Summary

Ski resorts attract people from all over the world who want to experience the many activities that one can do in the snow. Because of their popularity, ski resorts try to stand out from each other to attract the attention of possible ski-goers. We were tasked with the job of trying to plan a large ski resort where one could always find a new place to explore no matter how many times they came.

We were given a mountainous region of 5,500 square acres of potential ski slopes, and with this large expanse of land, we were able to design a ski resort that contained forty-eight different trails with a variation of twenty percent beginner trails, forty percent intermediate trails, and forty percent difficult trails. These trails covered over 160 kilometers of land ranging in height from 2,820 meters to 1,700 meters. To create the design, we started by printing out topographic maps and drawing rough sketches of our model. After we completed our sketches, we utilized various computer programs, such as Google Earth and Microsoft Paint, to bring our model into a more realistic and accurate setting.

Using Google Earth, we were able to create a model that more accurately determine the measurements of our trails. It also allowed us to bring to life our design of having a wide variety of trails for all skiers of different abilities. However, because we have such an expanse of trails spread over a large mountainous area, it is time consuming to travel to trails that are farther away. Despite the flaws, we believe that our model still achieves the goal of giving a skier a new experience every time they come.

Memo

Dear Ms. Mogul,

We have created a possible design for a ski resort on Wasatch Ranch. The design conforms to generally accepted standards of resort design, as well as maximizes use of the slope area available. The resort consists of 3 main ski villages, as well as a smaller beginner's village with access to the easiest trails and slopes. All of the villages are connected by a main road, which also connects to an overflow parking lot in case of an influx of visitors. From each village, a network of ski lifts extends up the mountain to each drop point, from which the majority of trails originate. Villages 1, 2, and the Children's Village are all connected to one grid of ski lifts, while Village 3, due to its remote location, has its own separate network. In total, the design contains 16 ski lifts, as well as a smaller tow lift branching from the Children's Village.

The ski trails placed are designed to maximize area covered, while also following contours in such a way that the difficulty level of each trail is well controlled. As would be expected, the majority of the easiest trails are connected to the Children's Village. However, there are other easy trails dispersed around the park, including one starting at the peak, specifically designed to give beginners the change to ski from the summit, without putting them in a situation they cannot handle. For intermediate and advanced skiers, we have plenty of medium and hard difficulty trails, with over 125 km of intermediate and hard slopes for them to enjoy.

When being compared to other world class ski resorts, the proposed design for the resort at Wasatch Ranch holds up well. Given the criteria of elevation change, skiable acres, total slopes, slopes of each difficulty, and number of lifts, Wasatch places fifth among

twenty of the best ski resorts world-wide. It has the most skiable acres, and its elevation change is second only to Whistler Blackomb. The slopes rank in the 6's and 7's for length, although number of actual trails is not taken into account. Our design also contains one of the longest continuous slopes in the world, measuring 17 km of consistent downhill. These factors combined would make this resort a wonderful attraction, with something for everyone to enjoy.

