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# KUBILAY GEOTHERMAL POWER PLANT PROJECT

## Environmental and Social Impact Assessment Report



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JUNE, 2016

ANKARA



## KUBILAY GEOTHERMAL POWER PROJECT

### ENVIRONMENTAL and SOCIAL IMPACT ASSESSMENT REPORT

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Revision Codes: A: Draft, B: Final Draft, C: Final

Project No: 16/003

June 2016

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## TABLE OF CONTENTS

<b>1. INTRODUCTION .....</b>	<b>1</b>
1.1 Objectives.....	1
1.2 Scope of the Report.....	1
1.3 Limitations of the Study .....	2
<b>2. PROJECT DESCRIPTION.....</b>	<b>3</b>
2.1 Purpose of the Project .....	3
2.2 Project Location .....	3
2.3 Project Components .....	4
2.3.1 Drilling of Geothermal Wells .....	4
2.3.2 The Power Plant.....	4
2.3.3 Transmission Lines.....	6
2.3.4 Access Roads .....	6
2.4 Project Proponents .....	6
2.5 Project Alternatives.....	6
<b>3. LEGAL FRAME.....</b>	<b>8</b>
3.1 Turkish Legislation.....	8
3.1.1 Turkish Environmental, Health and Safety (EHS) Legislation.....	8
3.1.2 Turkish Energy Legislation .....	10
3.1.3 Turkish Legislation on Land Use .....	11
3.1.4 Turkish Legislation on Conservation of Nature and Wildlife.....	12
3.2 International Standards.....	13
3.3 Environmental and Social Risk Categorization.....	14
<b>4. METHODOLOGY.....</b>	<b>15</b>
4.1 Methodology for the Baseline Assessment.....	15
4.2 Methodology for the Impact Assessment .....	15
<b>5. ENVIRONMENTAL BASELINE.....</b>	<b>18</b>
5.1 Geology and Earthquake Risks .....	19
5.2 Surface Water and Groundwater Quality .....	20
5.3 Climate .....	23
5.4 Soil Quality.....	23
5.5 Air Quality.....	24
5.6 Environmental Noise.....	25
5.7 Ecology .....	26
5.7.1 Flora .....	26
5.7.2 Fauna .....	30
<b>6. SOCIAL BASELINE.....</b>	<b>35</b>

<b>6.1</b>	<b>Socio-Economic Environment .....</b>	<b>35</b>
<b>6.2</b>	<b>Methodology .....</b>	<b>35</b>
6.2.1	Demography and Population.....	36
6.2.2	Livelihoods and Employment .....	37
6.2.3	Education .....	37
6.2.4	Health .....	38
6.2.5	Infrastructure and Services.....	38
6.2.6	Vulnerable Groups .....	38
<b>7.</b>	<b>ENVIRONMENTAL IMPACT ASSESSMENT .....</b>	<b>40</b>
<b>7.1</b>	<b>Construction Stage Impacts .....</b>	<b>41</b>
7.1.1	Impacts on Ecology .....	41
7.1.2	Water Supply .....	42
7.1.3	Wastewater Generation.....	42
7.1.4	Impacts of Geothermal Fluid from Well Testing on Surface Waters.....	43
7.1.5	Impacts of Solid Wastes on Soil and Groundwater .....	44
7.1.6	Impacts on Air Quality.....	47
7.1.7	Noise.....	48
<b>7.2</b>	<b>Operation Stage Impacts.....</b>	<b>49</b>
7.2.1	Impacts on Terrestrial Ecology .....	49
7.2.2	Impacts of Domestic Wastewater on Surface Waters.....	49
7.2.3	Impacts of Spent Geothermal Fluid on Surface Waters .....	49
7.2.4	Impacts of Solid Wastes.....	51
7.2.5	Impacts of Storage of Chemicals .....	53
7.2.6	Impacts on Air Quality and Odor Impacts .....	54
7.2.7	Environmental Noise Impacts.....	55
7.2.8	Climate Change Impacts .....	55
<b>8.</b>	<b>SOCIAL IMPACT ASSESSMENT.....</b>	<b>57</b>
<b>8.1</b>	<b>Population Level.....</b>	<b>59</b>
<b>8.2</b>	<b>Land Acquisition.....</b>	<b>60</b>
<b>8.3</b>	<b>Local Economy and Employment.....</b>	<b>62</b>
<b>8.4</b>	<b>Cultural Heritage .....</b>	<b>63</b>
<b>8.5</b>	<b>Impacts of Transportation .....</b>	<b>64</b>
<b>8.6</b>	<b>Community Health and Safety.....</b>	<b>65</b>
<b>8.7</b>	<b>Employment and Labor .....</b>	<b>66</b>
<b>8.8</b>	<b>Occupational Health and Safety.....</b>	<b>67</b>
<b>9.</b>	<b>CUMULATIVE IMPACTS .....</b>	<b>69</b>
<b>10.</b>	<b>E&amp;S Mitigation and Monitoring Plan.....</b>	<b>70</b>
<b>10.1</b>	<b>Construction Stage .....</b>	<b>70</b>
<b>10.2</b>	<b>Operation Stage.....</b>	<b>71</b>

## LIST OF ANNEXES

ANNEX-1	Photo-Log
ANNEX-2	Test Results
ANNEX-3	Social Profile
ANNEX-4	Stakeholder Engagement Plan

## LIST OF TABLES

Table 2-1. Analysis of Alternatives .....	7
Table 3-1. Turkish EHS Legislation Related to the Project .....	9
Table 3-2. Turkish Energy Legislation Related to the Project .....	10
Table 3-3. Project-related Turkish Legislation on Land-use .....	11
Table 3-4. Project-related Turkish Legislation on Conservation of Nature and Wildlife .....	12
Table 3-5. Permits Required for the Project .....	12
Table 4-1. Impact Types and Definitions .....	16
Table 4-2. Impact Criteria .....	16
Table 4-3. Significance Rating .....	17
Table 4-4. Overall Impact Rating .....	17
Table 5-1. Scoping of Environmental Issues .....	18
Table 5-2. Results of Surface Water Quality Analysis .....	20
Table 5-3. Test Results for Groundwater .....	22
Table 5-4. Results of Soil Quality Analyses .....	23
Table 5-5. Results of PM <sub>10</sub> Measurements .....	24
Table 5-6. Results of H <sub>2</sub> S and NO <sub>2</sub> Measurements .....	25
Table 5-7. Results of Noise Measurement .....	25
Table 5-8. Flora in the Project Area and its Environs .....	28
Table 5-9. Species of Reptiles and Amphibians in the Project Region .....	31
Table 5-10. Bird Species in the Region .....	32
Table 5-11. Mammals in the Project Region .....	33
Table 6-1. Population Figures of the Area of Impact .....	36
Table 6-2. Population Dynamics .....	37
Table 6-3. Vulnerable Groups .....	39
Table 7-1: Impacts of Construction Stage on Ecology .....	42
Table 7-2: Impacts of Drilling Effluents into Surface Waters .....	43
Table 7-3: Impacts of Waste Storage .....	46
Table 7-4. Impacts of Construction Activities on Air Quality .....	47
Table 7-5. Noise Impacts of the Construction Stage .....	48
Table 7-6. Impacts of Spent Geothermal Fluid .....	49
Table 7-7. Impacts of Waste Generation and Storage at Operation Stage .....	52
Table 7-8. Impacts of Chemicals Storage .....	53
Table 7-9. Odor Impacts During the Operation Stage .....	54

Table 7-10. Noise Impact of the Operation Stage .....	55
Table 8-1. Number of Household Surveys Implemented in the Quarters .....	58
Table 8-2. Impacts on Population Level .....	59
Table 8-3. Land Purchased for the Project Activities .....	60
Table 8-4. Impacts of Land Acquisition on Local Communities .....	61
Table 8-5. Impacts on Local Economy and Employment .....	62
Table 8-6. Impacts on Cultural Heritage .....	63
Table 8-7. Impacts of Project Transportation Activities .....	64

## LIST OF FIGURES

Figure 2-1. Project Area and Proximity to Settlements .....	4
Figure 2-2. Process Flow Chart .....	5
Figure 4-1. Sampling Points and Drilling Wells .....	15
Figure 5-1. Geological Map of Germencik and Environs .....	20

## LIST OF PHOTOS

Photo 5-1. Agricultural Areas Around the Project Site .....	27
Photo 7-1. Mud Pits Lined with Geomembrane .....	47

**ABBREVIATIONS**

2U1K	2U1K Engineering and Consultancy Inc.
AoI	Area of Influence
CO <sub>2</sub>	Carbon Dioxide
EA	Environmental Assessment
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPRP	Emergency Preparedness and Response Plan
ESA	Environmental and Social Assessment
ESDD	Environmental and Social Due Diligence
ESMMP	Environmental and Social Management and Monitoring Plan
GD NCNP	General Directorate of Nature Conservation and National Parks
GPP	Geothermal Power Plant
HS	Health and Safety
H <sub>2</sub> S	Hydrogen Sulphide
IFC	International Finance Corporation
MoEU	Ministry of Environment and Urban Planning
NGO	Non-Governmental Organization
OHS	Occupational Health and Safety
ORC	Organic Rankine Cycle
PDR	Project Description Report
PS	Performance Standards
SEP	Stakeholder Engagement Plan

# 1. INTRODUCTION

## 1.1 Objectives

2U1K has been appointed by Beştepeler Enerji Üretim Ticaret A.Ş. (hereinafter the Project Company) for the Environmental and Social Impact Assessment (ESIA) of the Kubilay Geothermal Power Project (hereinafter The Project).

The objective of this ESIA is to identify potential impacts of the proposed project and to recommend appropriate mitigation measures to reduce adverse potential impacts. The ESIA study is conducted by 2U1K on behalf of the Project Company, to be submitted to TKB, the financial intermediary.

The ESIA process is comprised of baseline environmental and social assessment, environmental and social impact assessment, designation of mitigation measures, stakeholder consultations and cumulative impact assessment.

Baseline information in the Report is supported with field studies that include:

- Overall site observations of drilling wells, mud-pits, storage conditions of chemicals and fuels and waste management;
- Observations for the flora and fauna assessments;
- Sampling for air quality measurements, groundwater and surface water sampling, soil sampling and environmental noise measurements;
- Social surveys including household surveys, focus group meetings, interviews with mukhtars;
- Consultations with key stakeholder groups.

A photo-log is available in Annex-1 to present pictures from field studies. Results of field tests and measurements are provided in Annex-2.

## 1.2 Scope of the Report

The Report is comprised of 10 Sections.

Section 1 is an introductory part that gives overall objectives of the ESIA Report, its contents and limitations in undertaking the associated studies.

Section 2 describes the Project components that are subject to assessment of environmental and social impacts.

Section 3 gives the legal framework including national and international legislative requirements as related with geothermal drilling and power generation. National frame compiles the Project-related laws and regulations on the basis of concerns of the environmental and social assessment. EHS, permits, energy generation, land use and



biodiversity conservation. International legal frame focuses on requirements of the World Bank operational procedures and the pertinent risk categorization for the specific Project.

Section 4 defines the methodology of data collection and impact assessment.

Section 5 gives environmental baseline situation to be considered in the long term monitoring process as well as the scoping of impact assessment process.

Section 6 gives social baseline situation to be considered in the long term monitoring process as well as the scoping of impact assessment process.

Section 7 is assessment of impacts on the environment. Focus is given on soil and groundwater contamination from discharge of geothermal drilling and operation stages, from mud pits opened during drilling stage, and H<sub>2</sub>S emissions during operation.

Section 8 is assessment of impacts on the communities. Social and economic impact assessment is backed up by a Stakeholder Engagement Plan (SEP) and the Community Profile of Social Surveys. The SEP prepared by 2U1K is available in Annex-4 of the Report.

Section 9 discusses cumulative impacts of the Project in conjunction with other geothermal projects in the region.

Section 10 presents the mitigation plan and the monitoring plan for environmental and social aspects to be complied with during both construction and operation stages.

### 1.3 Limitations of the Study

Besides site observations performed by 2U1K, the ESIA Report is limited to the statements of Project Company representatives and former reports (PDRs for the drillings and the power plant and EMP for the power plant) prepared during the course of project planning and license applications. In this respect, no modeling studies are performed in relation to environmental and social parameters. The ESIA process builds upon the available reports and supports them with additional baseline measurements of critical parameters and social surveys.

## 2. PROJECT DESCRIPTION

### 2.1 Purpose of the Project

The aim of the Project is to generate 24 MWe electric power by means of utilizing geothermal water. Beştepeler will be producing 160 GWh electricity on annual basis.

The Project is comprised of drilling and operation of 10 geothermal production wells and 6 reinjection wells in Moralı Quarter of Germencik District, Aydın. The Project Site is located over an area of 12 ha land. The operation license was secured in March 2013 for a period of 30 years from the Aydın Governorate. The license area is much broader, comprising an area of about 3000 ha. The Project is considered as a first stage of energy generation in the license area, which has been estimated to have an potential capacity of 75 MWe. Apart from the production and re-injection wells, the Project also comprises of a power plant and transmission lines for the geothermal water.

Owner of the Project is Beştepeler Enerji Üretim A.Ş. (Beştepeler hereinafter) who has taken over the geothermal field licenses from Karizma Enerji Gaz Maden Mermer İnşaat Taahhüt Ormancılık Sanayi ve Ticaret A.Ş., compiling 4 licenses under a single license.

Power generation process is based on the binary production technology called Organic Rankine Cycle (ORC) which makes possible 100% re-injection. Operation will include air-cooled condenser, hence no white plume will be emitted in contrast to flash power plants that uses geothermal steam directly. The secondary fluid used for the binary power generation system is n-butane, a low boiling point working fluid. Environmental impacts of an ORC power plant are very low as compared to flash technologies.

The Project is currently at construction stage. It is planned to complete construction activities in 3 years between 2015-2018. Construction is mainly comprised of drilling of wells and laying of above-ground pipelines.

### 2.2 Project Location

The Project area is located in the Moralı Quarter of the Germencik District of Aydın (see Figure 1-1). License area covers about 3000 hectares and the power plant covers an approximate area of 0.16 hectares.

Uzunkum Quarter is the closest settlement to the Project area. Distance to the nearest well from Uzunkum is about 0.6 km. The second closest quarter to the nearest well is Moralı with a distance of 0.8 km and the third closest settlement is Tekin Quarter at a distance of 2 km.

**Figure 2-1** shows location of the Project area and its proximity to nearby settlements.

As it can be seen from Google image power plant and wells are all Project components are located and surrounded by agricultural lands. It should be noted that the Project Company

has paid considerable effort for avoiding prime agriculture lands with high crop yields, hence located the wells and the powerhouse on marginal lands as much as possible. Aboveground piping has also been planned to be laid on borders of farmlands.

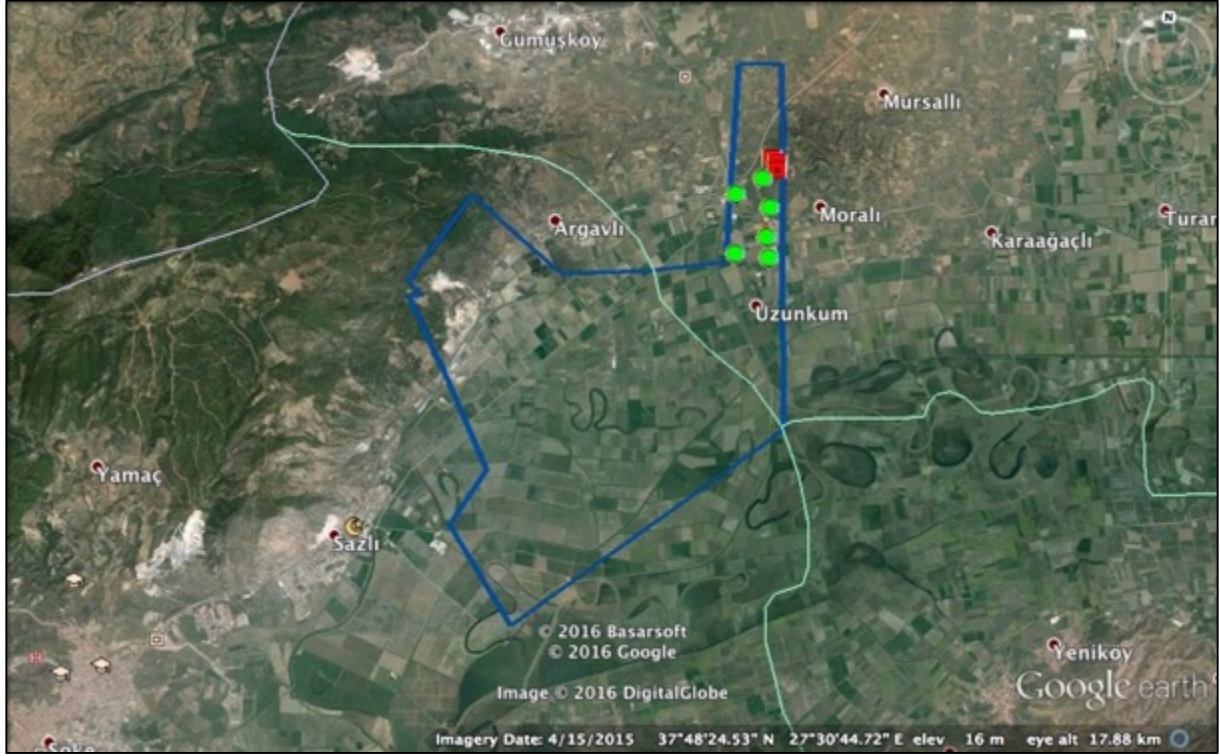


Figure 2-1. Project Area and Proximity to Settlements

## 2.3 Project Components

### 2.3.1 Drilling of Geothermal Wells

Exploration and reservoir evaluation activities include geological, geophysical, and drilling surveys for exploratory drilling and reservoir testing.

