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Technical, financial, economic, and environmental viability of a geothermal heated swimming pool and Spa Complex in Menengai, Kenya

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INTRODUCTION

The Menengai geothermal field is located in the central segment of the Kenya rift valley and is hosted partly within a major Quaternary volcano. The Geothermal Development Company (GDC) has been developing the Menengai Geothermal Field since 2011 with the intention of supplying steam to 3x35 MW power plants as part of the first stage (105 MWe Phase one) of development. GDC developed the field, drilled more than 50 wells, and set up the steam-gathering system, which was concluded in December 2020.

One of the power plant has been commissioned, and the other two are currently under construction with commissioning expected to be completed in 2026. It is envisaged that the Menengai Geothermal System will supply direct-use projects in addition to electricity generation projects. In this presentation we will describe the feasibility study completed to evaluate the technical, financial, economic, and environmental viability of a geothermal heated swimming pool and Spa Complex that is proposed.

MASTERPLAN

A project vision was developed by the multidisciplinary project team (subsurface, architecture, marketing, environmental) based on discussions held with GDC in Kenya, and this was developed into a preliminary Master plan layout drawing which illustrates the envisaged spa development over the long run at the selected site. Based on the anticipated market for the spa, it was recommended that the facility be developed in a staged approach with the first stage consisting of a much smaller facility that still embodies the vision of the spa that was agreed on, and offers the key services that were desired by GDC.



Figure 1. Masterplan for Stage 1-3

ECONOMIC VIABILITY

The initial capital investment (CAPEX) of geothermal spa facility typically includes the construction costs and above ground (plant) costs.

The proposed Stage 1 spa facility will have a wide variety of operational costs (OPEX). Whilst some can be estimated based on the demands of the facility (brine volume, electricity etc.) others are challenging to estimate at this stage of the project. However, it is anticipated that the operational costs of other analogous spa and hotel facilities such as Peninsula Hot Springs in Australia will be proportionally similar to those that will be incurred at the Menengai Geothermal Spa. By estimating OPEX costs accordingly, the Internal Rate of Return of the project was estimated and its sensitivity assessed.

Table 1. Sensitivity of Internal Rate of Return to increase/decrease in entry prices

Percentage Increase/decrease in Prices	Project IRR (10 yr)
-20%	13.58%
-5%	17.07%
0%	18.18%
5%	19.26%
20%	22.38%

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REFERENCES < HEADING STYLE>

Whitford, G. M. (2011). Acute toxicity of ingested fluoride. Fluoride and the Oral Environment, 22, 66-80.

FEASIBILITY STUDY

The Project Team explored the Menengai steamfield area with GDC and identified 6 potential sites that could be developed into a spa facility. Each site was assessed against an extensive list of criteria, however the key criteria identified were Scenery/visuals; Accessibility; Geothermal fluid supply; Environmental concerns; Anticipated cost (in comparison to the other options). Following the analysis, Option A was selected for the main feasibility study work.

