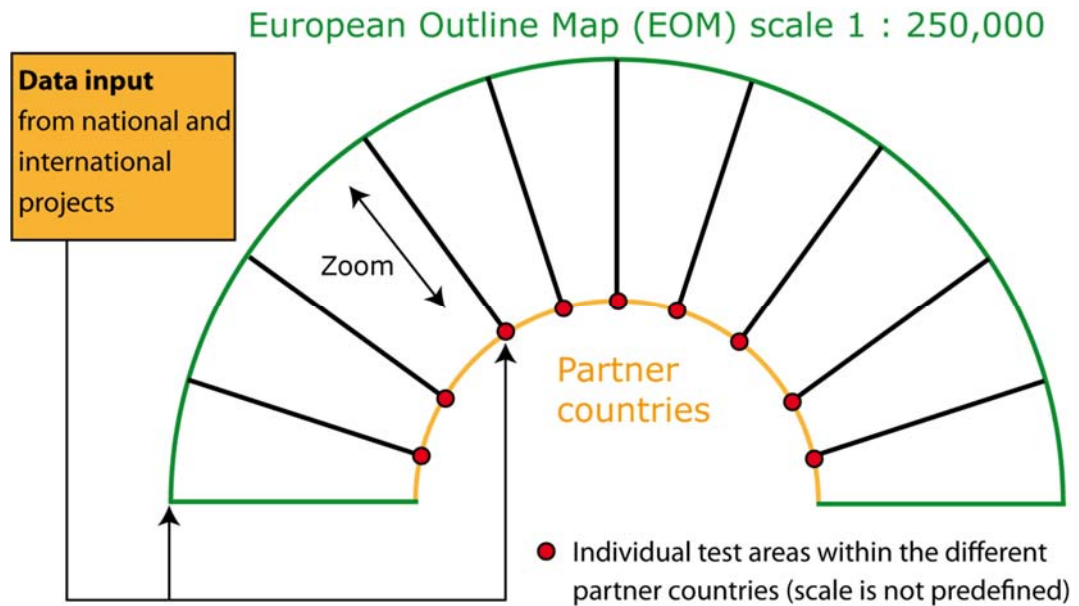


Figure 2: System interrelation between Test Areas and the Outline Map

For the time being the test sites are to be considered as country-specific 'data hotspots' which can be extended and will grow in line with the universal data harmonisations respectively data generating. In the long term, a full area covering data availability would be appreciated at a large scale level in the ideal case.

On the contrary, the European Outline Map (EOM) can be considered as a 'cheese cover' which covers the partner countries on a medium scale level and allows approximating the very Shallow Geothermal Potential (vSGP) for the first depth layer (0-3m) roughly. A corresponding development progress is shown in Figure 2.

To evaluate the demands of practical users within D3.3 an online questionnaire has been developed and sent to previously well-defined target groups and its members via Internet-link. The evaluation of this survey has been realised until the end of 2011. The interesting and valuable feedback has been evaluated and presented within the 3rd Progress Report (D1.3).

Furthermore, a Member Country data catalogue (D3.4) has been created at the end of the year 2011, based on the standardisation (D3.2) of the required (meta)data/-sets (D3.1). The final version of this deliverable has been submitted in month 17 (January 2012).

The harmonised country data catalogues are a concluding document listing and describing all required parameters that are needed for the estimation of the very Shallow Geothermal Potential (vSGP) within the Test Areas and for the European Outline Map (EOM) at scale 1 : 250,000, and also the corresponding data (sets), that are necessary for the GIS-implementation within Work Package 4.

Within the second process component 'Processing, Analysis & Visualisation' a Help Desk Forum (D4.1) has been installed to e.g. support the data providing partners in conversing the geodata required in D3.1.

For the analysis of the geodata a detailed Training Manual (D4.2), as the key instrument for the implementation of the WP3-specifications into practice, has been developed by the WP4-leader PLUS.

This training manual guided the data providing partners in the coordinated analysis of the geodata within their Test Areas as well as for the Outline Map's scope. The submission date of D4.2 had to be postponed because of the time delay of D3.1 & D3.2 and also due to the deadline for the respective country specific structure of the respective geodatabase (31<sup>st</sup> October 2011 – fixed at the meeting in Orleans, France).

Notwithstanding, it was possible to submit the following Deliverable 4.3 describing and illustrating the developed WebGIS interface technology in timeline with the DoW in month 18 (February 2012).

As a product of intense and joint-cooperative work on the appropriate analysis of all necessary country-specific geodata sets, it was managed to submit D4.4 (Geodata analysis) – which also represents the fourth milestone of the project (MS4: Geodata analysed) – in time (month 24 / August 2012).

In February 2012, in the run-up to the Reykjavik meeting in March 2012, WP5-leader ISOR and FAU discussed some first ideas for the strategy, content and realisation of the third project phase (Testing) with regard to D5.1 (Quality report on reality check of data).

During the reporting period from March to August 2012 a draft program had been developed how to efficiently realise the testing phase, including a timeline chart (Figure 3) illustrating the temporal and contentual relationship between the respective deliverables D5.1 – D5.4 as well as D4.5.

This report mainly covers the progress of WP5, which is mainly concerned with the testing of the projects Web-GIS appearance. With the 5th Work Package the project entered its 3rd and final phase (Figure 1). This chapter also contains a validation of the results.

As it turned out towards the end of the second phase, the project didn't progress as initially scheduled by the DoW. It was therefore necessary to make some changes in the working plan and the particulars of the tasks. The general objectives, however, stayed the same.

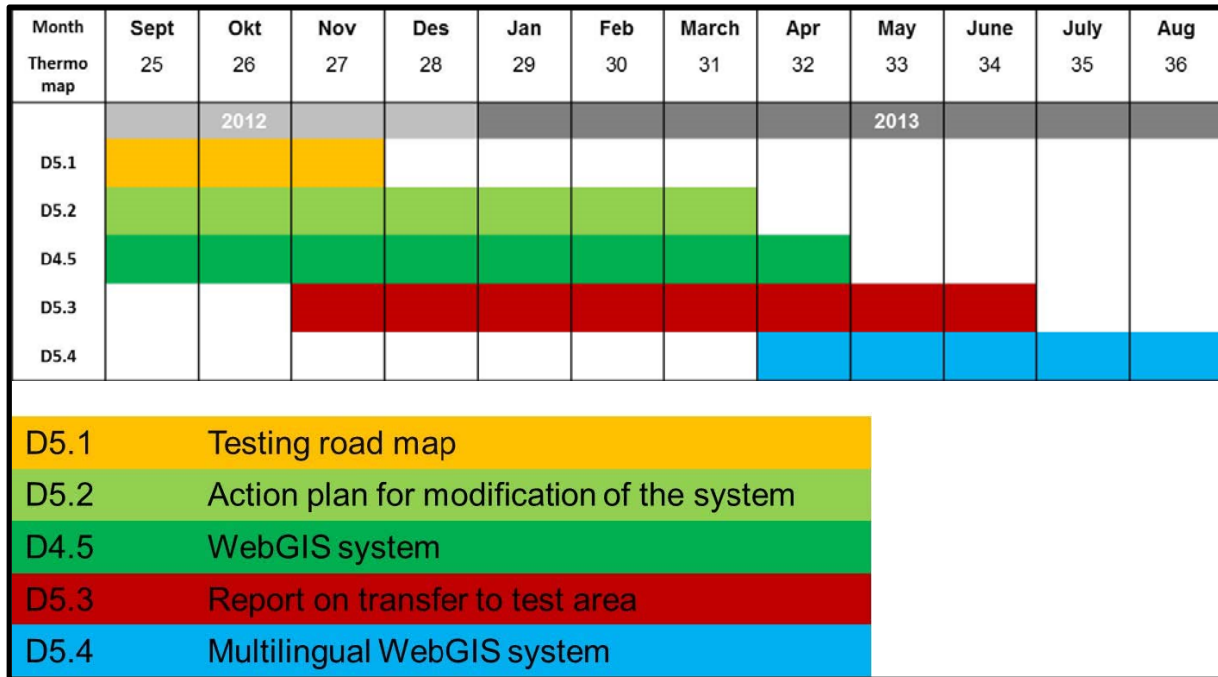


Figure 3: Planned timeline (month 25 – 36) for deliverables of WP4 and WP5.