Production field development involves drilling steam or hot water production wells and re-injection wells and processing of the reservoir output for use in the power plant. Drilling will continue throughout the life of the project, as production and injection wells need to be periodically updated to support power generation requirements.

### 2.3.2 The Power Plant

Power plant construction activities include construction of the power plant facility and associated infrastructure, including cooling towers, pipelines, and facilities for treatment and reinjection of wastewaters and gases.

The plant is planned as a binary plant that use a secondary working fluid, n-butane, with a low boiling point and high vapor pressure at low temperatures as compared to steam. The secondary fluid is operated through a conventional Rankine cycle: the geothermal fluid yields heat to the secondary fluid through heat exchangers, where the secondary fluid is heated and vaporizes. The vapor produced drives a turbine, then is cooled and condensed, and the cycle continues.

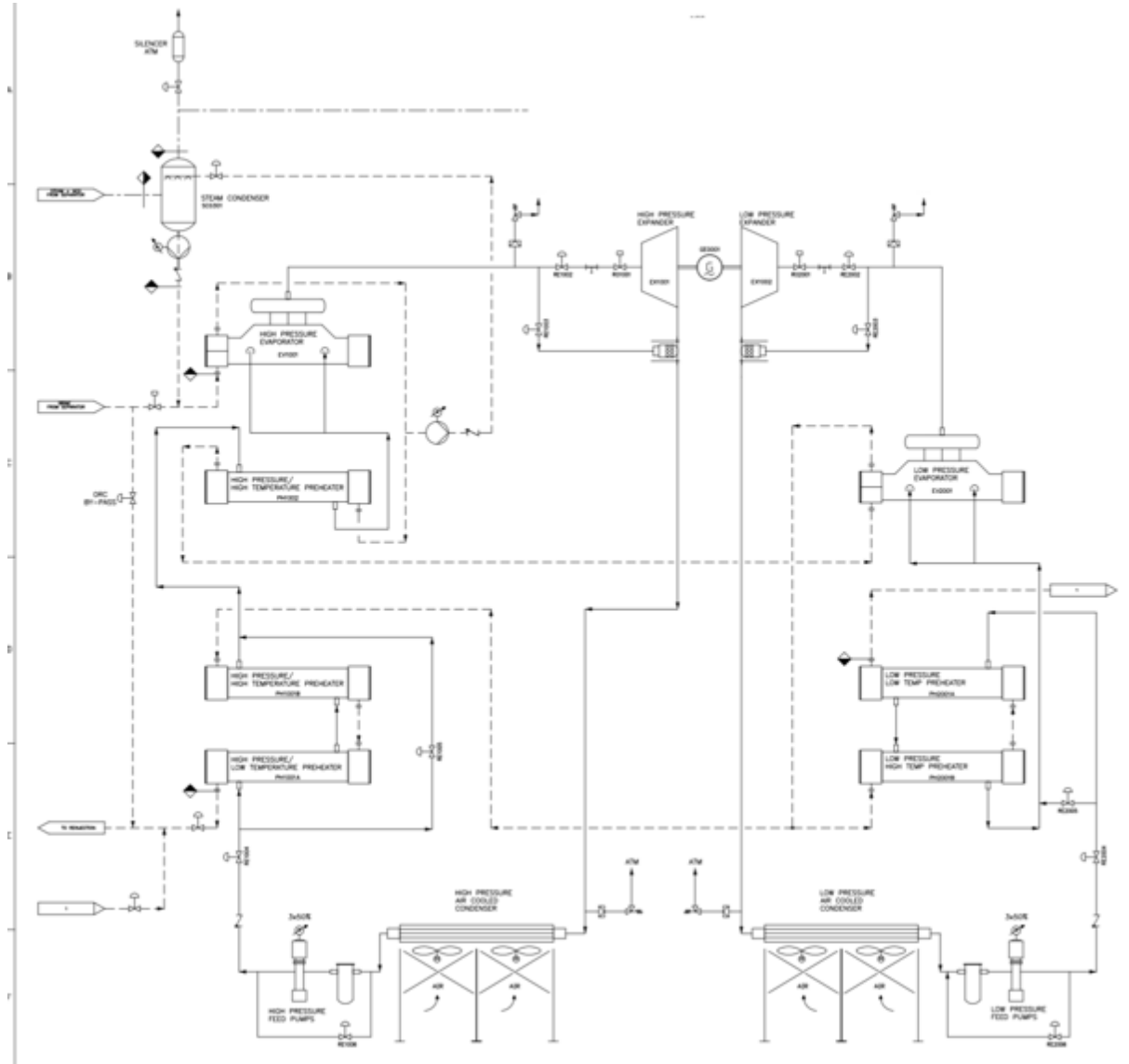


Figure 2-2. Process Flow Chart

In order to avoid extensive water use and wastewater discharge into natural rivers, the Project will use dry cooling. Air-cooled technology will be employed, where exhaust steam from the turbine flows through the tube bundles of an air-cooled condenser and is condensed using air flow induced by properly designed axial fans. The residual steam flows in counter

current. In this way, with the use of air-cooled technology, water resources will not be consumed, no emissions will result, no hot water discharge will be made into the river. Furthermore, dry cooling systems require very low maintenance.

### 2.3.3 Transmission Lines

Transmission line project will be developed following approval of TEIAS. The power plant will be connected to the TEIAS transmission line between Söke and Germencik from the switch yard to be constructed within the Site boundaries. Transmission will be through a 154 kV line of 3 km long.

### 2.3.4 Access Roads

Existing roads have been used by improving road conditions and extending road widths. No new access roads have been constructed.

## **2.4 Project Proponents**

Key proponents of the Project are:

- Project Company (Beştepeler),
- Development Bank of Turkey,
- International Financing Institution (World Bank),
- Contractors.

## **2.5 Project Alternatives**

The “no project” alternative would result in the continuation of the current situation, which would comprise of agricultural areas and unexploited geothermal water resources, and no development of the power plant planned in the Project. The Project is geared to meeting Turkey’s growing energy demand by means of renewable energy. Therefore, the “no project” alternative would result in a negative impact on national energy policies.

The Project is located within a rural agricultural area with no species of ecological conservation status. The level of economic development in the area is poor, so without the Project, there would be no new source of employment for the local communities. As for the environmental and social impacts, the Project does have the potential to result in various environmental impacts without mitigation measures.

Supposing that the Project Site is not situated on a geothermal reserve, a new power plant project could be located on the Project lands for developing a solar power or thermal power project. The site is not appropriate for wind power or hydropower development. Major points of comparison are land costs and environmental and social concerns. Comparisons are

based on an assumption of equivalent power generation with the use of different resources. Comparative analysis is given in Table 2-1.

Table 2-1. Analysis of Alternatives

Alternatives	Description	Advantages	Disadvantages
"No Project"	<ul style="list-style-type: none"> <li>• Agriculture continued as the only source of income.</li> <li>• No contribution to meeting national energy needs.</li> <li>• No exploitation of a valuable geothermal resource.</li> </ul>	<ul style="list-style-type: none"> <li>• No environmental impacts such as disturbance of surface waters and groundwaters.</li> <li>• No social impacts such as nuisance of odor and noise.</li> <li>• Protection of agriculture areas.</li> <li>• No costs encountered for environmental and social mitigation.</li> </ul>	<ul style="list-style-type: none"> <li>• Negative impact on national energy policies.</li> <li>• Negative impact on local economy by hindering employment opportunities.</li> </ul>
Solar Power Plant in the same geographic location	Solar panels would be installed on a much broader land area to account for the equal power generation (approximately 24 ha as compared to 7 ha used for the Project).	<ul style="list-style-type: none"> <li>• Less environmental issues to manage.</li> <li>• Less social issues to manage.</li> <li>• Employment opportunities during construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>• Considerably high land acquisition costs.</li> <li>• Geothermal reserve unexploited, hence potential economic value lost.</li> <li>• Few personnel to be employed at construction and operation stages.</li> </ul>
Coal fired Power Plant in the same geographic location	Coal fired power plant installed at the same geological location	<ul style="list-style-type: none"> <li>• Employment opportunities during construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>• Several environmental issues: cooling water requirement, disposal of ash, emission control systems, etc.</li> <li>• High cost of coal supply</li> <li>• Land requirement for coal stockpiles and ash disposal</li> </ul>
Geothermal Power Plant with Water-based Cooling vs air-cooled systems	Cooling with water would incorporate one or more cooling towers within the plant site	<ul style="list-style-type: none"> <li>• Less expensive</li> </ul>	<ul style="list-style-type: none"> <li>• Extensive need for reliable, clean water supply</li> <li>• More environmental concerns with respect to air-cooled geothermal power plant</li> <li>• Dry air cooling is much more practical.</li> </ul>
Geothermal Power Plant with flash technology in contrast to binary technology of the Project	Hot water flows up through wells in the ground under its own pressure. As it flows upward, the pressure decreases and some of the hot water boils into steam.	<ul style="list-style-type: none"> <li>• increases overall cycle efficiency</li> <li>• better utilizes the geothermal resources</li> </ul>	<ul style="list-style-type: none"> <li>• Larger emission of steam with fugitive gases including H<sub>2</sub>S.</li> <li>• Overall increase in capital cost.</li> </ul>



### 3. LEGAL FRAME

This ESIA study is carried out based on relevant national legislation as well as the lender's guidelines. The main legislation and guidelines are mentioned in the following sections together with their implications for the Project stages.

#### 3.1 Turkish Legislation

The key national laws and regulations presented in this section include the legal requirements to reduce the potential environmental impacts that may arise from the construction and operational activities of the Project. Turkish Legislation related to the Project are presented in the following sections under relevant subtopics.

##### 3.1.1 Turkish Environmental, Health and Safety (EHS) Legislation

"Environmental Law", which is ratified in August 1983 (amended with the Law dated May 29, 2013; No: 6486), is one of the principal legislation related to the Project. Several by-laws and decrees are enforced under the Environmental Law.

The "Regulation on Environmental Impact Assessment (dated November 25, 2014; No: 29186 and amended on February 9, 2016; No: 29619)" defines the administrative and technical procedures and principles to be followed throughout the EIA process. It should be noted that the Project was previously listed under Annex-II, Article 49-a of the Regulation, and a Project Description Report was prepared accordingly. As a result of the selection-elimination processes, the Project was exempted from the national EIA requirements with the "EIA is not required" decision made by the Provincial Directorate of Environment and Urbanization on November 26, 2014 (Decision No: 98914016 220-02 E-2014518). The rest of the national EHS legislation that the Project will comply with are presented as Table 3-1 below.

Table 3-1. Turkish EHS Legislation Related to the Project

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Waste Management Regulation	02.04.2015	29314	<ul style="list-style-type: none"> <li>Disposal of wastes generated by construction staff during construction stage and by operation staff during the operation stage</li> <li>Hazardous wastes generated at construction and operation stages</li> </ul>
Water Pollution Control Regulation	31.12.2004 10.01.2016	25687 29589	<ul style="list-style-type: none"> <li>Discharge of wastewater generated by site staff at construction stage and by operation staff during the operation stage</li> </ul>
Regulation on Landfill of Wastes	26.03.2010 11.03.2015	27533 29292	<ul style="list-style-type: none"> <li>Drilling mud generated during the construction stage</li> </ul>
Waste Oil Control Regulation	30.07.2008 05.11.2013	26952 28812	<ul style="list-style-type: none"> <li>Waste oils generated at construction and operation stages</li> </ul>
Waste Vegetable Oil Control Regulation	06.06.2015	29378	<ul style="list-style-type: none"> <li>Waste vegetable oils generated at construction and operation stages</li> </ul>
Packaging Waste Control Regulation	24.08.2011	28035	<ul style="list-style-type: none"> <li>Packaging wastes generated at construction and operation stages</li> </ul>
Medical Waste Control Regulation	22.07.2005 21.03.2014	25883 28948	<ul style="list-style-type: none"> <li>Medical wastes generated at construction and operation stages</li> </ul>
Regulation on the Control of End-of-life Tires	25.11.2006 11.03.2015	26357 29292	<ul style="list-style-type: none"> <li>End-of-life tires generated at construction and operation stages</li> </ul>
Regulation on the Control of Waste Batteries and Accumulators	31.08.2004 23.12.2014	25569 29214	<ul style="list-style-type: none"> <li>Waste batteries and accumulators generated at the construction and operation stages</li> </ul>
Regulation on the Construction of Septic Tanks at Places Where Sewer Construction is Not Feasible	19.03.1971	13783	<ul style="list-style-type: none"> <li>Septic tanks for the collection of domestic wastewater generated at construction and operation stages</li> </ul>
Regulation on the Noise Emission in the Environment from Equipment for Outdoor Use	30.12.2006	26392	<ul style="list-style-type: none"> <li>Noise levels caused by noise sources within the Project site at the construction and operation stages</li> </ul>
Industrial Air Pollution Control Regulation	03.07.2009 20.12.2014	27277 29211	<ul style="list-style-type: none"> <li>Dust emissions at the construction stage and CO2 emissions at the operation stage</li> </ul>
Regulation on Assessment and Management of Air Quality	06.06.2008	26898	<ul style="list-style-type: none"> <li>Emissions originating from the Facility during the operation stage</li> </ul>
Regulation on the Control of Odorous Emissions	19.07.2013	28712	<ul style="list-style-type: none"> <li>Odorous emissions generated during the operation stage</li> </ul>



Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Regulation on Assessment and Management of Environmental Noise	04.06.2010	27601	<ul style="list-style-type: none"> <li>Noise emissions at construction and operation stages</li> </ul>
Regulation on Soil Pollution Control and Point Source Polluted Areas	08.06.2010 11.07.2013	27605 28704	<ul style="list-style-type: none"> <li>Risks of soil contamination at construction and operation stages</li> </ul>
Regulation on the Control of Excavation Soil, Construction and Debris Wastes	18.03.2004	25406	<ul style="list-style-type: none"> <li>Transportation and disposal of excavation waste and construction debris at the construction stage</li> </ul>
Law on Occupational Health and Safety (6331)	20.06.2012	28339	<ul style="list-style-type: none"> <li>Health and safety measures to be taken during construction and operation stages</li> </ul>
Regulation on Buildings to be Constructed within the Seismic Zones	06.03.2007 03.05.2007	26454 26511	<ul style="list-style-type: none"> <li>Construction works within the scope of the Project</li> </ul>

### 3.1.2 Turkish Energy Legislation

Project-related Turkish energy legislation is presented below in Table 3-2.

Table 3-2. Turkish Energy Legislation Related to the Project

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Electricity Market Law No. 6446 (as amended with the Law numbered 6639) and relevant regulations	30.03.2013 15.04.2015	28603	Rights and responsibilities of the Project Company regarding electricity production and transmission Expropriation of private properties
The Law No. 5346 on the Use of Renewable Resources for the Generation of Electrical Energy (as amended with the Law numbered 6446) and relevant regulations	18.05.2005 30.03.2013	25819	Procedures and principles of the conservation and utilization of renewable energy resource areas Certification of the energy generated from the utilization of these resources
Geothermal Resources and Natural Mineral Water Law No. 5686 (as amended with the Law numbered 6527) and relevant regulations	13.06.2007 01.03.2014	26551	Monitoring requirements regarding geothermal resource preservation and being the right-holder for these resources

### 3.1.3 Turkish Legislation on Land Use

The Project site is located on a mine site that consists of pasture lands, which are stated within “Pasture Law No. 4342”, and public property. According to the statement of Provincial Directorate of Food, Agriculture and Livestock (dated November 04, 2014), receiving the required Land-use permits is an obligation for the Project Company. Project-related Turkish Legislation on Land-use are presented in Table 3-3.

Table 3-3. Project-related Turkish Legislation on Land-use

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Regulation on Geothermal Area Use for Electricity Generation	14.10.2008	27024	Land acquisition and use
Expropriation Law No. 2942 (as amended with the Law numbered 6645) and relevant regulations	08.11.1983 23.04.2015	18215	Expropriation of private properties
Pasture Law No. 4342 (as amended with the Law numbered 6552) and relevant regulations	28.02.1998 31.01.2015	23272	Permission(s) required for land use
Law on Soil Conservation and Land Use No. 5403 (as amended with the Law numbered 6537) and relevant regulations	19.07.2005 15.05.2014	25880	Permission(s) required for land use
Law on Aquaculture Resources No. 1380 (as amended with the Law numbered 5996) and relevant regulations	04.04.1971 13.12.2010	13799	Permission(s) required for land use
Law on Reclamation of Olive Cultivation and Inoculation No. 3573 (as amended with the Law numbered 4086) and relevant regulations	07.02.1939 28.02.1995	4126	Permission(s) required for land use

### 3.1.4 Turkish Legislation on Conservation of Nature and Wildlife

Project-related Turkish legislation on Conservation of Nature and Wildlife is presented below in Table 3-4.