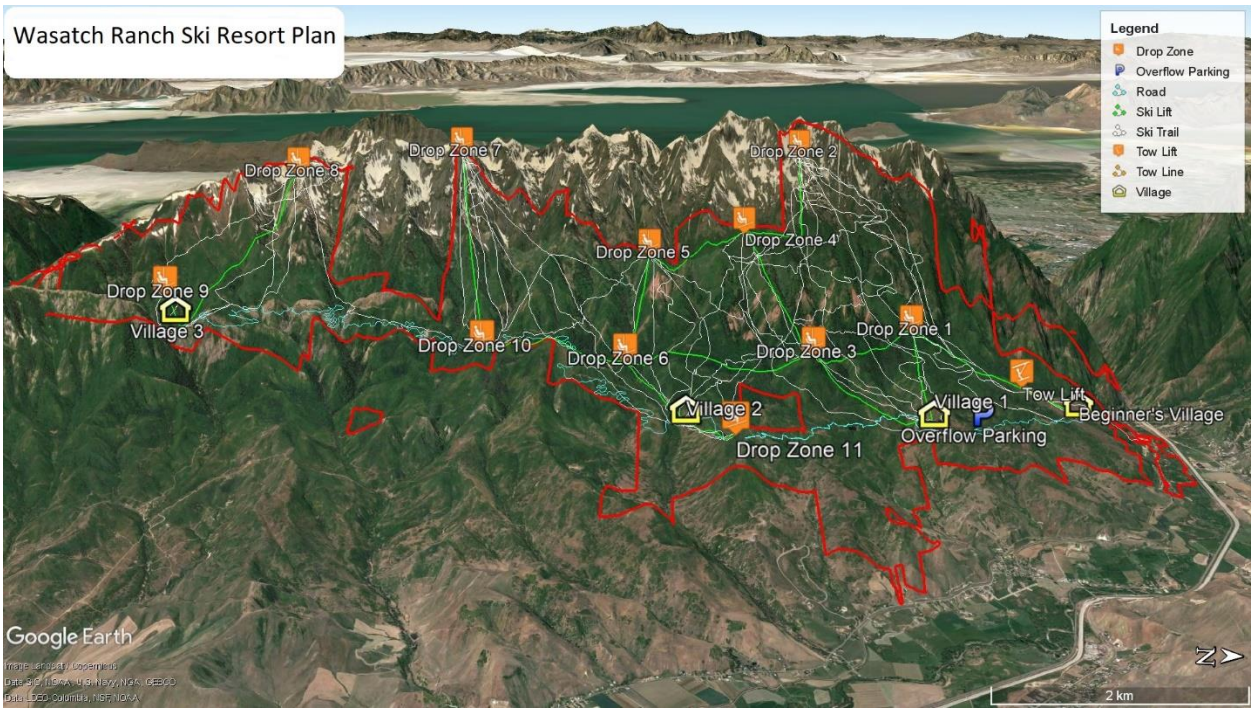

Figure 1. Map of proposed Wasatch Ranch Ski Resort design.

Introduction

Wasatch Peaks Ranch, a potential ski resort, in Peterson, Utah is up for sale. A group of individuals who are interested in developing the property for a possible future Winter Olympics has hired Ms. Mogul as their agent. Our team has been tasked by Ms. Mogul to map out potential ski on the ranch. In addition to a large number of trails, our design needs to include slopes of various lengths and difficulties. About twenty percent of the trails should be beginner trails, forty percent of trails should be intermediate trails, and the other forty percent should be difficult trails.

Assumptions

- Everything within the 5,500-acre area of potential ski slopes can be cleared to make the trails.
- All the creeks will be frozen over and covered in snow during winter.
- The cost of building the resort is not an issue.
- All trails will be kept in good condition for skiing.

Model Description

We were tasked with designing a new ski resort at Wasatch Peaks Ranch given a brochure and topographic map of the ranch in addition to comparison data from other North American ski resorts. In our design, we needed to classify our trails into three categories: beginner (green circle), intermediate (blue square), and difficult (black diamond). We decided to use the slope at the steepest part of the trail to determine the category of that trail. The provided map was inadequate in determining the slope of a trail as it did not provide a map scale or contour interval. We found the United States Geological Survey (USGS) contour map of the area which provided us with a map scale and contour

interval in addition to a more-detailed view of the topography. In addition to the trails, a ski resort needs ski lifts, which is how skiers move up the mountain; drop zones, which are the pick-up and drop-off locations of the ski lifts; and villages, which are the base camps for skiing. There also needs to be a road that connects the villages to the entrance so that people can drive in to the resort.