D5.1 was submitted in timeline with the DoW in month 27 (November 2012) within the last reporting period providing an overview of the combined testing strategy. It covers the work to be carried out by each project partner with regard to the improvement of the ThermoMap MapViewer via user seminars and an online survey as well as the analysis of soil and soft rock material from all Test Areas concerning the soil texture and heat conductivity for the validation of the developed estimation system of the very Shallow Geothermal Potential (vSGP) in Europe throughout the comparison of estimated and measured data (carried out by FAU soil laboratory).

While D5.1 only describes the evaluation- and comparability strategy, the results of the conduction are presented in the D5.2 (Action Plan on the Modification of the System).

D5.2 includes the results of the ThermoMap WebGIS evaluation, which was developed in the 4th WP. The survey was conducted through online questionnaire, in which users were asked to evaluate the WebGIS system.

It was decided to include the results of the User Seminars in the final version of the MapViewer. Therefore D4.5 was submitted along with D5.2 (April 2013), causing a certain delay in finishing WP4.

Since it was not possible to use data from existing GSHP projects the soil samples had to be collected individually. Invariably those samples were sent to the FAU, where they were put through the same analysis process under laboratory conditions. The results were presented in the report on the transfer of the system in the Test Areas (D5.3), which was delivered in July 2013.

D5.4 (Multilingual WebGIS Application) describes the translations process and the status of the translations of the data into the WebGIS. In order to disseminate the information effectively to the diverse users in Europe the MapViewer and the

accompanying documentation has been translated to the languages of the participating countries.

The result is a multilingual WebGIS application that can be used to view the very shallow geothermal potential in Europe. The translations significantly improve the usability for a proportion of the potential users in Europe.

To ensure the sustainable development of the MapViewer D1.6 (Sustainable Development Report) was delivered without delay in June 2013. The main objective of this Report is to describe a strategy for the sustainable development of the ThermoMap system. It includes a feasibility study, a business plan and a strategy map on how to sustainably develop the ThermoMap System for all of Europe. The industrial partners of the consortium REHAU and GBI were essentially involved in the progress of this working package.

In order to provide a proper overview of the project's performance D1.7 (Project Monitoring Report) was delivered at the official end of the project in August 2013. Its main objective is to describe the impact of the ThermoMap project's methodology and outcomes on the European geothermal market with regard to horizontal / vertical heat collectors, shallow geothermal drillings and systems as well as GSHP – Ground Source Heat Pumps.

In the D1.7 the monitoring of the project as well as the performance of the project on the Performance Indicators are evaluated and presented as stated in the Description of Work (DoW).

Finally the D2.2 (Proceedings of the Final Conference) was delivered in August 2013. It contains the schedule, and an overview of the results of the final conference of the ThermoMap project which took place at the 6<sup>th</sup> of June in the context of the European Geothermal Congress in Pisa.

## 1.2 Results (main results already achieved and expected final results)

During the set-up of the D3.1-catalogue for the Test Areas several parameters have proven themselves to be essential for the calculation of the thermal heat conductivity and the volumetric heat capacity.

Those parameters are the soil texture (grain size distribution), the bulk density, the water content (derived from the pore size distribution dependent on texture and bulk density) and the temperature (air respectively soil temperature).

For classifying the grain size distribution, the soil texture triangle according to the USDA system (modified to the project needs) is used for harmonisation purpose (see Fig. 4, page 8).

Further data sources with regard to important soil properties are for instance the World Reference Base for Soil Resources (WRB-) classification system (soil type), the ESDAC (meta)data set (soil type and texture class for the scope of the European Outline Map / EOM) and the Ad-hoc AG Boden (German Soil Survey Manual) for grain and pore size distribution ranges and values.

In the end, the exemplary calculation of thermal heat conductivity values at different moisture conditions (from dry over wet to fully water saturated) as a function of the evaluated parameters leads to an overall table of all possible values of the very Shallow Geothermal Potential (vSGP) for the ThermoMap project.

These calculated and applied values have been processed and visualised within the specially developed WebGIS tool (ThermoMap MapViewer) in the framework of Work Package 4 (see also chapter 2.2.3).

To evaluate the demands of practical users of the ThermoMap estimation system an online-questionnaire has been developed, released and evaluated (detailed results and related figures have been presented in the 3rd Progress Report, D1.3). The questionnaire was put online to make the answering more user-friendly and to reach more possible target group members.

Furthermore, a final member country data catalogue has been created by each data providing country partner for collecting the required data sets from national or international bodies (for details please see also D1.3 – 3rd Progress Report).

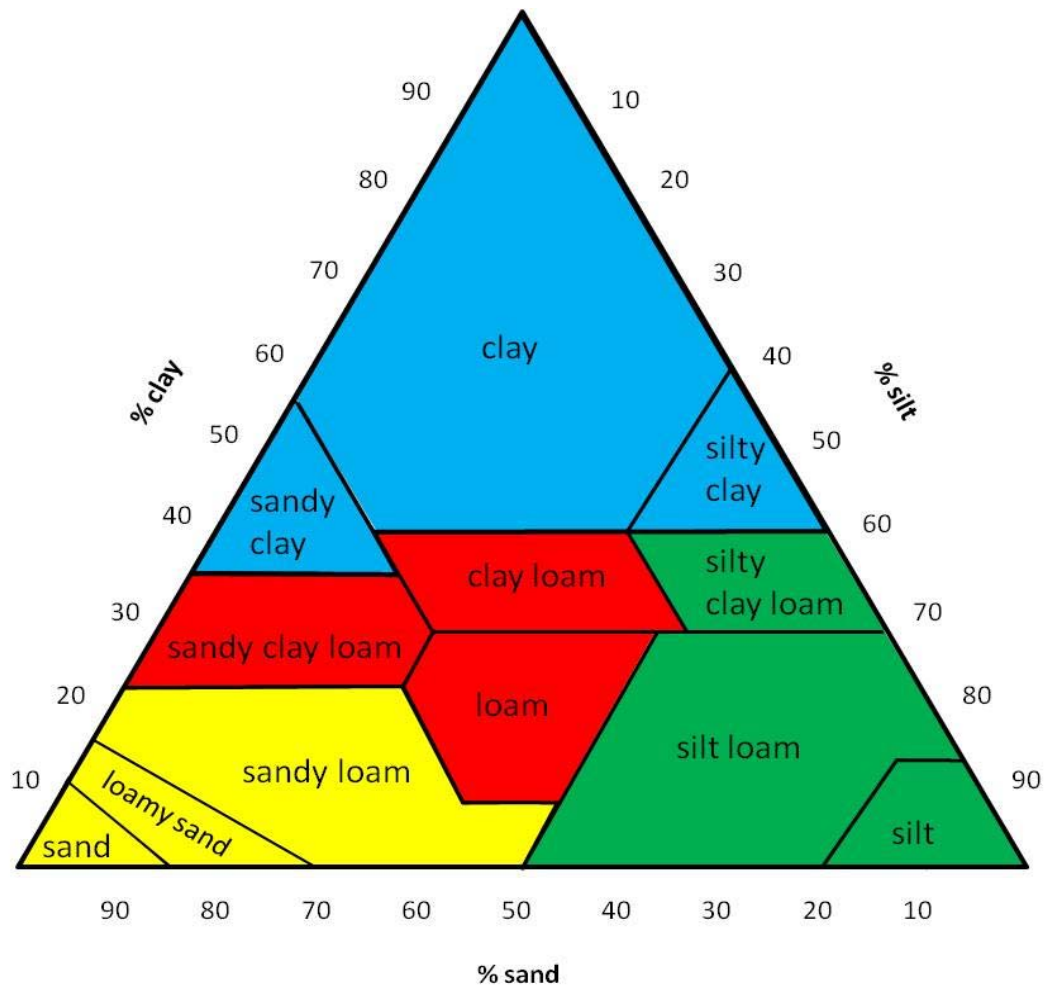


Figure 4: Soil texture triangle according to the USDA classification system the estimation is principally based on. The colouration reflects the main texture groups sand (yellow coloured classes), loam (red coloured classes), silt (green coloured classes) and clay (blue coloured classes).