**Table 3-4.** Project-related Turkish Legislation on Conservation of Nature and Wildlife

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Wetland Conservation Regulation	04.04.2014	28962	Conservation of the stream beds located within the boundaries of the project site
Regulation on the Management of Natural Assets, Natural Protected Areas, and State-Owned Lands Located on Environmental Conservation Lands	02.05.2013	28635	Measures to be taken during chance finds at the construction stage
Law on Conservation of Cultural and Natural Assets No. 2863 (as amended with the Law numbered 6552) and relevant regulations	23.07.1983 11.09.2014	18113	Measures to be taken during chance finds at the construction stage
Land Hunting Law No. 4915 and relevant regulations	11.07.2003	25165	Monitoring requirements regarding hunting and terrestrial wildlife

The Project Company is required to secure the permits mentioned below in Table 3-5.

**Table 3-5.** Permits Required for the Project

Permit/License	Date	Progress
"EIA Not Required" for the Power Plant	26.11.2014	Decision of Provincial Directorate of Environment and Urbanization
"EIA Not Required" for the drillings after the year 2013	26.06.2015 08.07.2015 25.08.2015	Decisions made by the Provincial Directorate of Environment and Urbanization since preparation of a Project Description Report is required for well drillings as of October 3, 2013.
Well Drilling Permits for the drillings prior to year 2013	March-September 2013	Exploration Activity Screening-Inspection Forms have been prepared and presented to Ministry of Environment and Urbanization, and letters of approval have been received for the well drillings prior to October 3, 2013.
Geothermal Fluid Discharge Permit	04.06.2015	Geothermal fluid discharge permission in 2 locations has been granted under certain conditions indicated in the Official Letter (No: 80481397-611.02-360848) by State Hydraulic Works (DSI)
Pipeline Route Permits	In progress	Agreements were reached with some of the Property owners, and negotiations are proceeding with the rest of them.
Land-use Permit	March - April 2016	Approvals in place by the Ministry of Food, Agriculture and Livestock

## 3.2 International Standards

Since the potential lender for the Project is Development Bank of Turkey (TKB), the Project must be in compliance with good international practice, including World Bank (WB) Safeguard Policies, guides, performance standards and best practices documents alongside the National EHS Legislation.

World Bank governs projects and activities by the Safeguard Policies in order to assure that they are conducted in an environmentally, financially and socially sound manner. Safeguard Policies include Environmental Assessments and other policies that define environmental and social adverse effects of the projects as well as their reduction and prevention. These policies are enlarged upon in “The World Bank Operations Manual”, which also provides guidance on compilation with the Operational Policies (OP), Bank Procedures (BP) and Good Practices (GP). OPS are defined as statements of policy objectives and operational principles including the roles and obligations of both the Borrower and the Bank, while BP are compulsory procedures to be followed by both the Borrower and the Bank and GP are non-compulsory advisory material. Specific policies related to the Project are listed below:

### Environmental Policies

- OP/BP 4.01 Environmental Assessment
- OP/BP 4.04 Natural Habitats

### Social Policies

- OP/BP 4.11 Physical Cultural Resources

### BP 17.50 Bank Disclosure Policy

The main objectives and tasks of the Project-related WB Safeguard Policies are explained below:

#### OP/BP 4.01 Environmental Assessment

- To ensure the proposed projects’ environmental and social sustainability and soundness
- To inform decision-makers about the environmental and social risks
- To increase transparency by providing stakeholder engagement in the decision-making process

#### OP/BP 4.04 Natural Habitats

- To conserve natural habitats and their biodiversity
- To avoid significant conversion/degradation of critical natural habitats
- To ensure the sustainability of services and products provided to human society by natural habitats

#### OP/BP 4.11 Physical Cultural Resources

- To ensure the identification and protection of Physical Cultural Resources (PCR), including archaeological and historical sites, historic urban areas, sacred sites, graveyards, burial sites and unique natural values
- To ensure the compliance with national legislation regarding the protection of physical cultural property

#### BP 17.50 Bank Disclosure Policy

- To support the decision-making process by allowing public access to information on environmental and social aspects of projects.

Under the Operational Policy for Environmental Assessment (OP 4.01), WB conducts an environmental scanning and classifies the proposed projects under Categories A, B and C, based on the level of their likely environmental impacts. Furthermore, Category B projects divide in two within its structure as B and B+, based on the special circumstances of the project in question.

### 3.3 Environmental and Social Risk Categorization

This ESIA Report proposes that the Project can be categorized as Category B+ based on a preliminary overview of potential environmental and social risks associated with the construction and operation of the project, with respect to WB criteria. The Category B is approached with due sensitivity on the social aspects, given the current public opposition on geothermal power projects in the region. Category B+ projects have relatively more impacts and mitigation measures as compared to Category B projects, which are, however, not significant enough to be recognized as Category A projects. The main difference of Category B+ from Category B is that Category B+ projects may require the preparation of a site-specific Environmental Assessment study.

## 4. METHODOLOGY

### 4.1 Methodology for the Baseline Assessment

Baseline data have been compiled through available reports, literature review and onsite measurements performed by 2U1K. Onsite sampling and measurements include the following. See Table 4-1 for the locations of the above samplings.

- PM10 sampling and analysis at drilling well M10 and Uzunkum Quarter,
- Soil sampling and analysis at two mud pits (near drilling wells M6 and M7) and one reference point at a nearby agricultural spot,
- Noise survey at the nearest receptor in Uzunkum Quarter,
- Water sampling from Miril Creek for surface water quality analysis,
- Groundwater sampling and analysis at drilling well M7.

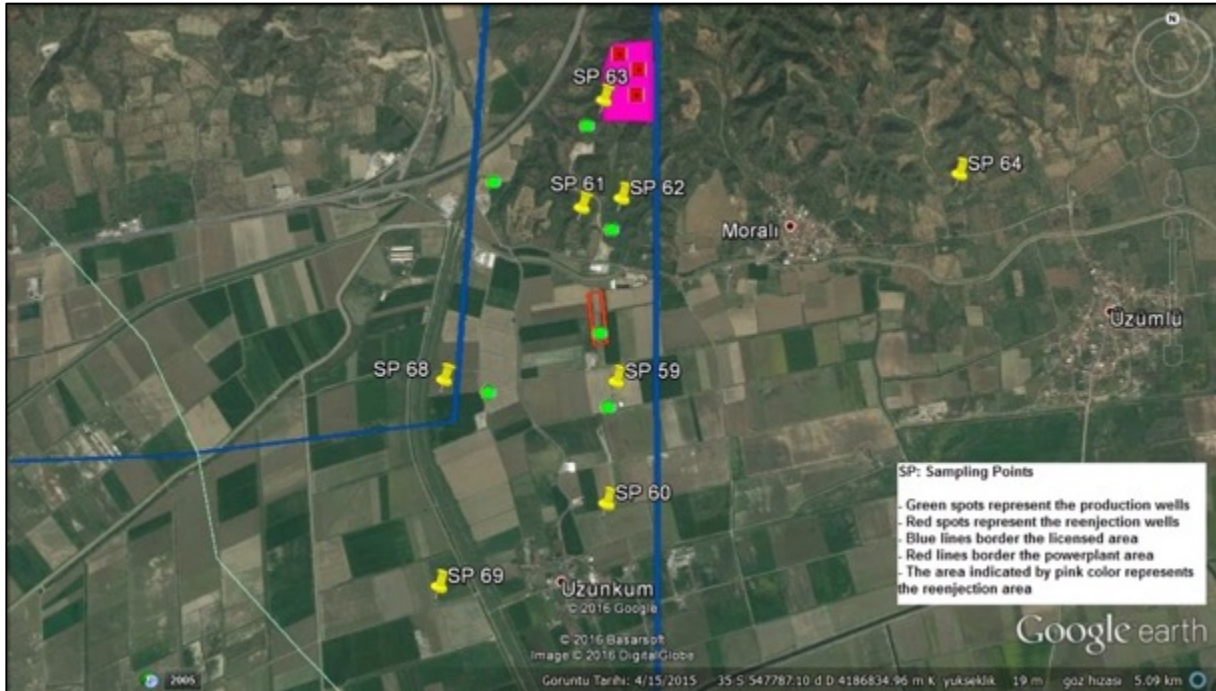


Figure 4-1. Sampling Points and Drilling Wells

### 4.2 Methodology for the Impact Assessment

Identification and evaluation of impacts begin with the stage of scoping process. Impact assessment is a result of determining the possible impacts of project related activities within the aspects of physical, biological and social environment. During the impact assessment of the Project, possible interactions between the Project and surrounding environment have been defined, in order to provide the entire potential Project related impacts. In that aspect, impact is defined as changes originated from project and project related activities. In order to

recognize impacts, the baseline study of the Aol has been established. General nature and types of the impacts categorized in Table 4-1 shown below.

Table 4-1. Impact Types and Definitions

Impact Type	Definition
<b>Positive</b>	Impacts that make positive changes over the current conditions.
<b>Negative</b>	Impacts that leads to new and undesirable changes over the current conditions.
<b>Direct</b>	Direct impacts occur through direct interaction of an activity with an environmental, social, or economic component.
<b>Indirect</b>	Impacts which are not a direct result of the project, often produced away from or as a result of a complex impact pathway.
<b>Cumulative:</b>	Impacts that consist of an impact that is created as a result of the combination of the project evaluated in the current project together with other projects causing related impacts.

As seen in Table 4-2, impacts may occur as positive, negative, direct, indirect and cumulative. Determination of the type of impact is the important step of the assessment process. The determination of the impact type is based on geographical size, duration, significance and likelihood of the impact. The table provides information regarding the process of determining impact significance, respectively.

Table 4-2. Impact Criteria

<b>Impact Extent</b>	<p><b>Project Area:</b> potential impacts that only cover the borders within the construction site.</p> <p><b>Local:</b> potential impacts area that covers 20 km within the construction activities of the project.</p> <p><b>Regional:</b> potential impacts that cover the throughout the district level.</p> <p><b>National:</b> potential impacts that expected to create changes in national level.</p>
<b>Impact Duration</b>	<p><b>Temporary:</b> extend of the impacts expected to be less than 6 months.</p> <p><b>Short-term:</b> impacts that are expected to only occur during the construction phase of the project.</p> <p><b>Long-term:</b> impacts that are expected to occur throughout the operation phase of the project.</p> <p><b>Permanent:</b> impacts that are expected to be permanent to the project affected people.</p>
<b>Likelihood of Impact</b>	<p><b>Not likely:</b> impacts that are not likely to occur.</p> <p><b>Likely:</b> impacts that are likely to occur in most circumstances.</p> <p><b>Certain:</b> the outcome of impacts will certainly occur.</p>
<b>Impact Magnitude</b>	<p><b>Negligible:</b> There is perceptible change to people's lives</p> <p><b>Low:</b> Communities are able to adapt with relative ease</p> <p><b>Medium:</b> Communities are able to adapt with some difficulty</p> <p><b>High:</b> Affected people/communities will not be able to adapt to changes</p>



For the determination of impact significance, the matrix below is used:

Table 4-3. Significance Rating

Likelihood		Unlikely	Likely	Certain
Impact Magnitude	Negligible	Insignificant	Insignificant	Insignificant
	Low	Insignificant	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Impact reversibility is used in order to finalize overall impact assessment. Reversibility can be applied with the use of the matrix below:

Table 4-4. Overall Impact Rating

Impact Reversibility		High Reversibility	Medium Reversibility	Low Reversibility	Irreversible
Impact Significance	Insignificant	Negligible	Negligible	Negligible	Negligible
	Minor	Negligible	Negligible	Low	Medium
	Moderate	Low	Low	Medium	High
	Major	Low	Medium	High	Critical



## 5. ENVIRONMENTAL BASELINE

Baseline assessment is comprised of field studies and desk-top review of various sources of information. Baseline assessment is focused on a series of environmental components, as listed below:

- Geology and earthquake risks
- Climate
- Hydrology and surface water quality
- Groundwater quantity and quality
- Noise
- Air quality
- Soil quality
- Ecology

Given that the Project is categorized as a Category B+ investment with limited significant impacts, a partial impact assessment is performed by 2U1K. In this respect, the ESIA Report is based on onsite baseline measurements and social surveys, as well as environmental and social reports developed formerly for the Project.

Table 5-1. Scoping of Environmental Issues

Project Activities	Environmental Issue	Possible Impacts	Baseline Parameters
Drilling	Effluent discharge	<ul style="list-style-type: none"> <li>• Discharge of drilling fluids including extracted water from exploration and operational wells during testing.</li> <li>• Discharge of extracted water during well testing.</li> <li>• Discharge of domestic wastewater from camp site</li> </ul>	<ul style="list-style-type: none"> <li>• Groundwater quality</li> <li>• Soil quality</li> <li>• Surface water quality</li> </ul>
Drilling	Drilling Mud	<ul style="list-style-type: none"> <li>• Storage and disposal of drilling mud including cuttings</li> </ul>	<ul style="list-style-type: none"> <li>• Groundwater quality</li> <li>• Soil quality</li> </ul>
Drilling	Groundwater contamination	<ul style="list-style-type: none"> <li>• Contamination of fresh groundwater resources in case of percolation of thermal groundwater during drilling and testing.</li> </ul>	<ul style="list-style-type: none"> <li>• Groundwater quality</li> </ul>
Drilling	Solid Waste	<ul style="list-style-type: none"> <li>• Storage and disposal of solid waste.</li> </ul>	<ul style="list-style-type: none"> <li>• Soil quality</li> <li>• Groundwater quality</li> </ul>
Drilling	Noise	<ul style="list-style-type: none"> <li>• Drilling rig, generators, traffic, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental noise</li> </ul>
Drilling, Construction,	Air Emissions	<ul style="list-style-type: none"> <li>• Possible toxic gas emissions during drilling and well testing (hydrogen sulfide)</li> <li>• Dust emission due to site activities, arrangement of drilling rig area, construction of access roads, traffic etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Climate</li> <li>• Air Quality (PM10, H2S)</li> </ul>

Project Activities	Environmental Issue	Possible Impacts	Baseline Parameters
Drilling and Construction	Ecosystem	<ul style="list-style-type: none"> <li>Disturbance of natural habitats from construction, e.g. dust, noise, un-seasonal working, poor siting of new works, disposal of untreated wastes, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Flora</li> <li>Fauna</li> </ul>
Drilling and Construction	Soil	<ul style="list-style-type: none"> <li>Loss of topsoil during preparation of rig sites, construction of access roads or disposal of excavated materials</li> <li>Damage to soil structure due to material storage, traffic, etc.</li> <li>Erosion due to uncontrolled surface run-off where vegetation is cleared</li> </ul>	<ul style="list-style-type: none"> <li>Soil quality</li> </ul>
Drilling	Emergency and environmental safety	<ul style="list-style-type: none"> <li>Well blowout during drilling</li> </ul>	-
Drilling and Operation	Water Resources	<ul style="list-style-type: none"> <li>Possible over flow from mud pit.</li> <li>Discharge of test water.</li> <li>Contamination/pollution of resource, drilling chemicals, fuel &amp; oil, hazardous wastes, wastewater, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Surface water quality</li> </ul>

## 5.1 Geology and Earthquake Risks

The Project area and its environs is comprised of metamorphic massif rocks of Paleozoic Age and sedimentary rocks of Myosene, Pliocene and Quaternary and volcanic rocks of medium aged Myosene. Metamorphic rocks include stratigraphically gneiss, schist, marble, quartzite and various schists. See Figure 5-1 for regional geology.

A geological survey was performed for the Project area and environs in February 2016. According to the Geological Survey Report, majority of the Project area and close environs is made up of 40-60 m thick alluvial layer constituted by materials brought by Menderes River and its tributaries. The alluvial layer is of metamorphic-sedimentary origin and contains gneiss, schist, marble, sand and gravel.

Project area is located on a flat topography. The top vegetative soil layer is of about 0.30 meters. Beneath the top soil is sandy silt layer at various depths of 0.30 to 2.00 meters; silty sand at a depth of 2.0 to 5.0 meters and silty sand with low amount of gravel at 5-15 meters depth. Groundwater level is observed at about 3 meters.

According to the Geological Survey Report, no karstic cavities are observed in the Project Area.

The Project area is located on a high risk earthquake zone, hence the Project is required to comply with the Regulation on "Buildings to be Constructed in Earthquake Zones" (Official Journal Issue: 26454, dated 26.03.2007).