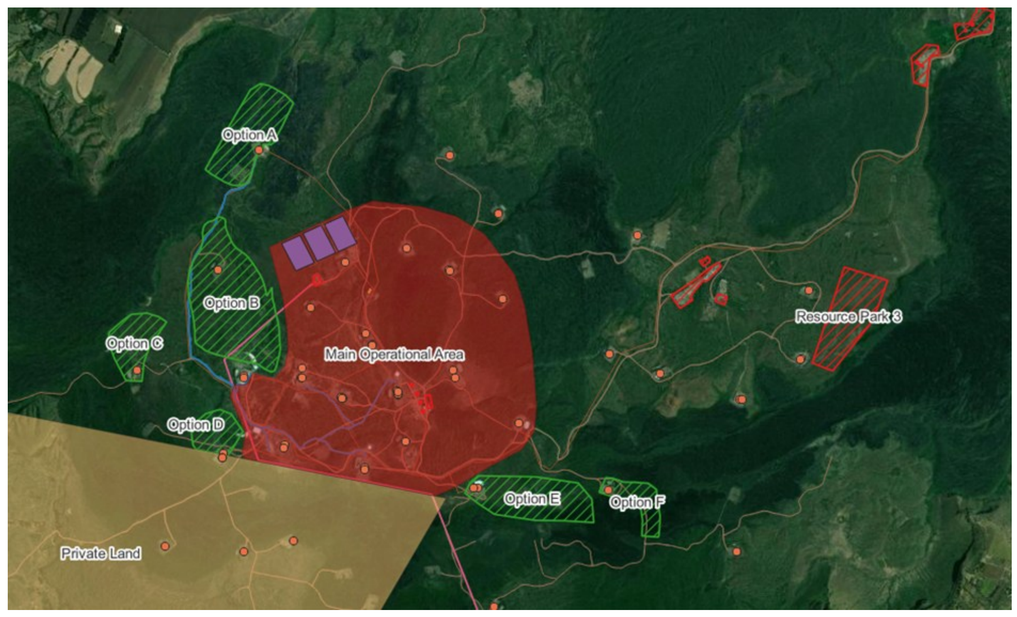


Figure 2. Spa facility site location options

After the preliminary Masterplan layout was produced, geothermal fluid requirements for the envisaged spa were calculated based on estimated pool and facility heating/cooling demands. A conceptual design for the plant equipment and back of house infrastructure required to deliver the heating, cooling and geothermal brine to the facility's features was developed and illustrated in the form of a process flow diagram.

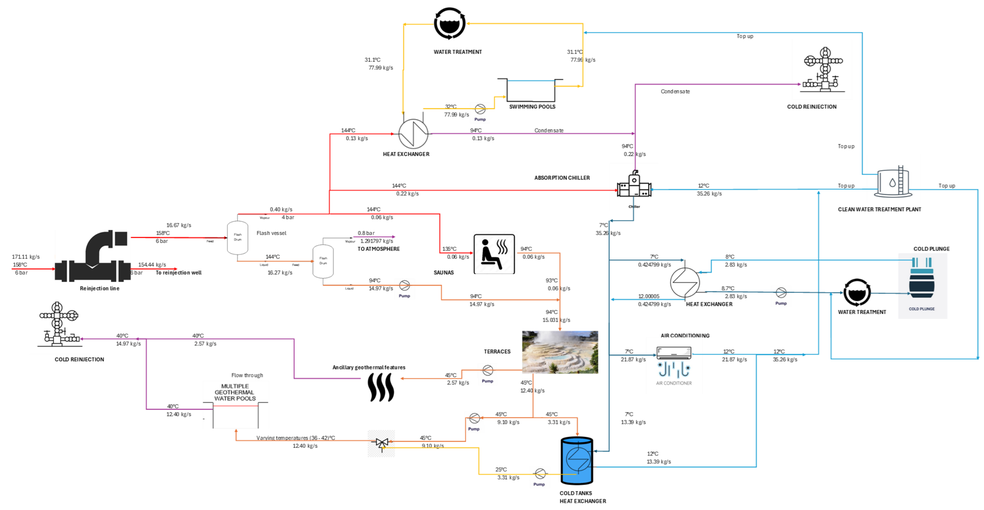


Figure 3. Process flow diagram

The geothermal fluid supply will be taken from the 105MWe re-injection line which transports 616 tons per hour of geothermal fluids at 158°C and 6 bar pressure to the re-injection well (MW-02) where it is re-injected into the reservoir. This is an extremely large volume of fluids and therefore this site is actually constrained only by the maximum viable size of the facility from the market assessment.

CONCLUSION

After investigating the feasibility of a geothermal spa facility located at the Menengai steamfield and assessing the technical, social, environmental, legal market and economic factors it can be said that there is good potential for a viable project, however more attention is required to address various risks/concerns, clarify uncertainties before progressing with design and construction. At this stage, the main concern to be investigated further is the high fluoride levels in the water that may pose a health risk to young children (Whitford, 2011 and Pinikvar, 2008).



Figure 4. Masterplan for Stage 1

At this stage the business case looks very positive and the current financial analysis results suggest that the projected return on investment would be in the region that is deemed attractive for investors in this sector.

The findings of this feasibility study clearly outline that GDC should partner with investors or developers with industry specific knowledge and expertise required to progress this project further.

The feasibility study will provide the information and analysis needed to show investors the potential of the project and address any major concerns.