Within the second process component 'Processing, Analysis & Visualisation' a Help Desk Forum (D4.1) has been installed, e.g. to support the data providing partners in converting the geodata required in the D3.1-catalogue or to provide a professional discussion platform for all consortium members working on the ThermoMap project.

After developing the Training manual for the coordinated analysis of geodata (D4.2) as well as the special WebGIS interface technology (D4.3) the analysis and appropriate visualisation of the harmonised geodata has been realised within the fourth reporting period so that the fourth project milestone has been achieved (MS4: Geodata analysed = D4.4; see chapter 2.2.3).

This sixth reporting period covers the finalisation of D4.5 of Work Package 4 – the WebGIS-Visualisation system. This final report represents the latest status-quo of



the geodata analysis for the test sites and the EOM level as well as the final design and functionalities of the ThermoMap MapViewer as a freely accessible online estimation tool for public and private users.

Not only the design and the functionalities of the ThermoMap MapViewer have been advanced, in particular with regard to the feedback of the user seminars between November 2012 and February 2013, but also a range of helping text modules and documents (Instruction Manual: [http://thermomap.edu-zgis.net/Instruction\\_Manual\\_Map\\_Viewer.pdf](http://thermomap.edu-zgis.net/Instruction_Manual_Map_Viewer.pdf) ; Technical Guidelines: [http://thermomap.edu-zgis.net/Technical\\_Guidelines.pdf](http://thermomap.edu-zgis.net/Technical_Guidelines.pdf)) have been developed to provide more information and to enhance the user-friendliness of the estimation system.

As final result the MapViewer version 1.1 has been released. It is fully multilingual and besides the elaborate visualisation and query functionalities contains the newest Calculator version for extern data input.

In the following some updated screenshots from the developed WebGIS interface are inset to gain some further impressions of the latest version of the ThermoMap MapViewer:



Figure 5: ThermoMap MapViewer – new introduction window

Figure 5 illustrates the new introduction window that the user is linked to when accessing the ThermoMap MapViewer. It provides a range of information, e.g.

about the overall aim of the project, the two scopes of visualisation (European Outline Map and Test Areas; see respective buttons), and general explanations about the vSGP and what to expect respectively not to expect from this tool.

Furthermore, one of the participating country's language can be chosen (all documents and text modules within the MapViewer are now available in all languages), furthermore several helping documents are provided. Table 1 shows the status of the translation activities on lingual progress. Due to the fact that the French (BRGM), the Greek (EKBA) and the Belgian (RBINS-GSB) partners agreed that for some snapshots it makes more sense to use the English description they were not translated.

	German	French	Roman.	Hungar.	Greek	Dutch	Iceland.
MapViewer text blocks	OK	OK	OK	OK	OK	OK	OK
MapViewer tooltips	OK	OK	OK	OK	OK	OK	OK
Report text blocks	OK	OK	OK	OK	OK	OK	OK
ESDAC Soil texture triangle (figure for Report)	OK	OK	OK	OK	OK	OK	OK
EOM Legend (figure for Report)	OK	OK	OK	OK	OK	OK	OK
Calculator text blocks	OK	OK	OK	OK	OK	OK	OK
Calculator tooltips	OK	OK	OK	OK	OK	OK	OK
Calculator Intro window text blocks	OK	OK	OK	OK	OK	OK	OK
Triangle tools text blocks	OK	OK	OK	OK	OK	OK	OK
Triangle for Soil texture calculator (figure)	OK	OK	OK	OK	OK	OK	OK
Calculator Report text blocks	OK	OK	OK	OK	OK	OK	OK
USDA Soil texture triangles (figures for Calculator Report)	OK	OK	OK	OK	OK	OK	OK
<b>Documents</b>							
MapViewer Instruction manual (11 pages)	OK	OK	OK	OK	OK	OK	OK
Figures for MapViewer Instr.Man.	OK	not translated	OK	OK	not translated	not translated	OK
Report Instruction manual (9 pages)	OK	OK	OK	OK	OK	OK	OK
Figures for Report Instr.Man.	OK	not translated	OK	OK	not translated	not translated	OK
Calculator Instruction manual (13 pages)	OK	OK	OK	OK	OK	OK	OK

Figures for Calculator Instr.Man.	OK	not translated	OK	OK	not translated	not translated	OK
Technical Guidelines (6 pages)	OK	OK	OK	OK	OK	OK	OK
Layer diagram (figure for Tech.Guidl.)	OK	OK	OK	OK	OK	OK	OK
Overview types collectors (figure for Tech.Guidl.)	OK	OK	OK	OK	OK	not translated	OK
Glossary (3 pages)	OK	OK	OK	OK	OK	OK	OK
List of Abbreviations (6 pages)	OK	OK	OK	OK	OK	OK	OK
Data sources (3 pages)	OK	OK	OK	OK	OK	OK	OK
MapViewer Technology (1 page)	OK	OK	OK	OK	OK	OK	OK
Disclaimer (2 pages)	OK	OK	OK	OK	OK	OK	OK

Table 1: Translationstatus of the WebGIS interface, help documents and the calculator.

The central documents are the Instruction Manual (How to use the ThermoMap MapViewer), the Technical Guidelines (providing more information on shallow geothermal systems), a Glossary with all used terms and their explanations, a document listing the relevant data sources for Test Area and EOM level, the MapViewer technology (technical specifications about the application) and the Disclaimer containing the imprint (see also Fig. 6).

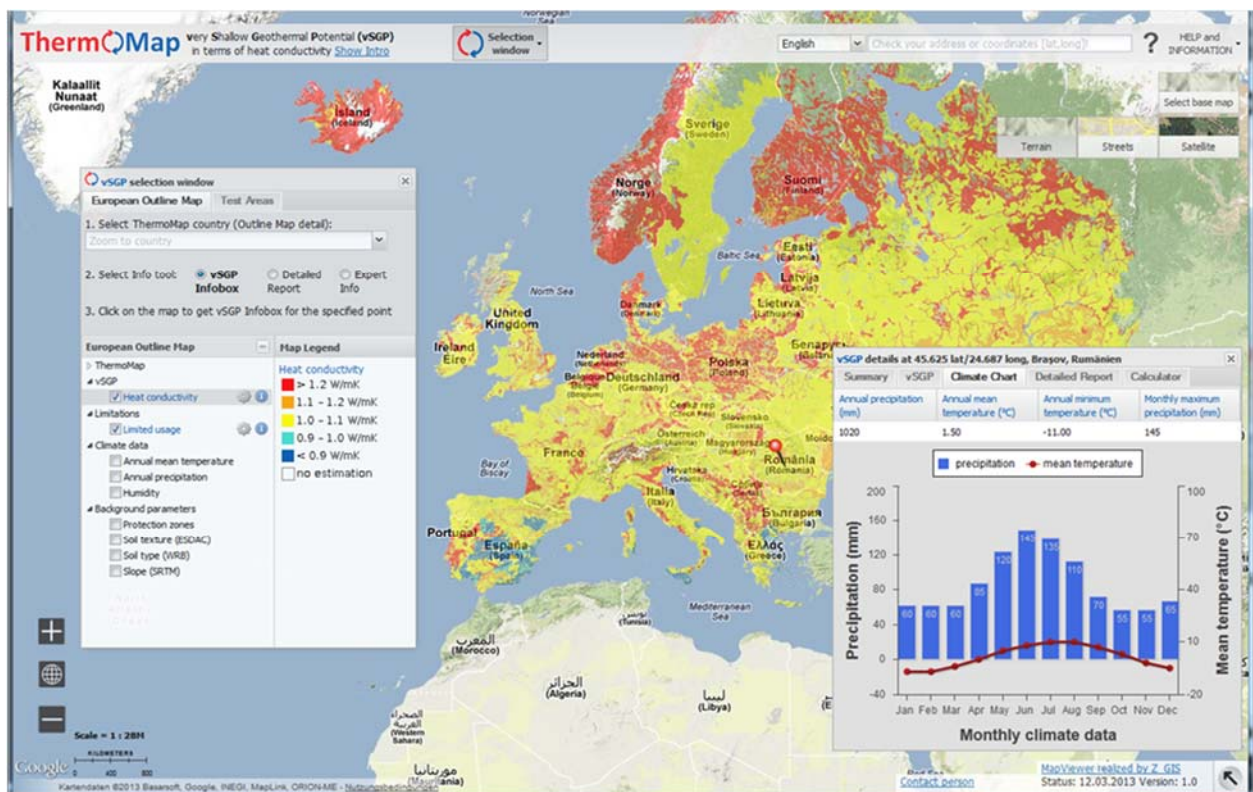


Figure 6: ThermoMap MapViewer – European Outline Map (EOM, final stage, without calculator)

A further development is the Report function as one of the tabs inside of the vSGP box (see Fig. 7). Besides of a summary about the geothermal properties, the indication of the very Shallow Geothermal Potential and a climate chart the report represents the possibility to save the retrieved information as a Location Information Sheet which is print ready or can be converted to a PDF file.