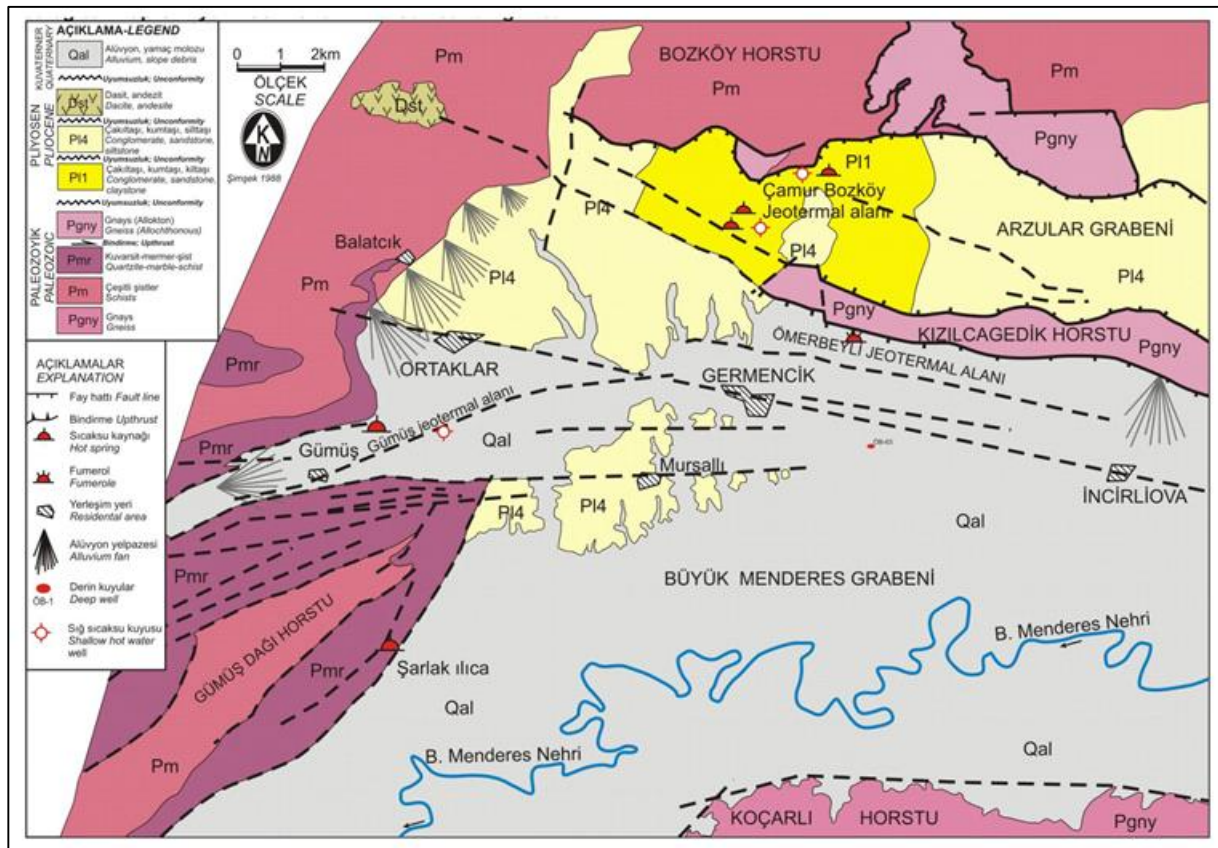


Figure 5-1. Geological Map of Germencik and Environs

## 5.2 Surface Water and Groundwater Quality

The Project area is located within the Menderes River catchment zone. The nearest tributary of Menderes River to the Site is the Mırıl Creek. Majority of the creeks are seasonal in the region. The Project will pose no impacts on the creeks and will comply with requirements of the Regulation on Conservation of Wetlands (Official Journal Issue: 27684, Date: 26.08.2010). Project Company performed water quality sampling from Mırıl Creek for baseline assessment on October 28, 2015. Results of water quality analysis are given in Table 5-2 below. Detailed laboratory reports are available in Annex-2.

Table 5-2. Results of Surface Water Quality Analysis

Parameter-Unit		Test Results
Temperature (°C)		23.6
Color	Wavelength 436 nm	0.5
	Wavelength 525 nm	< 0.5
	Wavelength 620 nm	< 0.5
pH		7.9

Parameter-Unit	Test Results
Conductivity ( $\mu\text{S}/\text{cm}$ )	3330
Oxygen Saturation (%) <sup>b</sup>	62.8
Dissolved Oxygen (mg/l) <sup>b</sup>	5.37
Chemical Oxygen Demand (mg/l)	25
Biochemical Oxygen Demand (mg/l)	8
Ammonium Nitrogen (mg/l) <sup>c</sup>	4.7
Nitrate Nitrogen (mg/L)	0.9
Nitrite Nitrogen (mg/L)	0.058
Total Kjeldahl Nitrogen (mg/L)	6.7
Total Phosphorus (mg/L)	0.68
Aluminum (mg/L)	0.035
Arsenic ( $\mu\text{g}/\text{L}$ )	19
Copper ( $\mu\text{g}/\text{L}$ )	< 2
Barium ( $\mu\text{g}/\text{L}$ )	106
Boron ( $\mu\text{g}/\text{L}$ )	3250
Mercury ( $\mu\text{g}/\text{L}$ )	<0.5
Zinc ( $\mu\text{g}/\text{L}$ )	7.2
Iron ( $\mu\text{g}/\text{L}$ )	36.5
Fluoride ( $\mu\text{g}/\text{L}$ )	450
Cadmium ( $\mu\text{g}/\text{L}$ )	<1
Cobalt ( $\mu\text{g}/\text{L}$ )	1.1
Chromium +6 ( $\mu\text{g}/\text{L}$ )	<20
Chromium (total) ( $\mu\text{g}/\text{L}$ )	< 2
Lead ( $\mu\text{g}/\text{L}$ )	<5
Manganese ( $\mu\text{g}/\text{L}$ )	3.5
Nickel ( $\mu\text{g}/\text{L}$ )	<5
Selenium ( $\mu\text{g}/\text{L}$ )	<5
Free Chlorine ( $\mu\text{g}/\text{L}$ )	<10
Cyanide (total) ( $\mu\text{g}/\text{L}$ )	<5
Sulphur ( $\mu\text{g}/\text{L}$ )	<2
Fecal Coliform (KOB/100 mL)	0

Parameter-Unit	Test Results
Total Coliform (KOB/100 mL)	500
Oil and Grease (mg/L)	< 10

As for the baseline groundwater quality assessment, a field test was performed by 2U1K at the water well near drilling well M7. The measurement location has been selected to analyze possible impact of the overflow at the mud pit near drilling well M7. Test results are given below in Table 5-3. Detailed laboratory reports are available in Annex-2.

It should be noted that the results of analyses are not indicative of contamination, but only a presentation of the baseline water quality. Hence, the results can not be attributed to any interpretation of Project impacts.

Table 5-3. Test Results for Groundwater

Parameter - Unit	Test Results
Amonium (mg/L)	<0.01
Arsenic (mg/L)	0.222
Mercury (mg/L)	<0.0005
Phosphorus from Phosphate (mg/L)	0.319
Conductivity (µS/cm)	2070
Cadmiyum (mg/L)	0.001
Chloride (mg/L)	265
Lead (mg/L)	<0.005
Nitrate(mg/L)	1.05
Nitrite (mg/L)	0.023
Sulphate (mg/L)	272
Tetrachloroethane (µg/L)	<0.07
Total Phosphorous (mg/L)	0.526
Total Pesticides (mg/L)	<0.001
Trichloroethane (µg/L)	<0.09

Test results indicate that groundwater from the shallow aquifer is of low water quality according to national legislation on water quality.

### 5.3 Climate

Climate in the region is dominated by Mediterranean climate characteristics, hot and dry summers and warm and rainy winters. The Menderes river valley enhances the warmth of the sea and winds that bring rain towards the inner land.

According to long-years meteorological data for Aydın province, average highest temperature is 36.1°C in July, and average lowest temperature is 4.3°C in January. Highest measured temperature was measured as 44.6 °C in July 1987, and lowest measured value was -7.6 °C in January 1964. Maximum total Daily precipitation was measured as 93.8 kg/m<sup>2</sup> in January 2009; highest wind speed as 106.2 km/hr in April 1964. The dominant wind direction is East and East-Southeast.

### 5.4 Soil Quality

2U1K has performed soil quality analyses in order to define baseline soil conditions at three locations (See Annex-1 to detect any soil contamination related with mud pits. Despite that the mud pits have been observed to be lined at the bottom and sides, overflow was seen at drilling station M7 during the site visit. In order to provide a comparative basis, soil sampling was made at drilling stations M6 and M7 and at a “reference point” upstream of M7 for background data. Geographical locations can be seen in Figure 4-1 in the preceding section. Range of parameters analyzed in soil samples include: total organic halogens, antimony, arsenic, copper, barium, boron, mercury, cadmium, zinc, chromium, lead, molybdenum, selenium and total petroleum hydrocarbons. Test results are given below in Table 5-4. Detailed laboratory reports are available in Annex-2.

Table 5-4. Results of Soil Quality Analyses

Parameters	Test Results at M7	Test Results at M6	Test Results at Reference Point
*Total Organic Halogens (TOX) (mg/ kg)	209.76	165.3	188.32
Antimony (mg/ kg)	<1.25	1.53	<1.25
Arsenic (mg/ kg)	16.73	35.14	22.02
Copper (mg/ kg)	17.12	38.42	21.43
Barium (mg/ kg)	48.65	139	44.84
Boron (mg/ kg)	28.08	46.53	29.36
Mercury (mg/ kg)	<0.25	<0.25	<0.25
Zinc (mg/ kg)	54.81	110.42	55.16
Cadmium (mg/ kg)	<0.25	<0.25	<0.25

Parameters	Test Results at M7	Test Results at M6	Test Results at Reference Point
Chromium (mg/ kg)	97.5	164.29	92.66
Lead (mg/ kg)	6.73	14.86	7.74
Molybdenum (mg/ kg)	<2.5	<2.5	<2.5
Selenium (mg/ kg)	<1.25	<1.25	<1.25
Total Petroleum Hydrocarbons (mg/ kg)	215.6	9.46	17.8

It can be seen from test results that the overflow of the mud-pit has caused localized soil contamination, which will be removed, restored and disposed off as hazardous waste, by the Project Company.

## 5.5 Air Quality

2U1K has performed air quality analyses in order to define baseline parameters as related with dust and H<sub>2</sub>S impacts of the Project. Test results for PM<sub>10</sub> are presented in Table 5-5, which indicate that the current dust emissions are below limits designated in the Regulation on Control of Industrial Air Pollution (Table 2.2 of Annex-2 of the Regulation). Table 5-3 presents results of H<sub>2</sub>S and NO<sub>2</sub> measurements performed between 17.02.2016 – 18.03.2016 for a duration of 720 hours.

Table 5-5. Results of PM<sub>10</sub> Measurements

Measurement Point	PM <sub>10</sub> Concentration (µg/m <sup>3</sup> )	Limit Values According to National Regulation (µg/m <sup>3</sup> )	
		STV*	LTV**
Close to M10	32	80	52
Nearest settlement (Uzunkum Quarter)	29		

\*STV: Short Term Value \*\*LTV: Long Term Value

Table 5-6. Results of H<sub>2</sub>S and NO<sub>2</sub> Measurements

Measurement Point	H <sub>2</sub> S Concentration (µg) (total)	NO <sub>2</sub> Concentration (µg) (blank)
1	<0.03	<0.01
2	0.05	0.02
3	0.07	0.04
4	0.05	0.03
5	0.05	0.02
6	0.05	0.02
7	0.07	0.04
8	0.04	0.01

## 5.6 Environmental Noise

2U1K has performed air quality analyses in order to define baseline parameters as related with noise impacts of the Project. Surveys were made on week days and weekend days at the nearest settlement unit of Uzunkum. According to the results of analyses, measured levels are under limit values set in the Regulation on Assessment and Management of Environmental Noise.

Table 5-7. Results of Noise Measurement

Period	Hours	Measured Noise Level Leq (dBA)	Measured Noise Level Leq (dBC)	Average Measured Noise Level Leq (dBA)	Average Measured Noise Level Leq (dBC)
Day (07:00-19:00)	07:00-08:00	46.3	61.3	52.8	67.9
	08:00-09:00	59.5	62.8		
	09:00-10:00	59.5	72.4		
	10:00-11:00	54.8	76.7		
	11:00-12:00	41.1	60.9		
	12:00-13:00	42.9	58.9		
	13:00-14:00	40.3	60.0		
	14:00-15:00	40.9	60.6		
	15:00-16:00	43.1	58.6		
	16:00-17:00	39.8	58.9		
	17:00-18:00	45.4	58.4		



Period	Hours	Measured Noise Level Leq (dBA)	Measured Noise Level Leq (dBC)	Average Measured Noise Level Leq (dBA)	Average Measured Noise Level Leq (dBC)
	18:00-19:00	42.2	57.4		
Evening (19:00 - 23:00)	19:00-20:00	52.9	68.9	50.6	64.6
	20:00-21:00	53.7	57.3		
	21:00-22:00	41.2	59.3		
	22:00-23:00	42.4	63.6		
Night (23:00 - 07:00)	23:00-00:00	38.3	62.4	49.3	63.0
	00:00-01:00	39.4	63.5		
	01:00-02:00	44.7	62.9		
	02:00-03:00	39.9	62.4		
	03:00-04:00	37.7	59.3		
	04:00-05:00	37.7	59.9		
	05:00-06:00	40.8	65.2		
	06:00-07:00	57.8	64.9		

According to IFC Noise Management Guidelines, for residential receptors, daytime and nighttime noise levels are 55 dBA and 45 dBA respectively. Despite compliance with national standards, results of noise measurement show that current level of noise during construction activities (drilling, excavation, construction) exceed limits at night time with respect to IFC limits.

## 5.7 Ecology

### 5.7.1 Flora

Vegetation and plant species of the Project site and its immediate environment have been assessed as a result of field studies and literature survey. The entire flora species of the region that is included in the resource "Flora of Turkey" have been reviewed in order to eliminate any potential errors. Endemic species with possible existence due to their habitat characteristics have been considered in particular.

Field studies have been conducted in addition to previous studies for determining the plant species within the Project site, and the information obtained have been supported by literature data. Determination of flora species has been based on field investigations while studies in the literature have been made use of for undefined plant species.

The Project area is within the Mediterranean phyto-geographical region, and is located in C1 square according to Davis' Grid System. The Project area is dominated by agricultural lands and has the characteristics of a flat topography. See [Photo 5-1](#).



[Photo 5-1](#). Agricultural Areas Around the Project Site

The surroundings of the Project area are composed of highly modified habitats surrounded by road networks, residential buildings and agricultural lands.

Legally protected and internationally recognized areas in the region have been determined as a result of field surveys and literature review. In this context, the protected area network of the region has been examined and the possible effects of the Project to these wildlife sanctuaries have been checked to prove that the Project area and the influence zone sufficiently far from the protected area network of Aydın.

The floristic structure of the project site and its immediate environment was determined by a detailed literature research and field surveys. According to the results of the surveys it can be seen that the area is covered with ruderal herbaceous plants and cultivated plants.

Table 5-7 lists possible flora in the project area and its environs as a result of the field observations and literature survey. Field surveys indicate that the natural vegetation has been destructed by anthropogenic impacts and has been replaced by cultivated plants. The herbaceous vegetation on the Project Site was not in good form, being quite degenerated.

As Table 5-7 shows, no endemic taxa, nor significance in terms of categorizations of IUCN and the Bern Convention, are detected among the listed species. In the overall, the flora and the vegetation of the project area are not important in terms plant biodiversity.