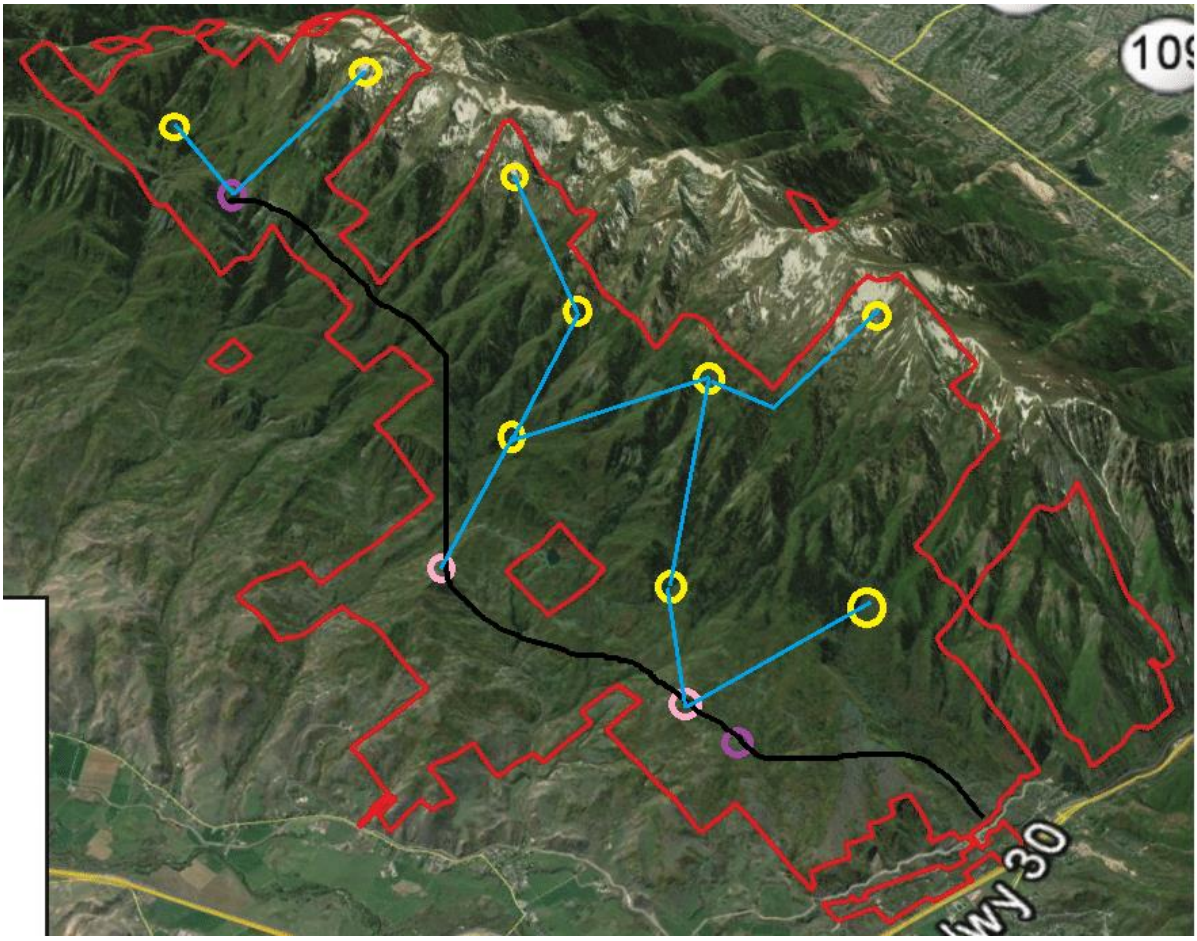

Figure 2. Our basic plan for the ski resort. Pink circles are villages, yellow circles are drop zones, blue lines are ski lifts, the black line is the road, and the purple circle is the overflow parking.

