Eagle Canyon Residential Development

Project Description: A engineering tasked the University students to find the feasibility of developing a sustainable residential area in a City in California. This project aims to maximize profit on the land by building single-family homes featuring a community pond and amenities. The client aims to profit at least twice the amount of 6.5 million dollars, the cost of the site.

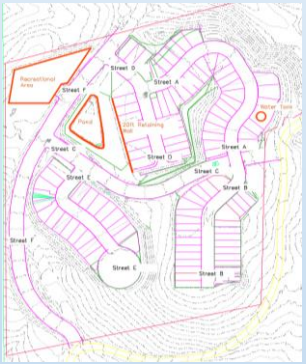
The capstone design project expands for two semesters beginning in August 2022 and ending in May 2023. During this time, Group 4 objectives included conducting a feasibility study based on the analysis of the site by the geotechnical, hydrological, environmental, structural, and transportation teams to meet the owner's demands. In addition, it is targeted to deliver a preliminary design according to the feasibility study. Following the Engineering Design Process, the project was divided into multiple stages across the two semesters.

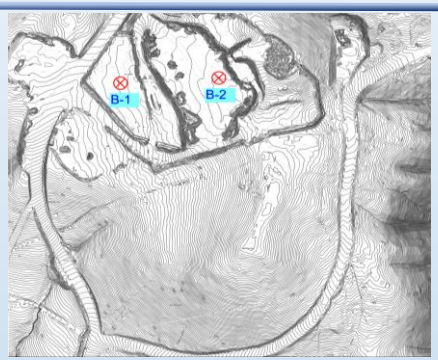
Alternative Selected for Preliminary Design: The alternative selected by the owner focuses on sustainability. The proposed grading attempts to adopt the existing land grade to prevent drastic effects in the surrounding areas visually and physically. It also attempts to provide open areas for optimum natural ventilation. The proposed grading will allow 102 lots. The intended use of the lots is single-family houses with a 45 ft average frontage. A more than 1-acre parcel will provide space for recreational use on the west side of the property.

Two main collectors will provide general access to the development, one running North-South, and the other running West-East. These collectors provide two access points to the area per the fire department code. A total of 4 local streets will give access to 3 main residential areas within the property line limits.

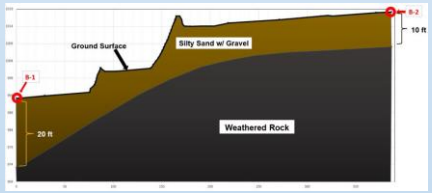
Features: The residential area will include a decorative half-acre pond filled with about 200,000 cfs of potable water. The pond will add aesthetic value to the residential area. The designed pond will include a waterfall, about 200 koi fish, and an open grass community space. Oxygen will be injected into the system through the waterfall, and there will also be a pump that circulates the water every 24 hours.

There will be a single water tank that will hold potable water for use by the residents. The water tank will be cylindrical in structure with a diameter of 30 ft and height of 24 ft. The material of the tank will be Glass Fused to Steel (GFS) to ensure sustainability goals are met since the material of the tank requires a low cost of maintenance.





Geotechnical: Boring logs were available to students to use throughout the designing process. The boring logs let the students understand what soil they would work with and the depths where the soil types changed. With the information given, students could determine the possible constraints that would be encountered for the grading of the land. One of the main concerns for the grading was the hilly terrain of the site because making the site completely flat would be very costly. Additionally, if the hills were to be kept, the slopes would be too steep and unsafe for housing and roads. Due to these concerns, the priority of the grading was to keep the magnitude of slopes at a minimum but, at the same time, preserve some of the natural terrains. As a result, all slopes in the proposed grading are 2:1. Making the slopes under 32° and, based on the slope stability analysis, will be stable and safe for vehicles to travel on. Furthermore, determining the bearing pressure and bearing capacity of the soil was essential in ensuring the soil could support the weight of the retaining walls and the water tank. A good erosion control plan was also necessary to minimize the amount of soil runoff and disturbance to the landscape. Erosion control measures are needed to prevent erosion, limit sediment, and manage drainage.