Table 5-8. Flora in the Project Area and its Environs

Latin Name	Endemism	IUCN	Bern Convention
ASPLENIACEAE			
<i>Asplenium trichomanes</i>	-	-	-
HYPOLEPIDACEAE			
<i>Pteridium aquilinum</i>	-	-	-
PAPAVERACEAE			
<i>Papaver minus</i>	-	-	-
POLYGONACEAE			
<i>Rumex tuberosus</i>	-	-	-
<i>Polygonum bellardii</i>	-	-	-
CUPRESSACEAE			
<i>Juniperus oxycedrus</i>	-	-	-
<i>Juniperus foetidissima</i>	-	-	-
<i>Juniperus excelsa</i>	-	-	-
APIACEAE			
<i>Eryngium creticum</i>	-	-	-
MALVACEAE			
<i>Althaea hirsuta</i>	-	-	-
<i>Malva sylvestris</i>	-	-	-
CISTACEAE			
<i>Fumana procumbens</i>	-	-	-
<i>Cistus laurifolius</i>	-	-	-
CARYOPHYLLACEAE			
<i>Silene macrodanta</i>	-	-	-
<i>Silene compacta</i>	-	-	-
LAMIACEAE			
<i>Lamium moschatum</i>	-	-	-
<i>Phlomis pungens</i>	-	-	-
LILIACEAE			
<i>Allium hirtovaginum</i>	-	-	-
<i>Ornithogalum armeniacum</i>	-	-	-

Latin Name	Endemism	IUCN	Bern Convention
GERANIACEAE			
<i>Geranium robertianum</i>	-	-	-
FAGACEAE			
<i>Castanea sativa</i>	-	-	-
<i>Quercus frainetto</i>	-	-	-
<i>Quercus cerris</i>	-	-	-
<i>Quercus pubescens</i>	-	-	-
<i>Quercus infectoria</i>	-	-	-
PINACEAE			
<i>Pinus brutia</i>	-	-	-
<i>Pinus nigra</i>	-	-	-
<i>Pinus sylvestris</i>	-	-	-
POACEAE			
<i>Aegilops triuncialis</i>	-	-	-
<i>Poa angustifolia</i>	-	-	-
<i>Triticum</i> sp.	-	-	-
<i>Avena</i> sp.	-	-	-
<i>Hordeum pusillum</i>	-	-	-
ASTERACEAE			
<i>Anthemis auriculata</i>	-	-	-
BRASSICACEAE			
<i>Eruca sativa</i>	-	-	-
<i>Alyssum minus</i>	-	-	-
<i>Capsella bursa-pastoris</i>	-	-	-
FABACEAE			
<i>Astragalus hamosus</i>	-	-	-
<i>Genista anatolica</i>	-	-	-
MYRTACEAE			
<i>Eucalyptus</i> sp.	-	-	-
BORAGINACEAE			
<i>Heliotropium dolosum</i>	-	-	-

Latin Name	Endemism	IUCN	Bern Convention
<i>Myosotis cadmaea</i>	-	-	-
ZYGOPHYLLACEAE			
<i>Peganum harmala</i>	-	-	-
RANUNCULACEAE			
<i>Ranunculus arvensis</i>	-	-	-
ROSACEAE			
<i>Potentilla recta</i>	-	-	-
<i>Pyrus communis</i> subsp. <i>communis</i>	-	-	-
<i>Rubus caesius</i>	-	-	-
OLEACEAE			
<i>Olea europaea</i> var. <i>Europaea</i>	-	-	-
<i>Phillyrea latifolia</i>	-	-	-
TYPHACEAE			
<i>Typha latifolia</i>	-	-	-
CORNACEAE			
<i>Cornus mas</i>	-	-	-
<i>Cornus sanguinea</i>	-	-	-
SALICACEAE			
<i>Salix caprea</i>	-	-	-
<i>Salix alba</i>	-	-	-
ERICACEAE			
<i>Arbutus andrachne</i>	-	-	-
TAMARICACEAE			
<i>Tamarix smyrnensis</i>	-	-	-

### 5.7.2 Fauna

Fauna inventory was prepared based on conducted fieldwork and a wide literature research. The status of the fauna in the region was evaluated according to the biological and ecological perspectives. Risk categories of fauna species were determined according to the IUCN red list categories which were published in Version 2015.4. In the fauna list that has been provided, species are written with the family names to which they belong to.

Forty-one species and sub-species are known to exist in the Project Area and in its surrounding. A fauna inventory was prepared on a large scale so that it also includes many species not observed directly in the Project Area. Endemic species are sensitive in terms of risk status. However, during the site visits it was found that the immediate area of the facility and the close environs are not used by the target species which are known to be endemic.

The Project Site includes water courses and rocky areas which are suitable for reptiles and amphibians, which makes the area suitable habitat for both groups. Possible species to be seen in the Project Area are listed in Table 5-9.

**Table 5-9.** Species of Reptiles and Amphibians in the Project Region

Latin Name	Endemism	IUCN Red List	Bern Convention
SALAMANDRIDAE			
Triturus vulgaris	-	LC/nt	ANN-III
BUFONIDAE			
Bufo viridis	-	LC/nt	ANN-II
Bufo bufo	-	LC/nt	ANN-III
RANIDAE			
Rana ridibunda	-	LC/nt	ANN-III
TESTUDINIDAE			
Testudo graecae	-	VU/nt	ANN-II
LACERTIDAE			
Lacerta saxicola	-	LC/nt	-
Lacerta trilineata	-	LC/nt	ANN-II
TYPHLOPIDAE			
Typhlops vermicularis	-	LC/nt	ANN-III
COLUBRIDAE			
Coluber jugularis	-	LC/nt	ANN-III
Eirenis modestus	-	LC/nt	ANN-II

In regards to Table 5-9, the scale of IUCN risk category LC/nt stands for “least concern/near threatened”.

For the fauna species taken under protection by Appendix – II and Appendix – III of the Bern Convention, measures stated in Article 6 and 7 of the Bern Convention have to be taken. In

particular, the following issues will be considered for the species listed in Appendix II in accordance with the 6<sup>th</sup> Article of the Bern Convention.

The species listed in Appendix II of the Bern Convention are strict. The species listed in Appendix III are periodically under protection.

Field data and literature research shows that the project area and surroundings are occupied by species which are known to exist in habitats altered by anthropogenic activities.

The bird species which were identified through literature and observed from field survey have been presented in Table 5-10 below.

Table 5-10. Bird Species in the Region

Latin Name	Endemism	IUCN Red List	Bern Convention
COLUMBIDAE			
<i>Columba livia</i>	-	LC	ANN-III
<i>Streptopelia decaocto</i>	-	LC	ANN-III
ALAUDIDAE			
<i>Alauda arvensis</i>	-	-	ANN-III
HIRUNDINIDAE			
<i>Hirundo rustica</i>	-	LC	ANN-II
MU SCICAPIDAE			
<i>Muscicapa striata</i>	-	-	ANN-II
TURDIDAE			
<i>Turdus merula</i>	-	-	ANN-III
<i>Saxicola ruberta</i>	-	-	ANN-III
SITTIDAE			
<i>Sitta krueperi</i>	-	-	ANN-II
CORVIDAE			
<i>Pica pica</i>	-	LC	-
<i>Corvus frugilegus</i>	-	-	-
<i>Garrulus glandarius</i>	-	-	ANN-III
PASSARIDAE			
<i>Passer domesticus</i>	-	LC	-
FRINGILLIDAE			

Latin Name	Endemism	IUCN Red List	Bern Convention
<i>Fringilla montifringilla</i>	-	-	-
<i>Fringilla coelebs</i>	-	LC	ANN-III
<i>Carduelis carduelis</i>	-	LC	ANN-II
UPUPIDAE			
<i>Upupa epops</i>	-	LC	ANN-III
PICIDAE			
<i>Dendrocopus syrtacus</i>	-	-	ANN-III
PHASIANIDAE			
<i>Alectoris chukar</i>	-	LC	ANN-III
<i>Coturnix coturnix</i>		LC	ANN-III
RECURVIROSTRIDAE			
<i>Himantopus himantopus</i>	-	LC	ANN-III
RALLIDAE			
<i>Fulica atra</i>	-	LC	ANN-III

The project area is located on agricultural areas with low fertility and thus its anthropogenic impacts have made the area unsuitable for mammal species, especially larger mammals which require considerably wide ranges.

Table 5-11. Mammals in the Project Region

Latin Name	Endemism	IUCN Red List	Bern Convention
MURIDAE			
<i>Mus musculus</i>	-	LC/nt	ANNEX-III
<i>Mus domesticus</i>	-	LC/nt	ANNEX-III
<i>Apodemus mystacurus</i>		LC/nt	ANNEX-III
MU STELLIDAE			
<i>Mustela nivalis</i>	-	LC/nt	ANNEX-III
<i>Martes foina</i>	-	LC/nt	ANNEX-III
HYSTRICIDAE			
<i>Hystrix cristata</i>	-	LC/nt	ANNEX-II
LEPORIDAE			
<i>Lepus europaeus</i>	-	LC/nt	ANNEX-III



Latin Name	Endemism	IUCN Red List	Bern Convention
TALPIDAE			
<i>Talpa europaea</i>		LR/lc	-
CANIDAE			
<i>Vulpes vulpes</i>	-	LC	ANNEX-III
SUIDAE			
<i>Sus scrofa scrofa</i>	-	LC/lc	ANNEX-III

## 6. SOCIAL BASELINE

### 6.1 Socio-Economic Environment

In this section, baseline data for the socio-economic aspects of the Area of Influence (AoI) is presented in order to provide a current situation against which the impacts of the Project can be assessed. The baseline takes into account present conditions, as well changing conditions (i.e. population, education) apparent in the baseline.

The baseline description has the following main objectives to:

- focus on receptors that were identified during scoping as having the potential to be significantly affected by the Project,
- describe and, where possible, quantify their characteristics (demography, economy, education, health, etc.),
- provide data to aid the prediction and evaluation of possible impacts and,
- inform judgments about the sensitivity, vulnerability and/or importance of resources/receptors.

The aim of the socio-economic baseline study is to describe the socio-economic conditions and trends in the areas potentially affected by the Project to understand potential effects and to develop appropriate mitigation measures. The socio-economic baseline defines the socio-economic issues of importance of provincial and local communities and establishes a baseline of socio-economic data that can be used for monitoring changes in the affected communities after the Project.

The following variables were selected for the discussion of the socioeconomic indicators of the settlements area around the Project site:

- Demography
- Economy and Employment
- Education
- Health
- Infrastructure and Services
- Vulnerable Groups

### 6.2 Methodology

Socio-economic data was collected using a combination of research methods. The baseline section was conducted by collecting, reviewing, and analyzing a range of secondary data, including data originating from the Turkish Statistical agency (TURKSTAT), Aydın Metropolitan Municipality, Germencik Municipality, local and provincial governorates.

TURKSTAT census data of 2013 is considered to be the most comprehensive, reliable and current statistical data regarding the communities affected by the Project.

In order to provide baseline information on the quarter level, national statistics are supported with information obtained from primary data collected from interviews with mukhtars that were carried out between the 16-20 February 2016.

The Area of Influence (AoI) of the Project calls for Moralı, Uzunkum and Tekin quarters.

#### 6.2.1 Demography and Population

This section presents general demographical information of Aydın Province and Germencik respectively and move on to further details within the borders of the AoI.

Aydın, situated in Aegean Region of Turkey, covers an area of 627.22 m<sup>2</sup> and has been recorded as the 20th most populated city in Turkey, with a population of 1,020,957. Furthermore, there are 17 districts and 489 quarters within the Province. The majority of the population lives in the city centre of Aydın. 60.8% of the population lives in the province and district centers, whereas the remaining 39.2% of the population lives in the towns and quarters. Germencik District on the other hand, has a population of 43,209 with a household size of 3.39, being the second largest household average within the Province (Turkish Statistical Institute, 2013).

As mentioned above, there are three quarters within the limits of AoI (Uzunkum, Moralı and Tekin) in Aydın. Moralı quarter has the population figures, whereas, Tekin quarter has the lowest figures. Further information regarding the population of the AoI can be found in Table 6-1.

Table 6-1. Population Figures of the Area of Impact

Quarter	Distance to Aydın Province	Distance to Aydın Germencik District	Quarter Population	Number of Households	Household Size
Moralı	34	9	586	164	3.5
Uzunkum	25	13	140	40	3.5
Tekin	30	14	273	106	2.5

During the field study it has been observed that the population figures of the quarters have been decreased due to reasons based on lack of economic opportunities over the years.

Table 6-2 presents the population changes in the quarters within the five years respectively as well as reasons that account for the changes.

Table 6-2. Population Dynamics

Village	Population Change within the Last 5 Years	Reasons
Moralı	Decreased	Lack of employment opportunities
Uzunkum	Decreased	Lack of income resources
Tekin	Decreased	Lack of population growth and decreased number of in-migration

It can be stated that Tekin quarter's major population is aged 65 and over, whereas, Moralı quarter has the most youth population among the villages in the Aol.

### 6.2.2 Livelihoods and Employment

The main economic activities in Aydın are based on agriculture, public and private industrial investments and tourism. Agriculture and livestock breeding are more dominant in Germencik district. Approximately 60% of the fig production of Turkey is in Germencik. Other agricultural products are cotton, olive and corn with significant contribution to national agricultural economy.

Similarly, agriculture and livestock breeding are the common economic activities in the three quarters in the Aol of the Project, as well. The main source of local income are retirement pensions, paid workforce and farming. In terms of livestock breeding, cattle are common in all of the three quarters. According to interviews with Mukhtars, Tekin quarter is observed to have higher economic standards, whereas, in terms of family income, Uzunkum quarter has a decreasing trend of economic standards due to low population figures and lack of economic opportunities.

### 6.2.3 Education

According to TURKSTAT, Aydın 2013-2014 education statistics, the literacy rate of people aged 6 or above is 97.3%, and high-schooling rate within the limits of national average. On the other hand, the literacy rate in Germencik District is 96.9%, yet with low rate of literate female population (Turkish Statistical Institute, 2013). In terms of comparing education conditions within the Aol, none of the three quarters occupy education facilities within their borders. Access to education is provided by means of transportation service to other schools in the nearest quarters or the district center. For primary education, community members tend to prefer closest neighboring schools, whereas high school students prefer the District center. Tekin quarter has the highest illiterate portion within the Aol, while almost all of the population in Moralı quarter is literate.

#### 6.2.4 Health

According to TURKSTAT, there are a total of 22 health organizations in Aydın, including 14 Ministry of Health institutions, 1 university institution and 7 private institutions (Turkish Statistical Institute, 2013).

In terms of health services within the Aol, although there are no health care facilities within the quarters, state family practitioners pay a weekly visit to the quarters. For further health services, community members have access to hospitals within the District or Province.

#### 6.2.5 Infrastructure and Services

Village rooms and coffee houses available in all of the three quarters provide place for community gatherings.

All the quarters are connected to the national electricity grid.

Drinking water is received mainly through groundwater and spring water, whereas industrial water is supplied also from the municipal network. Uzunkum and Tekin quarters use septic tanks for wastewater discharge, whereas Moralı quarter discharges directly into Moralı creek. Solid wastes are collected from the three quarters by Germencik District Municipality.

All three quarters have access to tele-communication services including telephone, mobile communication and internet.

Transportation is through either private vehicles or mass transportation by minibuses to the district center.

According to the mukhtars, all three quarters experience environmental issues such as lack of wastewater treatments, inefficient septic tanks and rareness of solid waste collection by the municipality.

In terms of the economic issues, all three quarters experience lack work opportunities, which results increase of low income families. Income from farming is considerably low.

#### 6.2.6 Vulnerable Groups

Majority of the vulnerable groups in the three quarters comprise mainly of individuals who are elderly people at age 70 and over and those that depend on state aids and contributions from community members. Moralı quarter has the highest figures in terms of individuals with almost no income and individuals who receive state health insurance. Further information regarding the vulnerable groups is given in Table 6-3 below.

Table 6-3. Vulnerable Groups

Quarter	Individuals Depending on State Aids and Community Contributions	Mentally or Physically Disabled People	Elderly People Aged 70 and Over, Living Alone	People with State Health Insurance	People with Very Low-income	Widows with no Children
Moralı	35	2	5	45	-	-
Uzunkum	5	6	2	-	-	-
Tekin	4	3	15	15	12	15

As shown in **Table 6-3** more than 50% of the population in Tekin quarter is aged over 70 and with the highest general figures of vulnerable groups.

## 7. ENVIRONMENTAL IMPACT ASSESSMENT

Based on an overview of baseline parameters, impact assessment is comprised of the following elements:

Assessment of impacts on surface waters and groundwaters:

- Degradation of surface water quality affecting local users
- Impacts on ecosystems from vegetation clearance and earth moving during construction;
- Pollution of surface water from drilling muds or water from testing wells;
- Surface and/or groundwater contamination from chemical spills and leaks from storage, transportation and use of chemicals and fuel on Project site;
- Cross-contamination of surface aquifer from drilling of new geothermal wells
- Surface water impacts from discharges of effluents from reinjection;

Assessment of noise impacts on communities:

- Noise from construction and drilling activities from site preparation, excavation and foundations, construction and drilling;

Assessment of impacts on soil:

- Degradation of soil by contamination from drilling mud and cuttings and other potential hazardous wastes,
- Degradation of land and soil by contamination from fuel or chemical storage facilities or spent oils, lubricants storage,
- soil contamination from fuel or chemical storage facilities or spent oils, lubricants storage, etc.

Assessment of impacts on air quality:

- Odor impacts of hydrogen sulphide ( $H_2S$ ) on the surrounding communities from operational emissions from Power Plant site;
- Release  $CO_2$  and other GHGs at operation stage.



## 7.1 Construction Stage Impacts

### 7.1.1 Impacts on Ecology

Site observations clearly indicate that the flora has been largely deteriorated due to anthropogenic activities.

The Project area is located within the Mediterranean phyto-geographical region and therefore has the characteristics of diverse vegetation along its coastal region. There are numerous fields within the Project area and its immediate environment due to the flat topography and alluvial deposits. Within the Project site, there are ruderal plants along the roadsides and around the irrigation and drainage channels as well as the dominant vegetation of field crops. Although it seems as a rich flora, it has lost its natural vegetation cover due to agricultural fields and gardens.

A certain amount of biomass will be lost during excavation works at the construction site. Top soil that will be skimmed from the surface will be reserved and used in site restoration and redevelopment of flora.

A large amount of the geothermal fluid that is required for energy production will be passed above the ground; therefore, the biomass loss will be minimized during the operations along the pipeline route. The Project pipeline is a fully enclosed system which does not create any adverse effects on the existing vegetation during the transportation of geothermal fluid to the facility.

Cold water that will be generated as a result of the closed-circuit production will directly be pumped back to the thermal reservoir without being discharged to any receiving body.

