Goodbye Gondola

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Github Repo

Overview

Goodbye Gondola intends to utilize visualization to increase awareness of the impact that proposed gondola construction in Little Cottonwood Canyon could have on climbing boulders. At the present moment, the Utah Department of Transportation is debating a final transportation recommendation after identifying the gondola as the preferred alternative in the summer of 2022. As Salt Lake residents, students, and climbers, we are alarmed by the immense and irrevocable impact that the gondola would have on the world class bouldering site of Little Cottonwood Canyon.

This visualization seeks to answer the question: "What boulders will be impacted directly by the gondola construction?" To answer this, users will be able to interact with the visualization to target specific boulder problems, as well as specific areas to easily see the impact at both large and small scales throughout the canyon. Another apparent question is: "How will our visualization promote user activism?" We hope that our usage of an intuitive and effective visualization helps users become aware of the negative impacts, which in turn will encourage them to act against the construction of the gondola. Our visualization page will include links to resources to help prevent the construction of the gondola so users may take tangible steps to oppose the gondola after gaining awareness.

Through this visualization, we aim to increase awareness of the threat of a gondola, as well as promote user engagement with the push against the gondola construction. We will also provide the climbing community and the broader Salt Lake community with these benefits:

- Increased understanding of impact of the gondola construction.
- An interactive easy to use visualization to share amongst the community.
- Increased awareness of the issue.
- Increased activism in the community.

Background and Motivation

Background

Little Cottonwood Canyon (LCC) is one of the most beloved canyons in the Salt Lake greater area, recognized for its world class resort skiing, backcountry skiing, climbing, hiking, birdwatching, and more. Little Cottonwood Canyon is a crucial destination for both locals and tourists, with over 2 million people visiting the canyon each year.

In 2017, the Utah legislature passed Senate Bill 277, *Highway General Obligation Bonds Authorization*, which included funding for transportation improvement projects that "have a significant economic development impact associated with recreation and tourism within the

state" and "address significant needs for congestion mitigation." The Utah Transportation Commission identified Little Cottonwood Canyon as a top priority due to its high volume of use and economic benefit from tourism.

In the spring of 2018, the Utah Department of Transportation (UDOT) began the S.R. 210 project with the goal of identifying and evaluating transportation improvement alternatives for S.R. 210, the road that runs through Little Cottonwood Canyon, and Wasatch Boulevard. UDOT began the project by conducting an Environmental Impact Statement (EIS) for Little Cottonwood Canyon (LCC) and Wasatch Boulevard in partnership with Utah Transit Authority (UTA) and the U.S. Department of Agriculture Forest Service. The Federal Highway Administration has assigned full responsibility under the National Environmental Policy Act (NEPA) to UDOT for carrying out the environmental review process and using federal-aid highway funding for identified projects. In their Final Environmental Impact Statement, UDOT identified the main purpose of this project: "to substantially improve roadway safety, reliability, and mobility on S.R. 210 from Fort Union Boulevard through the town of Alta for all users on S.R. 210."

UDOT released a draft EIS statement in the summer of 2021 and held an open comment period from June - September 2021, followed by a second public comment period from December 2021 - January 2022. After receiving a record-breaking 14,000 public comments, they released their final EIS and recommendation on August 31, 2022, with a public comment period from September - August 2022 and almost 10,000 comments received. UDOT plans to release their final record of decision in the winter of 2022/2023.

Transportation Options

In their Initial EIS, UDOT identified five primary alternatives. All travel times are estimated by UDOT and reflect time from the identified mobility hub to Alta.

1. **Enhanced Bus Service (No Additional Roadway Capacity).** This option would provide winter point-to-point bus service from mobility hubs directly to ski resorts. There would be 24 buses per hour in peak hours, serving an estimated 1,008 people per hour during peak hours, and no summer bus service. Tolling and other management strategies such as no-single occupant vehicles during peak periods would also be utilized.
    a. Travel time: 54 minutes
    b. Cost: 338M – 355M

2. **Enhanced Bus Service in Peak-period Shoulder Lane Alternative.** This option would provide the same bus service as in option 1, plus road widening in Little Cottonwood Canyon. Bus-only peak-period shoulder lanes would be added to S.R. 210 from the North Little Cottonwood Road/Wasatch Boulevard intersection to the Alta Bypass Road.
    a. Travel time: 36 minutes
    b. Cost: 493M – 510M