The report versions for the EOM and the Test Area level are consisting of an address and coordinates section, an overview map, potential map details with heat conductivity and limited usage layers, a disclaimer, introduction, graphics and predefined text blocks with integrated local values and interpretations of the prevailing conditions (see also example in Fig. 10-14).

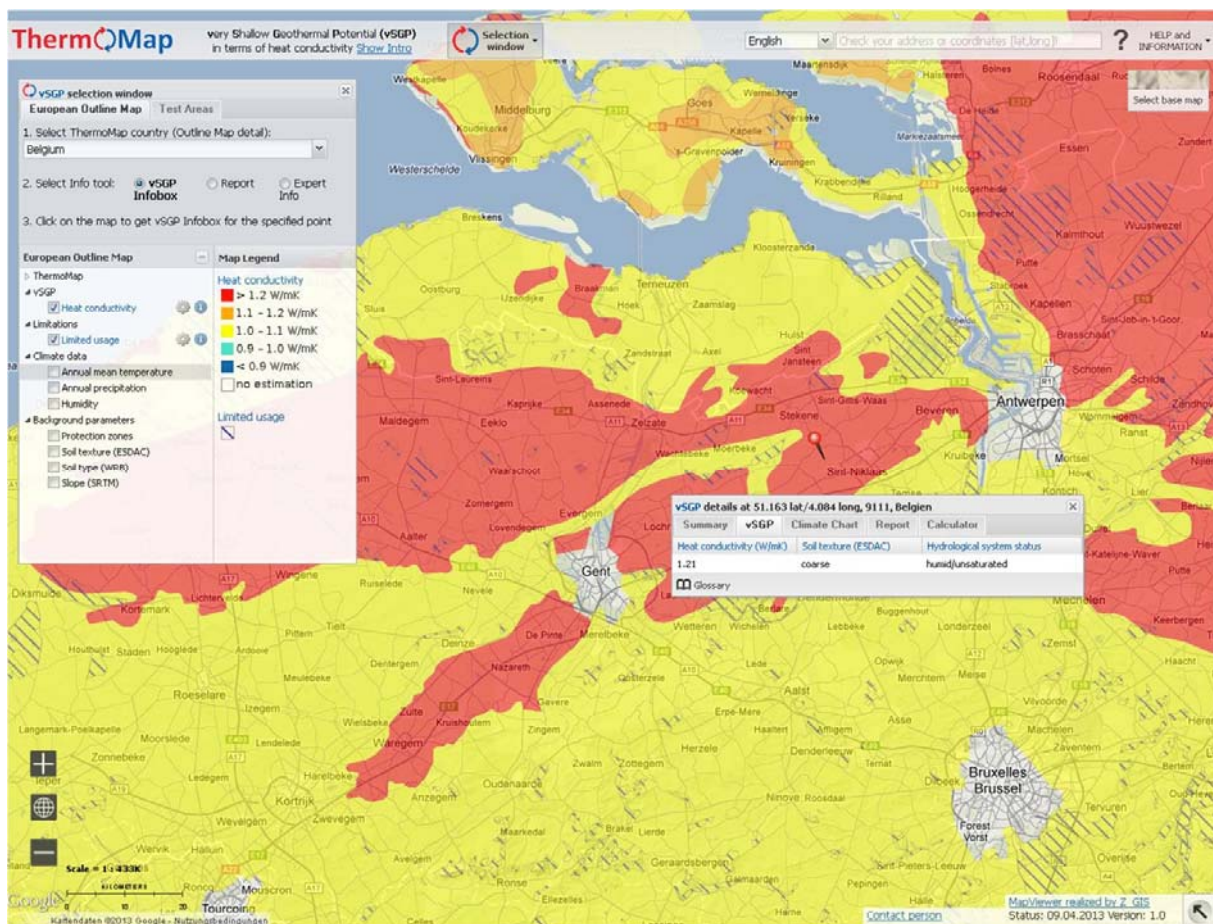


Figure 7: ThermoMap MapViewer – European Outline Map (EOM) with vSGP infobox

Figure 8 and 9 illustrate the design and contents at Test Area level. At this level more detailed information about the geothermal and other important properties of a location inside of a test site can be accessed for the three depth layers.

Furthermore, additional information regarding climate and other background parameters (e.g. ground water level, bulk density, soil texture, soil type, protection zones etc.) are provided.

In case of selecting the Expert info tool (see Fig. 9) the user is provided with all relevant data in form of a table. Tooltips, as used at many places within the MapViewer, explain the abbreviations when hovering with the mouse and a list of all abbreviations can also be accessed for further clarification.

The Report tool directly leads the user to the report function when clicking a point in the map.

In principle, it is always possible to switch between the two scopes of the MapViewer either by clicking the respective tab inside of the selection window or the selection window button within the semi-transparent toolbar (see Fig. 7).