The Project site and its vicinity are under intense human pressure due to the geothermal power plants, animal grazing and agricultural activities. Certain fauna species have previously moved away from the region due to such anthropogenic impacts. The existing fauna species consist of species that have adapted themselves to these impacts. Therefore, there are no species that may be damaged due to the facility construction.

Within this framework, noise-induced impact of the facility on the fauna is in question, because of which the faunal elements may abandon their nesting area. However, once the facility construction is over, faunal elements may use the region as their nesting area again.

The cold water to be generated as a result of the closed-circuit production will directly be pumped back to the thermal reservoir without being discharged to any other receiving body.

Table 7-1: Impacts of Construction Stage on Ecology

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Impacts of construction activities on the ecology are negative and both direct and indirect.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is temporary as species will possibly adapt to post-construction conditions.				
Impact Extent	Project Area	Local	Regional	National	
	The impact is local, limited to the Project Site and environs.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact is negligible as there are no critical habitats or species and the existing species will be able to adapt to the changes.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Impacts are likely as excavation works will remove some vegetation and top soil; and drilling activities will cause unfavorable conditions with dust and noise.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is negligible as as there are no critical habitats or species and the existing species will be able to adapt to the changes.				
Reversibility of Receptor	High	Medium	Low	Irreversible	
	General ecology will recover in time but it is evident that some species will move to new habitats.				
Final Impact Assessment	Negligible	Minor	Moderate	Major	
	Overall ecological impact is negligible, thereby mitigation measures will be necessary.				

## Mitigation Measures

Given the agricultural nature of the project area and surroundings, OP 4.36 is not triggered. Indirect impacts on ecology through emissions of noise and air quality or through discharges of effluent is mitigated in a large extent through the mitigation measure identified within the wastewater, noise and air sections of the Report. The residual impacts will be negligible with the implementation of these mitigations.

### 7.1.2 Water Supply

During the construction stage, water demand will consist of potable water and water to be used for dust emission prevention. Potable water will be supplied to field staff in 19 liter bottles. Water to be used for dust emission prevention will be brought to the construction site with tankers. There will be no water supply from surface or groundwaters in the region.

### 7.1.3 Wastewater Generation

Construction stage activities will result in domestic wastewater only. Concrete curing water will not be required as ready-mixed concrete will be used.

Considering the number of field staff will be 25 and taking the daily wastewater generation per capita value as 181 L/person-day, as indicated by Turkish Statistical Institute's 2014 data for Aydın province, the total domestic wastewater generation by the field staff will be 4.5 m<sup>3</sup>/day at the construction stage. Domestic wastewater generated at the construction stage will be collected in a septic tank in compliance with the Regulation on the Construction of Septic Tanks at Places Where Sewer Construction is Not Possible. The amount of water required for preventing dust emissions will be 5 m<sup>3</sup>/day.

#### 7.1.4 Impacts of Geothermal Fluid from Well Testing on Surface Waters

Test drillings are conducted in order to prove the commercial viability of potential resources. Geothermal fluids are hot and highly mineralized and, if released to surface water, could cause thermal changes and changes in water quality. Geothermal fluids are currently discharged into open drainage canals that lead into Menderes River. Geothermal fluid from well testing is cooled down to a temperature around 40°C during flow through the open canals as stated by the Project Company. Menderes is not a sensitive ecosystem as it is posed to discharges from several industrial resources as well as other geothermal plants in the region.

Table 7-2: Impacts of Drilling Effluents into Surface Waters

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Impacts of discharging geothermal test water into drainage canals is indirect and negative on surface waters.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is temporary as limited to the construction stage.				
Impact Extent	Project Area	Local	Regional	National	
	The impact is limited to the drainage canals, thereby local.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact magnitude could be considered negligible in environmental terms given the highly polluted receiving media, and the temporary duration of impacts. Yet the impact magnitude is considered "low" in terms of social distress in relation to uninformed sudden discharges from other geothermal projects in the region.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Impacts of waste generation on soil and groundwater resources are likely at construction stage based on risks of mud-pit overflows or improper waste handling.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is minor.				
Reversibility of Receptor	High	Medium	Low	Irreversible	
	Soil and groundwater quality can be reversed by restoration activities, at some cost.				
Final Impact Assessment	Negligible	Minor	Medium	Major	
	Impact is minor. Mitigation measures are required in the form of stakeholder engagement practices for informing communities as related with the possible schedules and about the possible impacts of effluent discharges.				

### 7.1.5 Impacts of Solid Wastes on Soil and Groundwater

Hazardous and non-hazardous solid wastes expected to be generated during the construction stage are domestic solid waste from construction staff, excavation debris, medical waste from the camp site, packaging wastes, end-of-life tires, waste batteries and accumulators and drilling mud.

#### Non-hazardous Domestic Solid Waste

Domestic solid waste in the construction stage is generated as a result of various consumptions of the field staff. Considering that the number of field staff will be 25 and taking the daily waste generation per capita value as 1.16 kg/person-day, as indicated by Turkish Statistical Institute's 2014 data for Aydın province, the total domestic solid waste generation by the field staff will be 29 kg/day.

#### Hazardous Waste

Hazardous wastes can possibly comprise of drilling muds if they contain oil-based inputs. Muds are generated at drilling wells as a result of injection of mixture of water, bentonite and emulsifiers to support the well, cool the drill bit and remove cuttings. Muds are currently collected in mud-pits. Any failure of the mud-pit has the potential to cause pollution of adjacent surface water courses which is of particular concern with oil-based muds as they are likely to contain oil-related contaminants. One significant overflow was observed during the site visits and lab analyses of samples from soil and groundwater at the location of the overflow, where soil sample was indicative of contamination with hydrocarbons. The Project Company will remove the mud-pit at M7 drilling station and dispose as hazardous waste and restore the mud-pit location.

#### Packaging Waste

Packaging waste generated during the construction stage are composed of recyclable materials such as metal, paper, plastics and glass.

#### Waste Batteries and Accumulators

Waste batteries generated during the construction stage will be separately collected in the waste battery containers found at the Project site.

#### Drilling Mud

Drilling mud will be generated as a result of drillings. Drilling mud is classified as "inert waste".

#### Waste Oils

Waste oil is expected to be generated from maintenance of the vehicles to be used during the construction stage.

Waste vegetable oil will be generated from the cafeteria, where the food service will be provided for 25 construction stage personnel.

### **Mitigation Measures**

Domestic solid waste generated during the construction stage will be monitored weekly by the Project Company, and they will be collected, transferred, stored and disposed of in compliance with the Waste Management Regulation.

The collected waste will be ultimately disposed of by being transferred to the nearest municipality. Furthermore, recyclable waste (i.e. glass, plastics, glass) will be collected separately at source as indicated in Section 2, Article 5 of the Waste Management Regulation, in order to be reintegrated into the economy.

Nearest hospitals will be used for possible injuries and health problems of 25 construction stage personnel. As a result of on-site first aid applications for injuries, medical waste will be generated; and they will be collected, transferred, stored and disposed of in compliance with the Medical Waste Control Regulation.

Packaging waste will be collected in separate containers in order to be reintegrated into the economy without being subjected to any chemical or biological process. In addition, compliance with the Packaging Waste Control Regulation will be ensured for their management during the construction stage.

Maintenance of the vehicles to be used during the construction stage will be managed by authorized technical services. However, end-of-life tire generation may occur in case of a mandatory tire change. In such cases, tires will be sent to licensed firms in accordance with the Regulation on the Control of End-of-life Tires.

Waste batteries will be sent to a Waste Battery Recycling Plant as stated in Section 2, Article 13 of the Regulation on the Control of Waste Batteries and Accumulators. In addition, temporary storage of waste batteries within the facility will be managed according to Section 4, Article 20 of the same regulation.

There will be no accumulator replacement within the construction site. However, empty accumulators generated in compulsory cases will be sent to firms to be replaced with full ones as stated in the Regulation on the Control of Waste Batteries and Accumulators. In addition, temporary storage of waste accumulators within the facility will be managed according to Section 4, Articles 18 and 19 of the same regulation.

Waste oils will be managed by authorized technical services, and oil change of the vehicles will be conducted by machine experts or service staff on leak-proof surface within the construction site, therefore a possible soil contamination will be prevented. In case of waste oil generation during an oil change, it will be stored and disposed of in accordance with the Waste Oil Control Regulation. Vehicle maintenance will be conducted periodically on a daily, weekly and monthly basis, and oil leakage will be avoided by using drip pans.

Vegetative waste oils will be collected separately to be sent to licensed firms in compliance with the Waste Vegetable Oil Control Regulation.

Table 7-3: Impacts of Waste Storage

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Impacts of mud-pits and hazardous waste storage are negative and direct. Improper storage of hazardous waste would cause infiltration of hazardous components into sub-layers of soil and the shallow aquifers.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact will be long-term if the impact is not detected on-time and cleaning procedures are not applied.				
Impact Extent	Project Area	Local	Regional	National	
	The impact is limited to local soils and the shallow aquifer.				
Impact Magnitude	Negligible	Low	Medium	High	
	Groundwater in the shallow aquifer is not used by local people. Still any contamination is not allowed by regulations.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Impacts of waste storage on soil and groundwater resources are likely at construction stage based on risks of mud-pit overflows or improper waste handling.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is moderate as oil contamination from oil based drilling muds can cause long term or permanent changes.				
Reversibility of Receptor	High	Medium	Low	Irreversible	
	Soil and groundwater quality can be reversed by restoration activities, at certain costs.				
Final Impact Assessment	Negligible	Minor	Medium	Major	
	Impact is medium and requires mitigation measures.				

The drilling mud is readily collected inside leak-proof mud pits lined with geomembrane (See [Photo 7-1](#)) eliminating the risks of leakage and soil contamination. When the process is over, mud pits will be left to dry and once completely dried, they will be covered up with the topsoil, which will be collected prior to drilling; hence land will be rehabilitated. The muds would be classified as hazardous waste if oil based drilling muds is used.





Photo 7-1. Mud Pits Lined with Geomembrane

#### 7.1.6 Impacts on Air Quality

Emissions during the construction stage are associated with dust from operation of onsite diesel vehicles, skimming of top soil layers, and excavation of mud pits and from transportation of ready-mixed concrete for power plant construction. Impacts will be temporary, limited to the construction period. Mitigation measures are currently in place in order to suppress dust emissions by means of water spraying and improvement of road conditions. With the measures taken to minimize nuisance o communities, dust impact will be negligible.

Table 7-4. Impacts of Construction Activities on Air Quality

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Dust emission impacts during construction is direct and negative.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is limited to the construction stage.				
Impact Extent	Project Area	Local	Regional	National	
	The impact is limited to nearby settlements, thereby local.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact is low as there will be some perceptible changes in people's livelihoods, but they will adapt with some relative ease.				

Likelihood of Impact	Unlikely	Likely	Certain	
	Dust emissions during construction stage is certain due to operation of construction vehicles and drilling equipment.			
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is minor as the impact is temporary and mitigation measures are in place.			
Reversibility of Receptor	High	Medium	Low	Irreversible
	Communities will be free from dust exposure once the construction stage is complete.			
Final Impact Assessment	Negligible	Minor	Medium	Major
	Impact is negligible, thereby there is no need for additional mitigation measures.			

### 7.1.7 Noise

Noise will be emitted from the onsite vehicles and machinery during the construction stage. According to calculation in PDR for different types of site vehicles and machinery, noise levels are below limits beyond 311 meters where the nearest settlements are located. Thereby, noise impacts during construction will be insignificant and temporary.

Table 7-5. Noise Impacts of the Construction Stage

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Noise impacts during construction is direct and negative.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is limited to the construction stage.				
Impact Extent	Project Area	Local	Regional	National	
	The impact is limited to nearby settlements, thereby local.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact is medium as communities can adapt with difficulty.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Noise during construction stage is certain due to operation of construction vehicles and drilling equipment.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is moderate as the impact is temporary and mitigation measures are in place.				
Reversibility of Receptor	High	Medium	Low	Irreversible	
	Communities will be free from noise once the construction stage is complete.				
Final Impact Assessment	Negligible	Minor	Medium	Major	
	Impact is minor, thereby there is need for additional mitigation measures for decreasing noise levels by means of good practices and proper scheduling of construction activities.				



As seen in baseline measurements of noise conducted during the construction activities, it is seen that current practices are incompliant particularly for nighttime noise limits. Compliance will be ensured with the IFC standards, which are lower than limits set in Turkish Regulation on Assessment and Management of Environmental Noise. IFC Noise Management Guidelines indicate limits of daytime and nighttime noise levels in the nearest receptor at 55 dBA and 45 dBA, respectively.

## 7.2 Operation Stage Impacts

### 7.2.1 Impacts on Terrestrial Ecology

Adverse impacts on terrestrial ecology and biodiversity imposed during the construction stage will disappear at the operation stage. No project-related adverse impacts on the ecology are anticipated for the operation stage.

### 7.2.2 Impacts of Domestic Wastewater on Surface Waters

During the operation stage, water demand will consist of potable water. Project Company will not use water for cooling since the plant is designed as air-cooled.

For domestic usage, potable water will be supplied to operation staff in 19-liter bottles.

The PDR calculates daily domestic wastewater generation by the personnel about 4.5 m<sup>3</sup>/day at the operation stage. Domestic wastewater generated at the operation stage will be collected in a septic tank in compliance with the “Regulation on the Construction of Septic Tanks at Places Where Sewer Construction is Not Feasible”. Wastewater collected in septic tank will be drawn by a sewage truck, and will be discharged at the nearest wastewater treatment plant. Hence, there will be no direct discharge into surface water.

### 7.2.3 Impacts of Spent Geothermal Fluid on Surface Waters

The ORC system will return the spent geothermal water (effluent) via reinjection wells back to the geothermal reservoir. With the use of reinjection system, the residual impact associated with operational discharges of brine geothermal fluid is assessed as having negligible significance. The geothermal effluent will be an issue in case of failure of the reinjection system mainly consisting of aboveground horizontal pipelines.

Table 7-6. Impacts of Spent Geothermal Fluid

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Impact of reinjection failure is direct and negative.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is temporary.				
Impact Extent	Project Area	Local	Regional	National	

	Failure of a surface pipeline would lead to contamination of a limited area, including soil and groundwater.			
Impact Magnitude	Negligible	Low	Medium	High
	According to the Regulation on Control of Soil Contamination, it is compulsory to restore contaminated soil. Furthermore, communities can be concerned that spillage from the reinjection system may harm their crops.			
Likelihood of Impact	Unlikely	Likely	Certain	
	Critical failure of the pipeline is unlikely with a good design and good operation practices including system monitoring. Yet it can happen at any time as an out-of-control aspect.			
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is moderate.			
Reversibility of Receptor	High	Medium	Low	Irreversible
	In case of temporary discharge into a creek, local community distress would rise. Discharge of geothermal fluid would destroy aquatic life in the surface water.			
Final Impact Assessment	Negligible	Minor	Medium	Major
	Impact is medium and requires mitigation measures for preventing impacts on soil and groundwater.			

## Mitigation Measures

Spent geothermal fluids generated during operation will be re-injected to the host rock formation, resulting in minor effluent volumes involving reject waters. Potential contaminants in geothermal effluents will vary according to the mineralogy of the host geological formation, temperature of the geothermal water, and site-specific facility processes (IFC EHS Guidelines for Geothermal Power Generation).

Potential for contamination of groundwater will be minimized by installation of leak-proof well casings in the injection wells to a depth to the geological formation hosting the geothermal reservoir.

In case of failure of reinjection line, system will be shut down. Project Company will develop an effluent management plan to minimize risk of effluent discharges. In the event of emergency discharge of geothermal water to surface waters, geothermal water will be discharged into a retained in a thermal pond, where the temperature of water will drop to allowable limits set by the Water Pollution Control Regulation. The storage pond will be lined and of sufficient size to allow for storage and required cooling to be carried out for the potential duration of the reinjection failure.

The impact of any potential failure of the reinjection system within the Project area can be effectively managed through good design, regular monitoring and development of appropriate emergency responses. Given that a critical failure of the pipeline is extremely unlikely and with a well-prepared management and monitoring plan in place, the residual impacts can be assessed as low.

#### 7.2.4 Impacts of Solid Wastes

Hazardous and non-hazardous solid wastes expected to be generated during the operation stage are domestic solid waste from operation staff, medical waste, packaging wastes, end-of-life tires and waste batteries and accumulators. A Waste Management Plan will be required for the different types of waste as described below.

##### Domestic Solid Waste

Domestic solid waste in the operation stage is generated as a result of various consumptions of the operation personnel. PDR estimates Daily domestic solid waste generation by personnel around 29 kg.

Domestic solid waste will be collected, transferred, stored and disposed off in compliance with the Waste Management Regulation. The collected waste will be ultimately disposed off by being transferred to the nearest municipal landfill. Furthermore, recyclable waste (i.e. glass, plastics, glass) will be collected separately at source as indicated in Article 5 of the Waste Management Regulation.

##### Medical Waste

Nearest hospitals will be used for possible injuries and health problems of 25 operation stage personnel. However, as a result of on-site first aid applications for injuries, medical waste will be generated; and they will be collected, transferred, stored and disposed of in compliance with the Medical Waste Control Regulation.