Transportation: We aim to develop a safe, efficient, and accessible transportation network that meets the standards of the City and the county. In addition, we must for the fire department codes to ensure the safety of residents in the area. Based on our analysis, we will develop a transportation plan that includes roadways (Collector and local roads), sidewalks, and bike lanes. We will consider any potential future developments in the area to ensure the network can accommodate increased traffic flow. This includes providing adequate access for fire trucks and emergency vehicles to the residential area, where we must consist of two exits that were considered in the plan to ensure residents can safely evacuate in the event of a fire or other emergency.

Structural: According to the chosen alternative, there are areas that have a height difference of 20 ft, which will need a retaining wall to support the soil laterally. Retaining wall calculations will include soil lateral load and earthquake lateral. In this project, there is no presence of a waterbed and surcharge load to be included in the calculations. In calculating the retaining wall, it is a must to consider the types of failure which can occur to the structure and design to sustain the environment. Once the retaining wall is designed, reinforced concrete calculation should also be conducted to understand how much concrete and rebar are needed to support the structure. Additionally, a cost analysis will also be conducted.

Health, Safety, and Welfare: The well-being of future residents is one of the priorities of Group 4. Clean potable water will be available in every home. Pipelines will be located so that if the sewer piping leaks, it will not interfere with the potable water pipeline. The potable water would remain clean for the residents to use.

Each of the disciplines made sure that codes and standards were implemented into their design. The proposed grading of the land ensured that its slopes were lower than the recommended value for optimum safety. The dimensions of the road were designed based on the Highway Design Manual. Traffic control methods will be implemented to make the roads safe and pedestrian friendly. Residents will have two ways to enter and exit the residential area in case of emergencies. It will also give the fire department two access roads to reach the homes. The necessary precautions will be taken throughout the construction process; OSHA guidelines will be followed. As the construction process begins, standards will be enforced, and proper training will be given to minimize any risks occurring. The priority for Group 4 was always the safety of residents and workers.

We want the residents to have a sense of community and live comfortably in their new homes and neighborhood. Those with children or pets, or those who enjoy the outdoors, can enjoy the scenic view of the pond and the amenities at the park.

Knowledge and Skills Gained: Throughout the 2022 Fall and 2023 Spring semesters, Group 4 needed to expand their knowledge from previous courses to develop the residential area. The research was conducted to learn more about design-oriented concepts to continue with the preliminary design that will be delivered to the client by May 2023. It was also necessary to increase our knowledge of computer aid design software for multiple disciplines.

Multiple computer software was used to optimize the design approach in this project. A new skill set has been developed during the course of the project. Starting with Google Earth Pro was needed to have a visual idea of the site conditions and relative location. Earth Pro aided us in drawing quick cross-sections across the given site. With these cross-sections brainstorming layout ideas took place considering the topographic conditions. The multiple ideas were modeled in Autodesk AutoCAD (2D layout) to accurately scale the dimensions of parcels and obtain a total number. After multiple iterations between different layout alternatives, three main alternatives were chosen to be recommended to the client based on their potential to fulfill all its needs. The three alternatives were modeled in Civil 3D with a preliminary grading plan that provided us with a cut-and-fill report to have a comparison variable between the three alternatives. Civil 3D was also the primary tool to model roads in horizontal and vertical directions. Currently, the use of Civil 3D continues with the modeling of gravity piping for the stormwater and sewage systems, plus the modeling of pressure piping for the delivery of potable water to each lot in the development. Other software that has currently been used in the preliminary design process are:

- FlowMaster
- SAP 2000

Collaboration of Faculty, Students, and Licensed Engineers: Group 4 worked on this project with the collaboration of their teammates and with the counseling of faculty. Effective communication was essential in guiding students in the right direction. Faculty gave students feedback on calculations, written reports, and oral presentations. This allowed the students to learn from their mistakes and improve their work. Students relied on one another to compute calculations. Calculations were divided among members, and students had to work collaboratively to ensure accuracy. The students would also conduct meetings outside class to update one another on progress, current deliverables, and areas where assistance was needed.