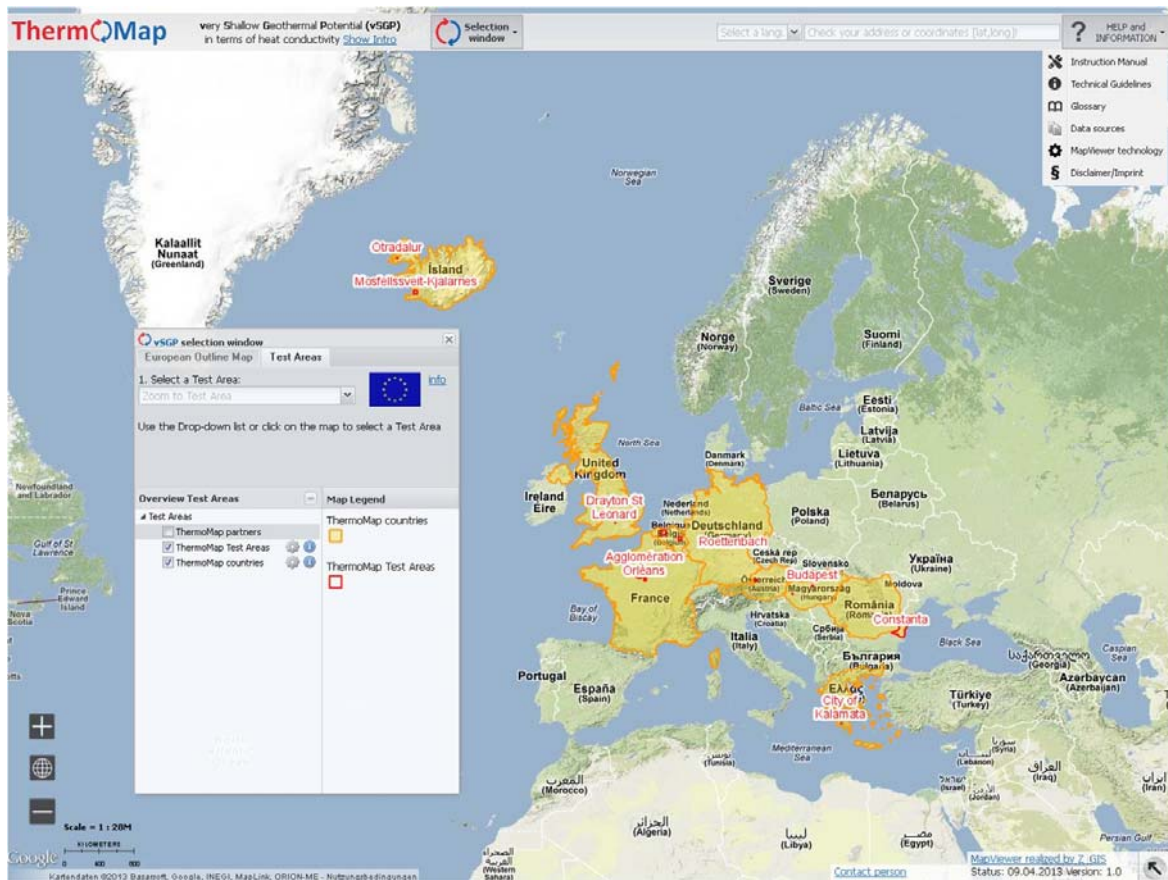


Figure 8: Overview of all Test Areas with information window

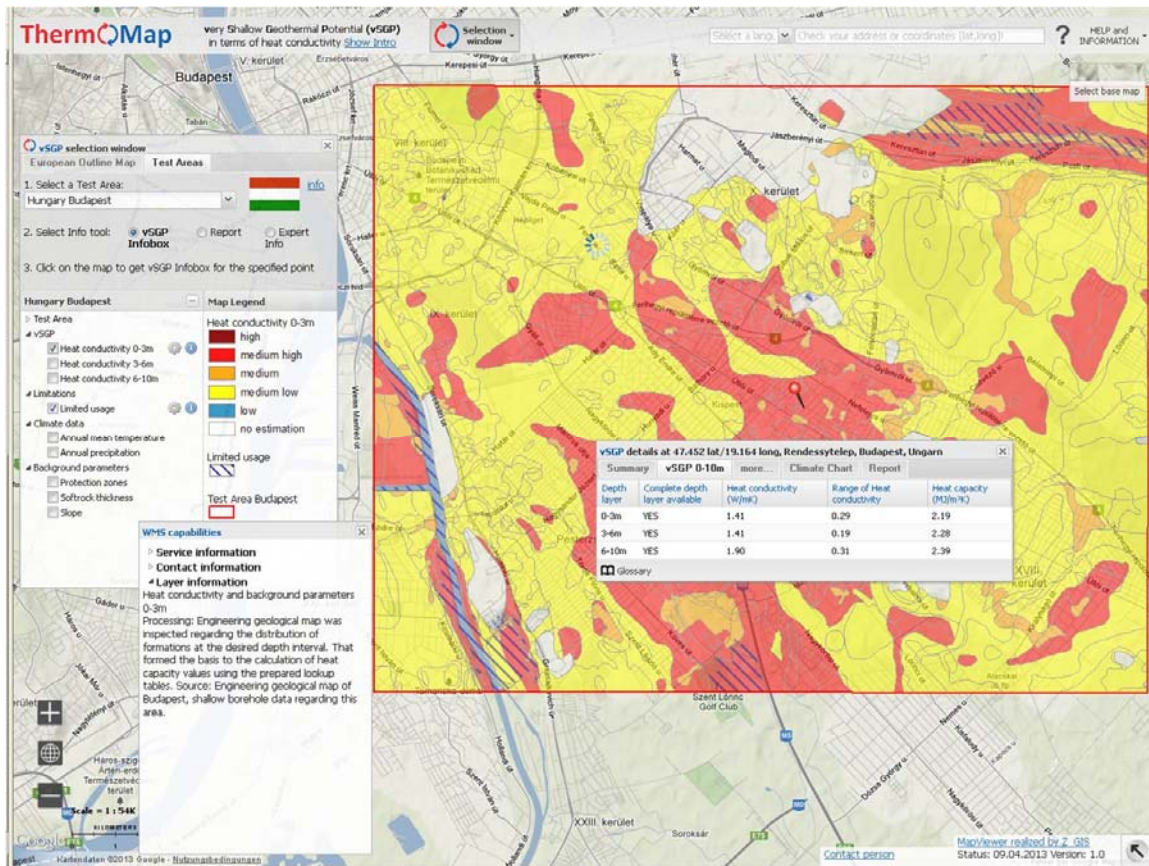




Figure 9: Example of a Test Area illustrating the vSGP for the first depth layer (0-3 metres)

**Address and location:**  
Lónyaytelep, Budapest, Ungarn  
47.4497° latitude and 19.1785° longitude



**Map legend:**  
Test Area Budapest



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**Overview maps of the chosen location**


**Disclaimer**  
The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. The European Commission doesn't accept responsibility for any use of the information contained therein. The data sources and processings of this Test Area and processings are the ThermoMap partner's responsibility; MFGI: Magyar Földtani és Geofizikai Intézet.

**Introduction**  
The values and parameters presented within the framework of this information system are generally based on the outcomes of the EU co-funded project ThermoMap (Project number CIP ICT PSP 250446, Website: <http://www.thermomap-project.eu/>). The key aim of the ThermoMap project was to develop an efficient estimation system for the creation of pan-European superficial geothermal potential maps as a supportive and informative planning tool for installing (very) shallow vertical and horizontal geothermal installations. For this purpose it has made use solely of existing geoscientific datasets and information which do not necessarily reflect the real on-site conditions with regard to all available parameters.

**Summary:** This site is suitable for installing a GSHP system without any limitations. For full system design please contact a shallow geothermal consultant to realise further detailed investigations.

**Possible limitations of usage**  
Based on the available data it can be stated that the chosen site is not located in a protection zone. The topographical analysis revealed a slope, which is less than 15°. Therefore, when installing a (very) shallow geothermal system, no issues with the venting and installation procedure should occur. The determined dominant soil type according to the acknowledged WRB classification system is here a not listed soil type. With this type of soil in principle no restrictions regarding a sustainable and efficient installation and operation of a (very) shallow geothermal system are known. All three depth layers are available for the usage of the vSGP since the thickness of the softrock zone is 10m or more.

**Address and location:**  
Lónyaytelep, Budapest, Ungarn  
47.4497° latitude and 19.1785° longitude



**Climatic conditions**  
The climate data, averaged over several years, results in a mean annual air temperature of 10.00 °C whereas the minimum annual air temperature is -7.80 °C. The amount of the annual precipitation is 500 mm. The maximum monthly precipitation of 61 mm occurs in the month of May. This implies *subarid* climatic conditions for the chosen area.

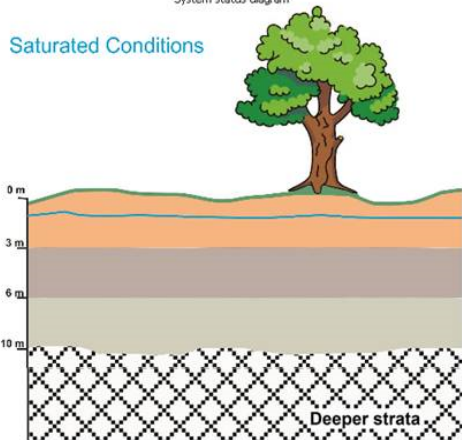
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**Tabular compilation of depth layer specific background parameters**

Depth layer	Complete layer available	Heat conductivity (W/mK)	Range of Heat conductivity	Heat capacity (MJ/m³K)	Bulk density (g/cm³)	Grain size (USDA)	Precision of USDA classification	Saturation
0 – 3m	YES	1.41	0.29 - 2.19	2.19	1.3	sand	Level 1	saturated
3 – 6m	YES	1.77	0.38 - 2.24	2.24	1.5	sand	Level 1	saturated
6 – 10m	YES	1.86	0.52 - 2.34	2.34	1.8	loam	Level 1	saturated


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**System status diagram**



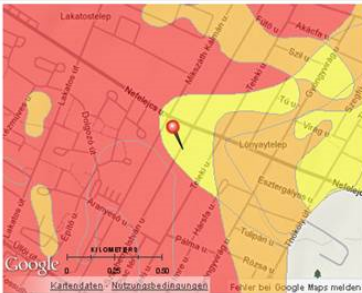
Deeper strata

**Address and location:**  
Lónyaytelep, Budapest, Ungarn  
47.4497° latitude and 19.1785° longitude



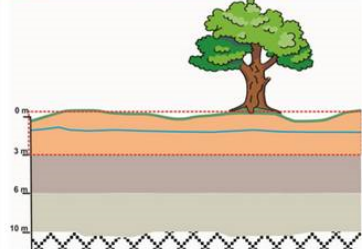
**Map legend 0 – 3m:**  
Heat conductivity  
■ high  
■ medium high  
■ medium  
■ medium low  
■ low  
□ no estimation  
Limited usage