Using an enlarged printed USGS contour map, we drew in approximate locations on where we wanted our villages and drop zones. After drawing in the villages and drop zones on the contour map, we put the points of the villages and drop zones on a bird's eye-view satellite map to gain a different perspective. We decided that the construction of the

villages and drop zones would be made easier if they are located on flatter land. Because the higher elevation is on the west side of the property, the villages would be located on the east side of the property. The property has two major parts: one large section in the north connected to one smaller section in the south by a thin strip of land. There are also various exclaves of land that we could use which we decided to ignore in addition to an enclave of land that we could not use. We decided that the northern section should have two villages due to its immense size, while the southern section should have one. The longest ski lift in North America is 3.4 km long, so we decided that our lifts should not exceed that length. We tried to space the lifts out evenly while at the same time trying to put them on as flat of land as possible. We put in nine drop zones, seven in the northern portion and two in the southern portion.

Now that we had our preliminary locations for our villages and drop zones, we used Google Earth to plot out our ski trails. We needed 160 km total of trail with about twenty percent beginner level, forty percent intermediate level, and forty percent difficult level, which when calculated out is about 32 km of beginner trails, 64 km of intermediate trails, and 64 km of difficult trails. We wanted to have trails of all different types—long trails, short trails, straight trails, curvy trails. We imported a map of the boundaries of the land that we could use, and we overlaid it with a contour map. Then, depending on the difficulty of the trail, we traced out a path of that trail using the contour lines to help us. There were creeks which flowed through the area, but we assumed that the creeks would be frozen and covered with snow during the winter, so our trails could go over them. After the line was drawn, the program displayed the maximum angle of descent and the length of the trail

over the surface. The line was adjusted so that the maximum angle of descent would fit in the guidelines for the intended difficulty.

As we drew more ski paths, we added two drop zones, making a total of eleven drop zones, and we moved some drop zones around as we realized that some parts of the property would be hard to reach if extra drop zones were not added. We decided that there would be sixteen ski lifts connecting the eleven drop zones. Because we wanted to attract skiers of all abilities, a Beginner's Village, where beginners can learn how to ski, was added to the very north of the area. An easy 700-meter trail with a tow lift was added for people who are new to skiing. Longer but easy trails were also added to the Beginner's Village. There are also a few other beginner trails spread throughout the resort.

We also needed an entrance to the resort. There were two major highways adjacent to our ski resort—I-84, which runs to the north, and I-15, which runs to the west. We decided that the entrance would be to the north as the topography of an I-84 entrance is less mountainous than an I-15 entrance, which would require a winding road through the mountain range. There is also an existing exit on I-84 that could be used to access the site. We also needed a road to connect all the four villages to the entrance, which we drew by using a contour map to guide us. The maximum grade for our road was about ten percent. Some parts of the road also cross over some ski trails. In those cases, we decided that a bridge would be built in which the vehicles can go under and the skier over. Because this venue could possibly host some events in the Winter Olympics, there could be a large number of visitors present at a given time. We added an overflow parking lot to mitigate the problem of a lack of parking spaces.

In the end, we had 161.7 km of trails. We had seven beginner trails, which totaled 32.3 km in length, twenty intermediate trails, which totaled 64.7 km in length, and twenty-one difficult trails, which also totaled 64.7 km in length. Twenty percent of our trails were beginner trails, forty percent of our trails were intermediate trails, and forty percent of our trails were difficult trails.

Analysis

At the beginning of the competition, we were given a spreadsheet containing seven categories of information about nineteen ski resorts across the world. After creating our model ski resort, we entered its information into the spreadsheet. Then, we assigned each resort a rank from one, the highest value, to twenty, the lowest value, for each category. Finally, we added up the ranks, and the resort that had the lowest total rank we considered the best. Our model resort had the fifth lowest rank. However, the three Olympic venues were ranked fifteenth, nineteenth, and twentieth, which we believe shows that our process for calculating the best ski resort is poor.