##### Packaging Waste

Packaging waste generated during the operation stage are composed of recyclable materials such as metal, paper, plastics and glass, which will be collected in separate containers in order to be reintegrated into the economy without being subjected to any chemical or biological process. In addition, compliance with the Packaging Waste Control Regulation will be ensured for their management during the operation stage.

##### End-of-life Tires

Maintenance of the vehicles to be used during the operation stage will be managed by authorized technical stations. End-of-life tires may occur in case of a mandatory tire change. In such cases, tires will be sent to licensed firms in accordance with the Regulation on the Control of End-of-life Tires.

##### Waste Batteries and Accumulators

Waste batteries generated during the operation stage will be separately collected in the waste battery containers found at the Project site and periodically will be sent to a Waste Battery Recycling Plant. Compliance will be ensured with the Regulation on the Control of Waste Batteries and Accumulators.

There will be no accumulator replacement within the construction site. Empty accumulators generated in compulsory cases will be sent to firms to be replaced with full ones as stated in the Regulation on the Control of Waste Batteries and Accumulators.

### Waste Oils

Waste oil is generated as a result of maintenance of vehicles and equipment. In case of waste oil generation during an oil change, it will be stored and disposed off in accordance with the Waste Oil Control Regulation. Vehicle maintenance will be conducted periodically on a daily, weekly and monthly basis, and oil leakage will be avoided by using drip pans.

Waste vegetable oil will be generated from the cafeteria, where the food service will be provided for 25 operation personnel; and it will be collected separately to be sent to licensed firms in compliance with the Waste Vegetable Oil Control Regulation.

### **Mitigation Measures**

A Waste Management Plan will be in place in order to mitigate impacts from storage of different streams of waste. The Waste Management Plan will comprise of mitigation measures on the basis of different lines of waste generation, and emergency response measures against possible emergency conditions associated with hazardous wastes particularly.

**Table 7-7.** Impacts of Waste Generation and Storage at Operation Stage

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Impact of waste generation without waste management is direct and negative on soil and groundwater.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is long term.				
Impact Extent	Project Area	Local	Regional	National	
	The extent of impact is local.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact will be high if no mitigation measures are taken and direct contact with ground would cause soil and groundwater contamination.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Impacts are likely if no waste management is implemented.				
Impact Significance	Insignificant	Minor	Moderate	Major	
	Significance of impact is major as lack of waste management practices would cause contamination of soil and groundwater.				
Reversibility of Receptor	High	Medium	Low	Irreversible	
	Soil and groundwater has low reversibility (depending on the contents of waste).				

Final Impact Assessment	Negligible	Minor	Medium	<b>Major</b>
	Impact is major and requires mitigation measures.			

Without any mitigation measures, risks of particularly hazardous waste storage would be high. Given the possible impacts, it is significant to implement a well established waste management practices mainly for proper storage of hazardous wastes. With a well established waste management plan, the impact level will be lowered to minor. Hence, it will be necessary to set monitoring procedures for groundwater and soil at critical locations, downstream and upstream of waste storage locations.

### 7.2.5 Impacts of Storage of Chemicals

During the operation stage; fuels, lubricants and other chemicals may pose risks of soil contamination due to poor storage conditions and practices. The magnitude of potential change in groundwater quality is assessed to be moderate, because the impact would cause a significant change in water chemistry but would be short lived and the impact highly localized. This could impact on water abstraction close to the site for both local residents. The impact of this risk is therefore assessed to be of adverse major significance without mitigation.

Table 7-8. Impacts of Chemicals Storage

Impact Type	Positive	<b>Negative</b>	<b>Direct</b>	Indirect	Cumulative
	Impact of improper chemicals storage is direct and negative on soil and groundwater.				
Impact Duration	Temporary	Short Term	<b>Long Term</b>	Permanent	
	The impact is long term.				
Impact Extent	Project Area	<b>Local</b>	Regional	National	
	Failure of a surface pipeline would lead to contamination of a limited area.				
Impact Magnitude	Negligible	Low	Medium	<b>High</b>	
	Impact is high if no mitigation measures are taken as leakages and spills would cause soil and groundwater contamination.				
Likelihood of Impact	Unlikely	<b>Likely</b>	Certain		
	Impacts are likely if no measures are taken against soil and groundwater contamination.				
Impact Significance	Insignificant	Minor	Moderate	<b>Major</b>	
	Significance of impact is major.				
Reversibility of Receptor	High	Medium	<b>Low</b>	Irreversible	
	Soil and groundwater has low reversibility (depending on the chemicals spilled or leaked).				
Final Impact Assessment	Negligible	Minor	Medium	<b>Major</b>	
	Impact will be major if no mitigations are taken.				

## Mitigation Measures

The Project Company will prepare and implement a Hazardous Chemicals Management Plan, supported with a Spill Response Plan. Appropriate containers will be used for segregation and permanent storage of chemicals and fuels on site. Suitable sized storage and well maintained containers with appropriate labelling will be ensured.

With a well established Hazardous Chemicals Management Plan, the impact level will be lowered to minor. It will be necessary to set monitoring procedures for groundwater and soil at critical locations, downstream and upstream of chemicals use and storage locations.

### 7.2.6 Impacts on Air Quality and Odor Impacts

Major gaseous emissions from geothermal power generation are CO<sub>2</sub> and H<sub>2</sub>S gases. The Site will be required to comply with limits indicated in the Regulation on Control of Industrial Air Pollution. Release of H<sub>2</sub>S gases during operation is usually associated with the severe odor in settlements close to geothermal plants. Given the binary process of geothermal power generation, H<sub>2</sub>S generation will be minimal as compared to other technologies. Still, the Project Company will conduct regular measurement of H<sub>2</sub>S emissions and commits taking additional measures if measurements indicate high levels of sulfide.

Table 7-9. Odor Impacts During the Operation Stage

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Odor impacts on communities are direct and negative, and cumulative.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is long-term throughout operation stage.				
Impact Extent	Project Area	Local	Regional	National	
	Impact can be regional together with cumulative impacts from other projects in the region.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact is medium given that communities in the Area of Influence will have to adapt to the exposure to nuisance. Communities are sensitive about the odor issue, as it also gives them an indication for their crops exposed to air pollution caused by geothermal power generation.				
Likelihood of Impact	Unlikely	Likely	Certain		
	The impact is unlikely as the Project will employ closed-circuit system which will minimize odor emissions, except for temporary odor release at times of maintenance and testing that odor will be emitted.				
Impact Significance	Insignificant	Minor	Moderate	Major	
	Significance of impact is minor.				
Reversibility of Receptor	Insignificant	Low	Medium	High	
	Reversibility of impact is high as odor will diminish once the source is closed down.				
Final Impact	Negligible	Minor	Medium	Major	

Assessment	Overall impact is negligible and does not require additional mitigation measures.
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### 7.2.7 Environmental Noise Impacts

PDR estimates operation stage noise levels around 30 dBA, which will be insignificant for the nearest settlements.

Table 7-10. Noise Impact of the Operation Stage

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Noise impacts on communities are direct and negative and cumulative.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact is long-term throughout operation stage.				
Impact Extent	Project Area	Local	Regional	National	
	Impact is local, limited to the settlements in the Area of Influence.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact is low given that communities in the Area of Influence will have to adapt to the exposure to nuisance.				
Likelihood of Impact	Unlikely	Likely	Certain		
	The impact is likely.				
Impact Significance	Insignificant	Minor	Moderate	Major	
	Significance of impact is minor.				
Reversibility of Receptor	Insignificant	Low	Medium	High	
	Reversibility of impact is high as noise will diminish once the source is closed down.				
Final Impact Assessment	Negligible	Minor	Medium	Major	
	Overall impact is negligible and does not require additional mitigation measures.				

### 7.2.8 Climate Change Impacts

Release of non-condensable gases from the geothermal reservoir raises the issue of impacts that cause climate change. Non-condensable gases are mainly composed of CO<sub>2</sub>, which has no direct impact on local air quality.

As greenhouse gas (GHG), CO<sub>2</sub> is associated with combustion of fossil fuels. The Project will lead to releases of greenhouse gases. During tests, but mostly during operation, CO<sub>2</sub> and methane (CH<sub>4</sub>) will be released.

The worldwide calculations show that the total amount of CO<sub>2</sub> avoided by implementing geothermal energy in place of coal prove that a beneficial impact of major significance is gained from geothermal power plants.

It should be recalled that binary power plants retain non-condensable gases in a closed loop system. The thermal water is reinjected after utilizing its heat at the heat exchanger resulting in near-zero emissions during the power production process as the non-condensable gases are never released to the atmosphere. However, if gas separation occurs within the circulation loop, some minor gas extraction and emission is likely. Still, the Project Company will be analyzing the amount and quality of CO<sub>2</sub> gas release during operation and will decide on a management strategy as to store or dissolve CO<sub>2</sub> in the reinjection water.



## 8. SOCIAL IMPACT ASSESSMENT

Although there have been innovations in national environmental legislation regarding the social aspects within the framework of the European Union adaptation process, the lack of social impact assessment process still continues. Turkish EIA legislation does not cover social environment and only limited its scope to the physical and ecological environment. The social environment topics that are included in national legislation are limited to stakeholder engagement and resettlement processes. Therefore, in order to cover the national gaps, the international financial institutions are taken into a consideration for investment projects to minimize environmental and social risks and take actions in equitable and transparent forms.

This section of the Report assesses the direct and indirect potential socio-economic impacts of the Project. Major social issues subject to assessment are:

- Changes in population
- Land-use and land resources,
- Local Economy and Employment,
- Cultural assets,
- Nuisance from noise and odor,
- Nuisance from transportation vehicles,
- Community health and safety,
- Access of employees to labor rights,
- Employees health and safety.

Both quantitative and qualitative data collection techniques were used during social impact assessment. Details of data collection are given below.

### Collection of Primary Data

Community level assessments were conducted between 16-20 February 2016 for the purpose of gathering primary data, and include the following:

- 6 focus group meetings held with women and men separately;
- 11 in-depth interviews with the government agencies and non-governmental organizations in the district and the province.
- Survey with 28 households, and
- Survey with mukhtars for community level surveys.

Further information regarding the interviews occurred for the scope of the Project can be found in Table 8-1 below.

Table 8-1. Number of Household Surveys Implemented in the Quarters

Area of the Settlement	Distance to the Project Site	Population	Number of Surveys
Moralı	800	586	13
Uzunkum	600	140	5
Tekin	2000	273	10
<b>Total Number of Surveys: 28</b>			

Male and female participants have been separately involved in the focus group discussions so as to examine gender related concerns.

In order to provide a quantitative analysis of the community level and household surveys, “Statistical Package for the Social Sciences” software has been used for data entry.

### Secondary Data Collection Techniques

Secondary data was collected and prepared through regional and national statistics, newspaper archives and project documents. Secondary data holds an important role in reaching key stakeholders and project affected people before designing the field study. Information gathered from the secondary data increases the quality of field study and time efficiency during the field study.

Sources of information generally used for the SIA are:

- Data from Turkish Statistical Institute (TURKSTAT)
- Information from Germencik Municipality
- Evaluation reports of Non-Governmental Organizations
- Project Description Report for the Geothermal Power Project (dated November 2014)
- Project Description Reports for the Drillings (May-July 2015)
- Environmental Management Plan prepared for the Project
- Information on social parameters, gathered during public participation meetings

Profile of the communities in the AoI can be seen in Annex-3, based on data collected through field surveys.

## 8.1 Population Level

### Impacts

Participants of the household survey stated that there has currently been no impacts of the Project regarding the magnitude of population. No impacts are anticipated for the future as well. Considering that employees would be from the local people during drilling works, the total employment for both construction and operation phases is 25 people, which would not account for a considerable population increase.

Focus group participants stated that project staff has contributed positively to the local economy by means of shopping in the quarters in the AoI. Some of the household survey participants from the three quarters expressed their concerns regarding lack of information on environmental and health impacts of the Project. Either based on their experience or misguided information about other geothermal projects in the region, they fear that there would be an increase in environmental pollution and cancer risks.

Table 8-2. Impacts on Population Level

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Changes in population level can not be attributed directly to the Project, given the economic concerns in general. Based on misguided information at the level of communities, local people may migrate out of the region in order no to face health risks.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	The impact will be long-term or permanent, given that people would not come back once they migrate to other towns and cities.				
Impact Extent	Project Area	Local	Regional	National	
	Impact is local, limited to Germencik district.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact would be high if local people migrate and have to adapt to a new location.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Local people would not migrate if they are informed about impacts and measures related with the Project.				
Impact Significance	Insignificant	Minor	Moderate	Major	
	Significance of impact is moderate.				
Reversibility of Receptor	Insignificant	Low	Medium	High	
	Once communities migrate, it is not likely that they may come back to their current settlements, thereby reversibility would be low.				
Final Impact Assessment	Negligible	Minor	Medium	Major	
	Impact is medium, and efforts are needed for not contributing to an economic displacement and associated population decrease.				

### Mitigation Measures

Despite that the Project provides job opportunities for the residents of nearby settlements, it may also speed up the already migrating population on economic terms. The Project Company will perform effective public consultation and stakeholder engagement in order to provide correct and unbiased information on possible environmental and health impacts of the Project as well as the mitigation measures that will be taken. The Project Company will establish a grievance mechanism, which will support the information disclosure process. No residual impacts are anticipated.

## 8.2 Land Acquisition

### Impacts

The range of magnitude of land occupied by drilling stations vary from 0.2 to 0.6 ha area and the power plant will occupy an area of about 1.6 ha. Acquisition for these lands is complete by means of purchasing from land owners except for the well location M8, which has been rented in stead of purchase. The operation license does not require acquisition of the whole license area of about 3000 ha. The required lands for the production and reinjection wells and power plant are presented in the Table 8-3 below:

Table 8-3. Land Purchased for the Project Activities

Name of Quarter	Project Unit	Size of Land (m <sup>2</sup> )
Moralı	Geothermal Well	42,398.6
Moralı	Geothermal Well & Power Plant	16,349.3
Moralı	Geothermal Well	8,436.16
Moralı	Geothermal Well	58,775.44
Moralı	Geothermal Well	9,278.32
Moralı	Geothermal Well	5,179.65
Uzunkum	Geothermal Well	4,372.92
Moralı	Geothermal Well & Power Plant	5,563.00
Uzunkum	Geothermal Well	6,360.00
<b>TOTAL</b>		156,713.39

The largest amount of land purchase has been made in Moralı Quarter. Thereby, it can be stated that Moralı is the most affected settlement in terms of land acquisition. Still, it should be noted that the Project Company has paid considerable effort for avoiding prime agriculture lands with high crop yields, hence located the wells and the powerhouse on marginal lands as much as possible. Aboveground piping has also been planned to be laid on borders of farmlands.

Land purchases have been made on willingness of sellers. During the household surveys, 43% of participants have responded to questions regarding the topic of land acquisition. The majority of feedbacks are from Moralı and Uzunkum quarters. Community members from Tekin did not participate in this section of the survey.

All the participants of the household survey in Moralı Quarter stated their satisfaction for the land acquisition process and experienced no opposition. They assumed that the land acquisition was realized with the high market values and that now they have opportunities for different investments such as buying alternative agricultural lands in the area.

**Table 8-4.** Impacts of Land Acquisition on Local Communities

Impact Type	Positive	<b>Negative</b>	<b>Direct</b>	Indirect	Cumulative
	Land acquisition can be considered negative and indirect if former owners of farmlands can not use acquisition payments appropriately, causing economic displacement.				
Impact Duration	Temporary	Short Term	Long Term	<b>Permanent</b>	
	The impact would be permanent if acquisition payments can not be used for replacing agricultural activity.				
Impact Extent	Project Area	<b>Local</b>	Regional	National	
	Impact is local.				
Impact Magnitude	Negligible	<b>Low</b>	Medium	High	
	Impact magnitude is rated low as former landowners are stated to have already invested in new farmlands and are now able to adapt with relative ease as presumed.				
Likelihood of Impact	Unlikely	Likely		<b>Certain</b>	
	The impact is certain as land is acquired for the purpose of the Project.				
Impact Significance	Insignificant	<b>Minor</b>	Moderate	Major	
	Significance of impact is minor.				
Reversibility of Receptor	Irreversible	Low	<b>Medium</b>	High	
	Given that the lands acquired are not the only income sources of the former owners, and the high rates of prices paid, reversibility can be considered as medium in terms of economic welfare of former owners.				
Final Impact Assessment	<b>Negligible</b>	Minor	Medium	Major	
	Impact is negligible.				

### Residual Impacts

The land acquisition process was handled by setting prices higher than the market value considering the long-term income from agriculture is lost permanently. It has been stated by the Project Company that majority of the project affected individuals (former landowners) have already purchased new farmlands for investment purposes, with the payments received from land acquisition for the Project. Although no residual impacts are anticipated, it is recommended that the Project Company monitors through engagement with former landowners and local people in general.

### 8.3 Local Economy and Employment

#### Impacts

The most important contributor of the Project to the local economy is the employment provided in drilling works during construction. Currently there are 150 workers at the Site with their ongoing drilling and testing works. 60% of the the workforce is from Germencik. 15 workers are from Moralı Quarter by February 2016. Employees generally work in positions that do not require specific qualifications.

Operation period is planned to have three shifts. Workers from the region will be given priority for employment opportunities.