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**Schematic diagram 0 – 3m:**





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**Geothermal situation 0 – 3m**

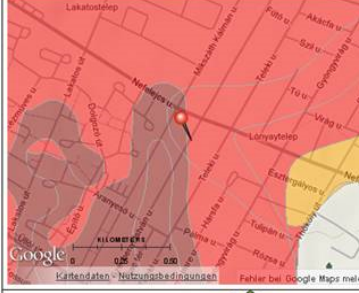
The thermal heat conductivity of the soil matrix is defined essentially by its texture, water content and bulk density. At the chosen site at 0 – 3m depth the **grain size** according to the USDA classification is determined as **sand**. The classification precision is **Level 1**. The **heat conductivity** under unsaturated conditions can range from **0.76 W/mK** to **1.05 W/mK**. For the prevailing **saturated conditions** it is estimated as **1.41 W/mK**. These parameters were calculated according to the KERSTEN (1949) formulas. The **heat capacity** of **2.19 MJ/m³K** is calculated according to formulas after DEHNER (2007). For the calculations a predefined value had to be assumed for the **bulk density**. Within this depth layer the applied value is **1.3 g/cm³**. In summary, it can be stated on the basis of the presented geoscientific parameters that the chosen location shows a **medium high conductivity** without any limitations for the utilisation of the very Shallow Geothermal Potential (vSGP) in terms of heat conductivity. For full system design please contact a shallow geothermal consultant.

**Address and location:**  
Lónyaytelep, Budapest, Ungarn  
47.4497° latitude and 19.1785° longitude



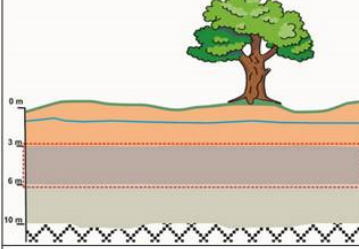
**Map legend 3 – 6m:**  
Heat conductivity  
■ high  
■ high (partial)  
■ medium high  
■ medium high (partial)  
■ medium  
■ medium (partial)  
■ medium low  
■ medium low (partial)  
■ low  
■ low (partial)  
□ no estimation  
Limited usage

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**Schematic diagram 3 – 6m:**




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**Geothermal situation 3 – 6m**

The thermal heat conductivity of the soil matrix is defined essentially by its texture, water content and bulk density. At the chosen site at 3 – 6m depth the **grain size** according to the USDA classification is determined as **sand**. The classification precision is **Level 1**. The **heat conductivity** under unsaturated conditions can range from **0.87 W/mK** to **1.25 W/mK**. For the prevailing **saturated conditions** it is estimated as **1.77 W/mK**. These parameters were calculated according to the KERSTEN (1949) formulas. The **heat capacity** of **2.24 MJ/m³K** is calculated according to formulas after DEHNER (2007). For the calculations a predefined value had to be assumed for the **bulk density**. Within this depth layer the applied value is **1.5 g/cm³**. In summary, it can be stated on the basis of the presented geoscientific parameters that the chosen location shows a **high conductivity** without any limitations for the utilisation of the very Shallow Geothermal Potential (vSGP) in terms of heat conductivity. For full system design please contact a shallow geothermal consultant.

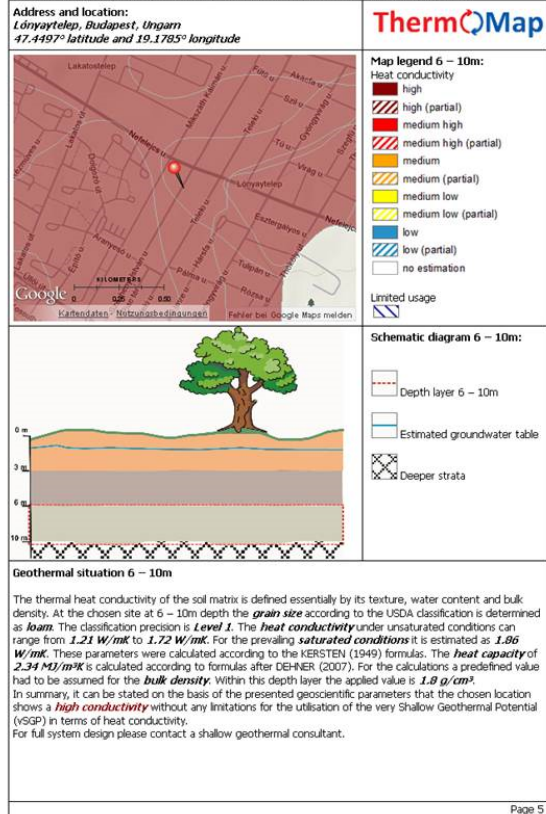


Figure 10-14: Report example from a Hungarian Test Area

The calculation function of the MapViewer additionally offers the possibility to insert extern data from subsoil analysis or the like for calculating the vSGP for one single map location using the available background parameters of the EOM, e.g. climate data. The introduction window is shown in Figure 15.



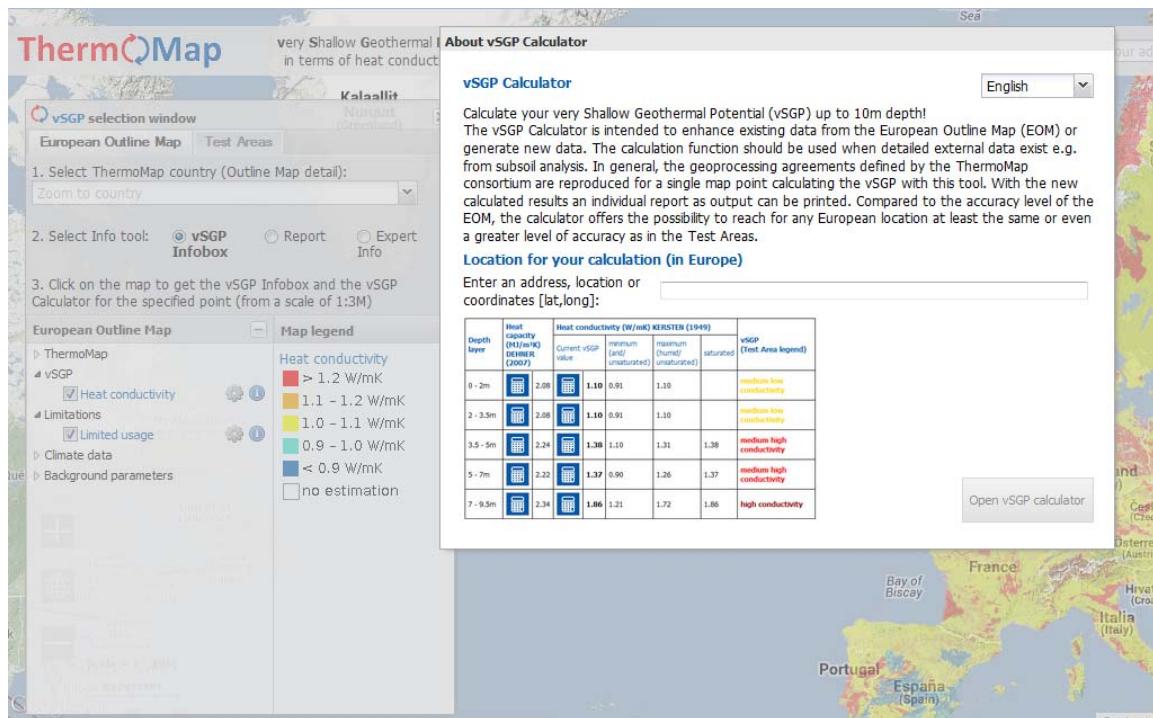


Figure 15: Introduction window of the ThermoMap calculator

In the run-up to the Reykjavik meeting in March 2012, WP5-leader ISOR and FAU discussed first ideas for the strategy, content and realisation of the third project phase (Testing) with regard to D5.1 (Quality report on reality check of data).