Some weaknesses with our model ski resort are that we relied heavily on Google Earth to calculate distances, and percent slope. We trusted that the program runs correctly, and that its data is correct. Another weakness is that we were generating ski trails by sight, not by a mathematical formula, so there may have been a more optimal strategy to place our trails. A strength of our model is that we were able to use Google Earth, which allowed us to more easily design our ski resort. Because we used a graphical design program, we were able to plan the resort as a whole, and not go trail by trail across the mountain. Google Earth also gave us the ability to import pictures into the program, so we were able to have a correct idea of where our boundaries were, while being allowed to manipulate the image in

many ways. If we did not use Google Earth, and instead designed on a two-dimensional picture, we would have had to create our resort from a perspective that was not optimal. However, Google Earth allows us to zoom in and out of the picture, and it let us move around the image in a three-dimensional area. This allowed us to see and use contour lines more easily.

Conclusion

Our model attempts to design a competent ski resort for Wasatch Ranch. Using various modeling tools and methods, such as Google Earth and sketching on physical maps, we created a system of base ski villages, drop zones, and trails that conform to the standards given. The model consists of 15 lifts, 162 km of slopes, and 4 base villages that connect to form the resort on a whole. We believe that our design would make a viable location both for recreational use as well as Olympic use. However, due to the limitations of our modeling software and data, we cannot be sure of this fact, as visitor capacity and wait times were not taken into account. Also, some of our assumptions may not be entirely realistic, and if some things were assumed incorrectly, the entire model may be rendered invalid.

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Appendix

Trail Name	From	To	Distance (km)
Beginner Trails			
E1	Drop Zone 9	Village 3	1.0
E2	Drop Zone 2	Village 1	17.6
E3	Drop Zone 1	Beginner Village	4.0
E4	Drop Zone 5	Village 2	4.6
E5	Drop Zone 6	E5	1.0
E6	Drop Zone 1	Beginner Village	3.4
E7	Tow-Lift	Beginner Village	0.7
	Total Distance Beginner		32.3

Trail Name	From	To	Distance (km)
Intermediate Trails			
M1	Drop Zone 9	Village 3	0.8
M2	Drop Zone 3	Village 1	2.0
M3	Drop Zone 7	Drop Zone 6	4.0
M4	Drop Zone 3	Village 1	2.4
M5	Drop Zone 5	Drop Zone 3	3.8
M6	Drop Zone 5	Village 2	3.3
M7	Drop Zone 2	Drop Zone 1	4.2
M8	Drop Zone 1	Village 1	2.1
M9	H16	H4	2.4

M10	M3	H3	1.8
M11	Drop Zone 11	Village 2	1.0
M12	Drop Zone 11	Village 2	1.1
M13	Drop Zone 2	E6	5.7
M14	Drop Zone 4	Village 2	4.4
M15	Drop Zone 2	Village 2	6.5
M16	Drop Zone 7	Village 2	6.3
M17	Drop Zone 5	Drop Zone 10	4.1
M18	Drop Zone 8	Drop Zone 9	3.9
M19	Drop Zone 3	Village 2	3.5
M20	E2	E2	1.4
	Total Distance Intermediate		64.7

Trail Name	From	To	Distance (km)
Difficult Trails			
H1	Drop Zone 8	Village 3	6.0
H2	Drop Zone 7	Drop Zone 10	2.8
H3	Drop Zone 5	Drop Zone 6	1.6
H4	Drop Zone 6	Village 2	1.8
H5	Drop Zone 2	Village 1	5.2
H6	Drop Zone 2	E7	5.1
H7	Drop Zone 8	Village 3	3.1
H8	Drop Zone 4	Drop Zone 3	2.5

H9	H5	H5	1.0
H10	E2	E7	1.8
H11	Drop Zone 2	E7	3.6
H12	Drop Zone 7	Drop Zone 10	2.6
H13	Drop Zone 7	Drop Zone 10	2.8
H14	Drop Zone 8	Drop Zone 10	4.3
H15	Drop Zone 7	H2	2.5
H16	M3	H2	1.5
H17	Drop Zone 4	Village 2	4.0
H18	Drop Zone 2	Village 1	6.1
H19	Drop Zone 8	H7	1.9
H20	Drop Zone 5	E5	2.4
H21	Drop Zone 4	Drop Zone 3	2.1
	Total Distance Difficult		64.7