85% of the participants of the focus group meetings were from Moralı Quarter and stated that they were pleased with the employment opportunities created within the quarter but also that the number should be increased.

Table 8-5. Impacts on Local Economy and Employment

	Positive	Negative	Direct	Indirect	Cumulative
Impact Type	Employment opportunities will create a positive impact directly from the Project. All geothermal projects will contribute to increased local employment and may reverse out-migration in cumulative terms.				
Impact Duration	Temporary	Short-Term	Long Term	Permanent	
	Impact is long-term. Higher employment opportunities will be possible during construction, and less during operation stage.				
Impact Extent	Project Area	Local	Regional	National	
	Impact will provide benefit particularly to Germencik District.				
Impact Magnitude	Negligible	Low	Medium	High	
	Impact magnitude is positive and medium.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Employment opportunities within the region and the associated improvement of the local economy are certain impacts of the Project.				
Impact Significance	Insignificant	Low	Moderate	Major	
	Impact will be moderate.				
Final Impact Assessment	Negligible	Minor	Medium	Major	
	The Project will contribute to problems of unemployment as a positive impact.				

#### Enhancement Measures

The Project will have a Business Ethics Policy/Good Neighbor Policy that commits the Project to 'Buy Local'.

The Project Company will have a Human Resources policy which observes wage standards, working hour regulation, freedom of association and staff encouragement. This policy will be developed by the Project Company to cover local employment and training of local people.

### **Residual Impacts**

Positive impacts will be enhanced with the implementation of the enhancement measures described.

## **8.4 Cultural Heritage**

### **Impact Definition**

There are no cultural assets known at the Project Site that need to be protected with respect to the definitions of the Law on “Conservation of Cultural and Natural Assets” (Law No. 2863, ammended with the Law No. 5226). However, an ancient city called “Magnesia ad Meandrum” is located within the boundaries of Tekin Quarter. Construction stages of all geothermal projects in the region could pose risks of disturbing possible cultural assets.

**Table 8-6. Impacts on Cultural Heritage**

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Risks related to cultural heritage are direct and negative.				
Impact Duration	Temporary	Short Term		Long Term	Permanent
	Issues of chance finds are possible within the construction stage of the Project. Impacts would be permanent if no chance-finds procedures are implemented.				
Impact Extent	Project Area	Local		Regional	National
	Impact extent is local.				
Impact Magnitude	Negligible	Low		Medium	High
	Impact magnitude is medium because no designated cultural conservation status exists in within the license area. Yet, the license area is close to Magnesia, which still includes risks of a chance-find.				
Likelihood of Impact	Unlikely		Likely		Certain
	Impacts on cultural heritage are unlikely given that the license area is not a designated cultural conservation site.				
Impact Significance	Insignificant	Minor		Moderate	Major
	Impact will be moderate with chance-finds procedures in place.				
Reversibility of Impact	Irreversible	Low		Medium	High
	Salvage excavation in case of a chance-find would account for low reversibility.				
Final Impact Assessment	Negligible	Minor		Medium	Major
	Given the impact magnitude is rated medium.				

### Mitigation Measures

The Project Company will ensure that the Chance Find Procedure is effectively applied.

### Residual Impacts

With the implementation of a chance finds procedure, the residual impact of the Project is considered to be low.

## 8.5 Impacts of Transportation

### Impacts

Transportation impacts directly related with the Project has been addressed by household survey participants from Uzunkum and Morali Quarters. Majority of participants from Tekin Quarter assumed that this is a cumulative impact related with the other geothermal projects in the region. According to residents of Tekin; heavy vehicles are damaging the roads and they fear that heavy vehicles may cause closure of narrow roads and that residents may not be able to use roads in the emergency situations. Furthermore, communities are concerned that gaseous emissions and dust from heavy vehicles may cause community health issues and may pose safety issues especially on children.

Table 8-7. Impacts of Project Transportation Activities

Impact Type	Positive	Negative	Direct	Indirect	Cumulative
	Traffic load caused by heavy vehicles is a direct and negative impact arising from the Projects are operating in the region.				
Impact Duration	Temporary	Short Term	Long Term	Permanent	
	Since the heavy machineries will be used for the drilling and construction period of the Project, it is going to be a short term impact.				
Impact Extent	Project Area	Local	Regional	National	
	Impacts related to transportation and traffic load is expected to be local.				
Impact Magnitude	Negligible	Low	Medium	High	
	Given the public nuisance expressed during surveys, traffic and transportation are assumed to pose a medium level impact.				
Likelihood of Impact	Unlikely	Likely	Certain		
	Impacts of transportation operations on community health and safety is unlikely with measures taken.				
Impact Significance	Insignificant	Minor	Moderate	High	
	Level of impact significance is minor.				
Reversibility of Impact	Irreversible	Low	Medium	High	
	Health and safety risks associated with traffic loads from heavy vehicles will disappear once the construction stage is over.				
Final Impact	Negligible	Minor	Medium	Major	



Assessment	Given the short term of impacts, high reversibility and measures taken, the impact is considered negligible.
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### ***Mitigation Measures***

The Project Company will prepare and implement a site specific Traffic Management Plan so as to adequately manage traffic in the access roads used by communities. In case of disturbing access roads, the Project Company and its contractors will be responsible to improve the roads back to their original status. Communities will be informed about schedules of transportation and also on safety and security measures to be taken at the level of individuals.

The Project will implement an awareness raising information disclosure with local stakeholders regarding the risks related to the movement of heavy vehicles and increased traffic in the area. The main focus of this campaign will be during the construction phase and will focus on local residents and children. It will be implemented in coordination with local community groups such as Mukhtars.

An Emergency Response Plan to be developed for the Project will be inclusive of emergency issues related with traffic safety as well. This will provide details of what will happen in the case of a major traffic related incident and define roles and responsibilities. The plan will also be disclosed as part of the stakeholder engagement activities.

### ***Residual Impacts***

Strict health and safety standards will be implemented including traffic management plan to reduce road related accidents. With the implementation of above mitigation measures the residual impact of the Project are considered to be low.

## **8.6 Community Health and Safety**

### ***Impacts***

Community health and safety issues are associated with pollution factors that may arise from drilling, construction and operation period of the Project. Local people have expressed their concerns and worries during surveys that the geothermal projects in the region may cause climate change, agricultural activities may be negatively affected from sulfide emissions, grazing lands may shrink due to soil contamination, and that groundwater resources may get polluted. These concerns are mainly rooted in speculative information from other geothermal projects in the region.

The most severe impact on communities is raised as the nuisance caused by noise from Project activities. About half of the community members in all three residential areas complain about noise which becomes more disturbing during night time.

## **Mitigation Measures**

The Project will operate on a closed system and the Project Company will take measures for lowering emissions that cause nuisance.

The Project Company will monitor emissions and noise and take immediate measures where necessary. However, farmers are currently misinformed and misguided by other interest groups toward opposition against the Project by means of unproven and non-scientific information. A well-structured stakeholder engagement will minimize public concerns by clearly explaining the project operations, mitigation measures and possible residual impacts. It is recommended that the stakeholder engagement process can be backed up with cooperation with universities to undertake research studies and monitor interactions between geothermal drilling and crop production. A stakeholder engagement plan is prepared by 2U1K. Please see Annex-4.

## **8.7 Employment and Labor**

### **Impacts**

The Project Company will be responsible for human resources for the drilling, construction and operation periods. Turkey is currently in the middle of a harmonization process with the European Union and labor laws are being reviewed to ensure alignment. The Project will comply with national labor, social security and occupational health and safety laws as well as the principles and standards of ILO convention. Based on the national principles embodied in the ILO convention, the Project Company will take measures by:

- not employing children under the age of 18,
- eliminating forced labor and ensuring a Human Resources Policy compatible with the European Convention on Human Rights and the Turkish Constitution,
- eliminating discrimination based on language, race, sex, political opinion, philosophical beliefs and religion in the employment relationships,
- ensuring workers' access to the right of collective bargaining (Act of Collective Bargaining Agreement on Trade Unions Act No. 6356 and 4857 Labor Law)
- ensuring access to the Project grievance mechanism that is functional effectively

Labor Law (4857) applies to all establishments and to their employers, employees, employer's representatives and employee representatives, irrespective of the subject matter of their activities. The Project Company is yet to develop a formal grievance procedure for workers although an informal procedure is in place. The Project Company Human Resources Policy will have provisions for age, wages, working hours, disabled employees, non-employee workers (i.e. sub-contractors), health and safety; and workers camps.

Construction work involves high risk activities with the potential for accidents that may result in injuries and potential fatalities.

### ***Enhancement Measures***

Project Company will ensure that its HR Policy will maintain that all workers will have contracts that clearly state the terms and conditions of their employment and their legal rights. Workers will be provided with information including, but not be limited to, entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits (such as leave for illness, maternity / paternity or holiday). All workers will be able to join trade unions of their choice and have the right to collective bargaining. Contracts will be verbally explained to all workers where this is necessary to ensure that workers understand their rights prior to any employment contract to be signed. Wages, benefits and conditions of work offered will be comparable to those offered by equivalent employers in Aydın. Although an informal grievance mechanism is currently in place, the Project and all contractors will put in place a formal worker grievance mechanism.

## **8.8 Occupational Health and Safety**

Specific health and safety issues in geothermal power projects include the potential for exposure to geothermal gases, confined spaces, heat and noise.

Occupational exposure to geothermal gases, mainly hydrogen sulfide gas, may occur during non-routine release of geothermal fluids (for example, pipeline failures) and maintenance work in confined spaces such as pipelines, turbines, and condensers. The significance of the hydrogen sulfide hazard may vary depending on the location and geological formation particular to the facility.

Noise is mainly related to well drilling, steam flashing and venting. Other sources include equipment related to pumping facilities, turbines, and temporary pipe flushing activities. Noise abatement technology includes the use of rock mufflers, sound insulation, and barriers during drilling, in addition to silencers on equipment in the steam processing facility.

### ***Mitigation Measures***

Where there is a potential for exposure to hazardous levels of hydrogen sulfide, Project Company will implement measures such as installation of hydrogen sulfide monitoring and warning systems, development of a contingency plan for hydrogen sulfide release events, establishing facility emergency response teams, providing adequate ventilation of occupied buildings to avoid accumulation of hydrogen sulfide gas, development and implementation of a confined space entry program, and providing workers with a fact sheet about the chemical composition of liquid and gaseous phases with an explanation of potential implications for human health and safety.

In order to mitigate occupational exposure to heat occurring during construction activities as well as operation and maintenance, the Project Company will ensure that time required for work in elevated temperature environments is reduced, drinking water is accessible; surfaces where workers come in close contact with hot equipment are shielded, personal protective equipment (PPE) are used as appropriate, including insulated gloves and shoes; and appropriate safety procedures during the exploratory drilling process are implemented.

An occupational health and safety management plan is in place and includes response measures for the situations of accidents, sabotages, fire and electricity shocks, commutable diseases, hydrogen sulfide releases, well blowouts, earthquake, floods, storms and chemical spills.

### ***Residual Impacts***

The overall residual impact on occupational health and safety of the labor force will be minimum when an OHS management system is fully in place and measures are taken.

## 9. CUMULATIVE IMPACTS

There are several other geothermal power plants in Germencik district of Aydın, such as Kerem GPP (24 MW), Deniz GPP (24 MW), Gümüşköy GPP (13.2 MW), Maren GPP (44 MW), Galip Hoca GPP (47.4 MW), all in operation. There are also other GPPs in neighboring districts of Aydın.

Given that the Project is at construction stage, nuisance of dust and noise are associated with the drilling and construction activities and transportation activities. Such nuisance is considered as low and temporary, limited to the construction period. Hence dust and noise impacts are not considered to pose a cumulative impact along with other project in the district.

Odor caused by hydrogen sulphide from geothermal fluid can be considered to pose a cumulative impact during the operation stage. Continuous monitoring of hydrogen sulphide levels and grievance from communities will be crucial for determining requirements for extended odor control. Technical measures to abate hydrogen sulphide can be designated once the power plant is operational, given that the sulphide content of geothermal fluid is not known. Still, the closed circuit make-up of the Project will accomplish significant abatement of hydrogen sulfide emissions and related odor.

One of the drivers for the Project is clean electricity generation without depleting the resource and minimizing emissions of greenhouse gases (GHGs) associated with combustion of fossil fuels. Yet, the Project will lead to releases of greenhouse gases, mainly CO<sub>2</sub>. During construction, CO<sub>2</sub> will be released from combustion sources such as the diesel generators and the construction plant engines. During tests, but mostly during operation, CO<sub>2</sub> and methane CH<sub>4</sub> will be released as non-condensable gases. The impacts of emissions of greenhouse gases are global, hence cumulative. By nature of these emissions, the specific impacts of any single project cannot be easily assigned.

Discharge of geothermal fluids from test drills into the drainage canals that lead to Menderes River is a common practice in other geothermal power plants in the region. Test stage is temporary and the operation stage will employ use of reinjection wells, hence the issue will be mitigated as soon as the operation starts.

## 10. E&S Mitigation and Monitoring Plan

### 10.1 Construction Stage

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity
Soil contamination	Practices of storage of chemicals and fuel containers	Appropriate storage practices in line with regulations and best practices.	Soil quality for heavy metal and hydrocarbons at critical spots (Quarterly)	Project Company and Contractors
Soil and groundwater contamination	Mud pits	Bottom lining of mud pits and adequate and timely closure.	Soil and groundwater quality at downstream of mud-pits and critical spots (Quarterly)	Project Company and Contractors
Soil and groundwater contamination	Practices of solid waste storage	Appropriate storage practices in line with regulations and best practices.	Groundwater quality at downstream of mud-pits and critical spots (Quarterly)	Project Company and Contractors
Groundwater contamination	Chemicals from drilling	Appropriate well casing	Groundwater quality measurements (Monthly)	Project Company and Contractors
Surface water discharges	Surface water pollution from	Temperature of effluent to be cooled before discharge	Temperature records at each discharge	Project Company and Contractors
H <sub>2</sub> S emission	Temporary odor due to H <sub>2</sub> S release from test waters	Use of gas separators	Ambient monitoring of H <sub>2</sub> S concentrations.	Project Company and Contractors
OHS	Poisoning from H <sub>2</sub> S	PPE use	PPE monitoring (Daily)	Project Company and Contractors
Emergency	Well blowout during drilling	Emergency Response Plan	Ambient monitoring of H <sub>2</sub> S concentrations.	Project Company and Contractors
Community HS	Nuisance from noise and dust	Noise control by use of mufflers, etc. Drillings to be stopped at night time	Environmental noise measurement at receptors. (Monthly and upon grievance)	Project Company and Contractors
Cultural Heritage	Possible archeological finds	Chance finds procedure	Reporting by archaeologists (Quarterly and upon any chance finds)	Project Company and Contractors

## 10.2 Operation Stage

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity
Soil contamination	Practices of storage of chemicals and fuel containers	Appropriate storage practices in line with regulations and best practices.	Quarterly sampling and analysis	Project Company
Soil and groundwater contamination	Mud pits	Bottom lining of mud pits and adequate and timely closure.	Quarterly sampling and analysis downstream of mud-pits	Project Company
Soil and groundwater contamination	Hazardous waste storage Dangerous chemicals storage	Appropriate storage practices in line with regulations and best practices. Solid Waste Management Plan Dangerous Chemicals Management Plan (to be prepared)	Quarterly sampling and analysis downstream of storage locations	Project Company
Groundwater use	Sustainability of shallow aquifers	-	Water level measurements (Monthly)	Project Company
Groundwater contamination	Chemicals from drilling	Appropriate well casing	Groundwater quality measurements (Monthly)	Project Company
Surface water discharges	Surface water pollution from	Temperature of effluent to be cooled before discharge	Temperature records at each discharge	Project Company
H <sub>2</sub> S release	Temporary odor due to H <sub>2</sub> S release from test waters	GHG Management Plan (to be prepared)	Continuous ambient H <sub>2</sub> S level at sensitive receptors	Project Company
OHS	Poisoning from H <sub>2</sub> S	PPE use	PPEs (Daily inspections)	Project Company
CO <sub>2</sub> release	Gas release from steam separation	-	CO <sub>2</sub> emission level at the entry to the power plant, monthly	Project Company
Odor and Health and Safety based on H <sub>2</sub> S emissions	H <sub>2</sub> S emission from separation of steam and condensate during dry cooling	Health and safety awareness training for communities about risks Development of an emergency preparedness and response plan to be enacted in the event of abnormal operation	H <sub>2</sub> S monitoring records	Project Company

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity
OHS	Workers health and safety risks during well operations	OHS System including measures for gas poisoning and blow-out measures	Daily internal inspections	Project Company
Population	Migration off the settlements in Germencik	Employment opportunities, Stakeholder engagement, Grievance mechanism	Quarterly minutes of meetings with communities, Grievance records	Project Company
Community H&S	Nuisance from odor	Closed system will minimize odor emissions.	Continuous monitoring of Odor from H <sub>2</sub> S	Project Company
Cultural Heritage	Possible archeological finds	Chance Finds Procedure	Reporting by archaeologists (Quarterly and upon any chance finds)	Project Company