Within the project period from March to August 2012 a draft program on how to efficiently realise the testing phase has been developed, including a timeline chart (Figure 3, page 5) illustrating the temporal and contentual relationship between the respective deliverables D5.1 – D5.4 as well as D4.5.

In September 2012 at the Budapest meeting, first ideas for further explanatory MapViewer related documents, like e.g. an instruction manual, a glossary, etc., were discussed among the consortium. As described above the development of these auxiliary documents as well as improving the content and functionalities of the ThermoMap MapViewer have been the main activities within that period.

With regard to Work Package 5 one main task to carry out was the realisation and evaluation of user & promotional seminars in all partner countries for creating D5.2 (Action plan on the modification of the system) which was to be submitted in month 31 (March 2013) according to the DoW. D5.2 is therefore based on the outcomes of a user survey realised by an online-questionnaire (timeframe: 1<sup>st</sup> December 2012 – 28<sup>th</sup> February 2013) focusing on the functionality of the ThermoMap MapViewer. Due to the constellation that the development of the WebGIS-Visualisation (D4.5) is also based on this user feedback it is considered as most expedient to prepare and submit both deliverables together (beginning of April 2013 after the Easter break).

Each partner organised at least one seminar using various dissemination material (PowerPoint presentations, poster, flyer, live presentations of the MapViewer etc.). During each of the 13 seminars in the last reporting period the evaluation of the MapViewer was continuously enhanced (D5.2).

The overall feedback was very positive with regard to the general topic of very shallow geothermal energy and the visualisation system of the vSGP, as can be looked up within D5.2. The first statement one of the user questionnaire shows a very high level of satisfaction with the ThermoMap MapViewer (see Figure 16).

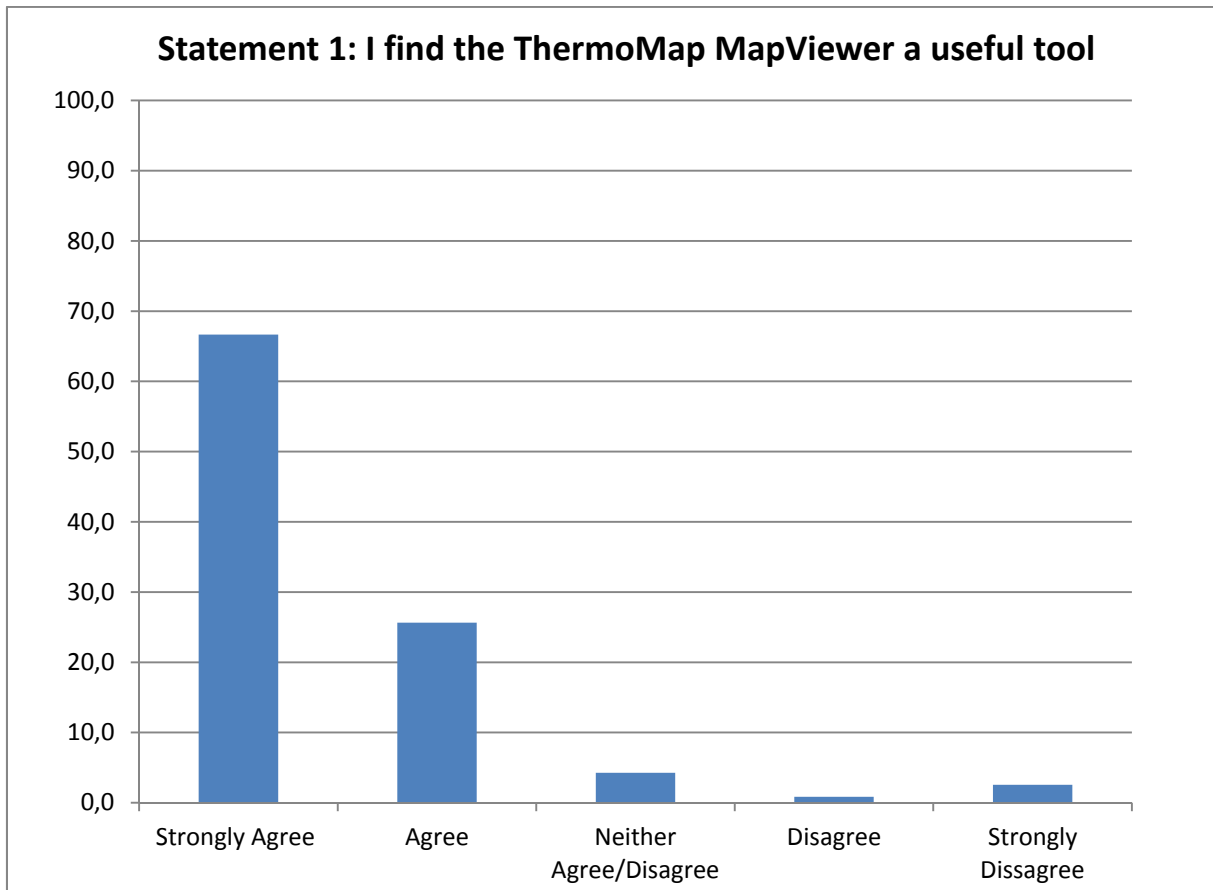


Figure 16: the number of the beast

The promotion was continued during the reporting period of the 6<sup>th</sup> progress report. Consequently 6 promotion seminars (see Table 2) and 5 other dissemination events were realized. The following table provides an overview of the 13 realised and evaluated ThermoMap user & promotional seminars within the last reporting period.

Type of event	Number of parti-	Place	Persons involved from the ThermoMap	Institutions involved respectively participating + type/title of seminar and / or presentation(s)	Date
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	ci-pants		project consortium		
Promotional Seminar, 5 March 2013, Reykjavik, Iceland	25	Reykjavik, Iceland	Gunnlaugur M. Einarsson, Skúli Víkingsson (ISOR)	ISOR & Orkusetur: 5 presentations including the ThermoMap project and the MapViewer application (participants from local governments, engineering firms, installers and the scientific community)	05.03.2013
Promotional Seminar, 7 March 2013, Athens, Greece	100	Kalamata, Greece	Apostolos A. Arvanitis (EKBA)	EKBAA workshop with 3 sessions followed by policy makers, geologists, engineers, professors, employees of the responsible Ministry, PPC-Renewables S.A., municipalities, representatives of private companies and institutions, GHPS designers and installers, privates etc: 1st: Opening addresses and an introductory presentation on Geothermal Heat Pump Systems 2nd: Detailed presentation of the ThermoMap project (methodology and Web GIS-based visualization) 3rd: Application of Geothermal Heat Pump Systems in Greece - Examples and Case Studies	07.03.2013
Promotional Seminar, 25 March 2013, Orléans, France	30	Orléans, France	Florence Jaudin, Charles Maragna (BRGM)	University of Orleans: Training for technical assistants of energetics engineers, with a specialization in geothermal energy (incl. presentation of the ThermoMap MapViewer)	25.03.2013
Promotional Seminar, 27 March 2013, London, UK	40	London, UK	Jon P. Busby, Melinda Lewis, Russell Lawley (BGS-NERC)	Ground Source Heat Pump Association (GSHPA) meeting entitled 'Reaping the benefits of GSHPs with the RHI' (co-sponsored by the GSHPA, BGS and REHAU): Presentation on the rational, methodology and results of ThermoMap (by J. Busby, BGS) and online, interactive demon-stration of the MapViewer (by R. Lawley, BGS)	27.03.2013
User & Promotional Seminar, February 2013, Salzburg, Austria	8	Salzburg, Austria	Peter Zeil, Hermann Klug, Lucia Morper-Busch (PLUS)	ERDWÄRME AUS OBERFLÄCHENNAHEN BODENSCHICHTEN: Informationsveranstaltung Geothermie-Potenzial und technische Umsetzung (in German) in cooperation with IFFB für Geoinformatik Z_GIS Universität Salzburg & EuRegio Salzburg – Berchtesgadener Land – Traunstein, Wirtschaftsförderungsgesellschaft Berchtesgadener Land, Wirtschaftsförderungs-gesellschaft Traunstein, Sonnenkreis Traunstein und Energieberatung Salzburg	10.04.2013 (postponement)
Promotional Seminar, 7 May 2013, Brussels, Belgium	22	Brussels, Belgium	Pierre-Yves Declercq, Estelle Petitclerc (RBINS-GSB)	Shallow geothermal energy in Belgium through the European project of ThermoMap: Presentations about the ThermoMap project (by M. Dusar), the methodology (by P.-Y. Declercq) and the MapViewer (by E. Petitclerc) as well as on case studies by REHAU & MASSER	07.05.2013

Table 2: User and Promotional Seminars during the reporting period

Some impressions from the events can also be viewed on the ThermoMap website under the events section as well as related material from the seminars. A total of 225 attendees participated in the user & promotional seminars of the ThermoMap project

As mentioned before, the working plan was subjected to some changes, due to the fact that it was not possible to use data from existing GSHP projects within the Test Areas. The soil samples had therefore to be collected individually, and sent to the FAU where they were analysed.

Therefore each country partner was asked to send a range of samples from different locations and depth layers of a test site to the soil laboratory at the University of Erlangen-Nuremberg (FAU). 312 samples (Table 3) have been collected and sent to Erlangen showing a high variability of texture and geological/mineralogical origin. This could be detected by analysing the grain size distribution (Fig. 18). The analysis of the samples (Fig. 17) with regard to the measurement of thermal heat conductivity (and volumetric heat capacity) was carried out at different levels of water content (from dry over wet to fully saturated) and under differing bulk density conditions (Fig. 19 & 20) to reflect the variability of soil and under-ground moisture and density with increasing depth.

Test area	Number of samples
Zalakoppány	8
Budapest	0
Mosfellsveit	3
Otradalur	1
City of Liège	20
City of Gent	59
Büchenbach	41
Röttenbach	44
Agglomeration of Orleans	0
Kalamata	11
Eure-et-Loir department	13
Mondsee catchment	9
Constanța	79

Drayton St. Leonard	24
<b>Total</b>	<b>312</b>

Table 3: Number of samples collected by each partner.



Figure 17: Soil samples drying for preparation



Figure 18: SediGraph – measurement instrument for measuring soil texture (grain size distribution)



Figure 19: TK04 – measurement instrument for measuring thermal heat conductivity

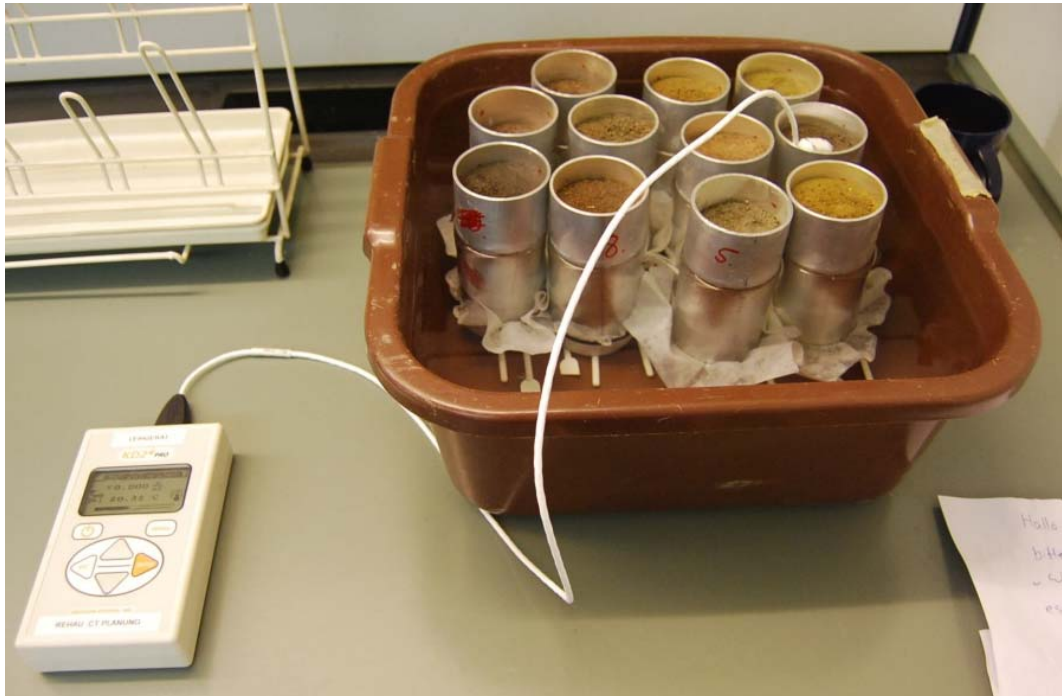


Figure 20: KD2Pro – measurement device for measuring thermal heat conductivity



Figure 21: Field measurement with the KD2Pro device in one of the test sites

The laboratory measurements, together with data from field measurements (Fig. 21), will provide valuable data to the project consortium to validate the project results with measured and literature data for optimising the estimation procedure.

The results based on laboratory investigation show a good agreement towards the calculated values based on the ThermoMap methodology (detailed description in D3.2).

A detailed summary of comparing and evaluating the sample analysis is presented within D5.3 (Report on the transfer of the system in the test areas) which was submitted in month 35 (July 2013) as one basis for the validation of the ThermoMap estimation procedure of the vSGP.

As a last step within WP5 the ThermoMap MapViewer and the Calculator was extended by multilingual options (see Fig. 22) for the user interface to increase the user-friendliness and expand the group of end users. The objectives of D5.4 (Multilingual WebGIS application) were therefore successfully implemented.



Figure 22: Choice of different partner languages within the ThermoMap MapViewer (circled red)

### 1.3 Final results, use and potential implications with regard to socio-economical and societal aspects

The analysis of the harmonised geodata was conducted in a specially developed GIS environment (second phase of the project – Visualisation / Work Package 4 – Figure 1) and facilitated by standardised methods. The resulting very shallow geothermal potentials (vSGP) are visualised on a local scale in 14 test sites across Europe and on a medium scale for all partner countries (European Outline Map; scale 1 : 250,000).

The resulting values of the main parameter thermal heat conductivity and all background parameters were integrated in a specific Web Service (ThermoMap MapViewer user interface) freely accessible for all interested target groups via Internet (see Fig. 5-9). There is also a possibility for the user to retrieve the information as an output file (report, see Fig. 10-14) and to use a range of additional information documents for the use of the MapViewer.

Since the geodata analysis as well as the development of an appropriate visualisation and the user-friendly functionality were continuous processes, the MapViewer interface changed and improved during the third phase of the project (Testing / Work Package 5 / Fig. 1) to reach the best solution until the project end which was officially in August 31<sup>st</sup>. In this context there was a close cooperation with all target groups of the ThermoMap estimation system (see also timeline of WP5: Fig. 3, page 5).



With special regard to the general discussion about the provision of renewable and sustainable energy forms and the turning away from conventional fossil energy resources, the ThermoMap project can give new impulses for a decentralised, sustainable and low environmental impacting energy supply of the future, utilising the natural heat potential of the very shallow underground in an efficient way. Thus, the project and its developed estimation system for vSGP can be regarded as a significant contribution to the EU 2020 targets.

ThermoMap will provides different user-groups with an interactive information tool running in a web browser – the ThermoMap MapViewer. Private users may check the shallow geothermal potential of their local environment, whilst community planning and administration authorities may test the geothermal potential of their entire administrative unit.

Each interested target group can benefit from the information and data that will be available in an attractive and user-friendly way to be able to contribute their individual share for a greener future in energy, heating and cooling supply.

The ThermoMap project addresses private users who for example want to build or renovate a house in a sustainable way; it also addresses community planning and administration authorities, which want to display new housing areas and want to inform about the utilisation of the very shallow geothermal potential in terms of horizontal and/or vertical heat collector systems at the same time.

Researchers participating in the ThermoMap project had access to the entire geodata pool, which is set up in Web Map Service (WMS), Web Coverage Service (WCS) and Web Feature Service (WFS). For stakeholders interested in the used geodata sets the WP4 person responsible can be contacted for further details, e.g. for shape-files or other data.