3. **Gondola Alternative A (Starting at Canyon Entrance).** This option would build a gondola from the entrance of Little Cottonwood Canyon to the Alta Ski Resort, with stops at Snowbird and Alta ski resorts only. The gondola would provide 30 gondola cabins per hour, serving an estimated 1,050 people during peak hours. Enhanced bus service would be provided from mobility parking hubs to the gondola base station, as there would be no parking at the base station.
    a. Travel time: 63 minutes
    b. Cost: 554M – 561M

4. **Gondola Alternative B (Starting at La Caille).** This option would provide the same gondola service as in option 3, but the base station would exist at La Caille, about 0.75 miles northwest from the entrance to Little Cottonwood Canyon. It would provide 2,500 parking spaces at the La Caille base station.
    a. Travel time:55 minutes
    b. Cost: 533M – 550M

    .
5. **Cog Rail Alternative (Starting at La Caille).** This option would build a cog rail beginning at La Caille, about 0.75 miles northwest from the entrance to Little Cottonwood Canyon. It would stop at Snowbird and Alta ski resorts only. It would have service every 15-minutes during peak hours, serving around 1,000 people hourly during peak hours. It would provide 2,500 parking spaces at the La Caille base station.
    a. Travel time: 55 minutes
    b. Cost: 1,051M – 1,064M

In their Initial EIS, UDOT identified option 2, Enhanced Bus Service in Peak-Period Shoulder Lane Alternative, and option 4, Gondola ALternative B, as preferred alternatives. In their Final EIS, UDOT identified the Gondola Alternative B as the preferred alternative.

Public Opinion and Impact

The preferred alternative, Gondola Alternative B, would have extreme and irrevocable impacts on Little Cottonwood Canyon. It would disproportionately affect user groups outside of resort skiers, such as backcountry skiers, climbers, and hikers. Local organizations that represent outdoor user groups, and environmental protection groups have taken a strong stance in opposition of the gondola, including Save Our Canyons, the Salt Lake Climbers Alliance (SLCA), Friends of Little Cottonwood Canyon, and Wasatch Backcountry Alliance.

Local governmental leaders have also taken a stance against the gondola. The Salt County Council and Salt Lake County Mayor Jenny Wilson passed a joint resolution condemning the gondola. The Salt Lake City Council and Salt Lake City Mayor Erin Mendenhall passed a similar joint resolution against the gondola plan. Sandy Mayor Monica Zoltanski has been outspoken about her opposition to the gondola.

As data visualization students and climbers, we want to use visualization to display the effects that the proposed gondola would have on climbing in Little Cottonwood Canyon, with a focus on boulders that will be directly affected by gondola stations. A joint study from the SLCA and University of Utah found that Little Cottonwood Canyon ranked as the most popular and frequently used climbing destination in the Wasatch. Despite this, the United States Forest Service stated in a letter to UDOT that "individual cliffs, boulders, groups of boulders, bouldering problems" are not significant enough for protections when assessed individually. We hope that our visualizations help the public understand the immense and irrevocable impact that the gondola would have on the world class bouldering site of Little Cottonwood Canyon.

Questions

The main question we hope to answer is: "What boulders will be impacted directly by the gondola construction?" We hope to be able to identify bouldres that will be directly harmed by gondola tower construction as well as areas and boulders that would sit under gondola lines.

We have a number of sub-questions that we hope our visualization answers, such as:

- Of affected boulders, what is the breakdown by grade and popularity?
- How does this compare to the breakdown by grade and popularity of all boulders in the area?
- What portion of total boulders would be affected by the gondola?
- Which of the most popular boulders will be affected?
- Which specific areas will be affected?

Lastly, we hope that our visualization answers the question: "What can I do to oppose the gondola?" We will include links to educations resources about UDOT's environmental impact statement process as well as links to advocacy groups and steps that individuals can take to take a stand.

Data

Source

The data for the gondola and tower locations were generated manually. We used the Final EIS, published by UDOT, to identify tower locations. We zoomed in as close as we coud to each tower and found the corresponding pin on Google Maps. We then saved the latitude and longitude of each tower.

The data regarding all of the boulders in Little Cottonwood Canyon will be gathered from Mountain Project. This will also provide Latitude and Longitude information, as well as a list of

problems featured on each Boulder. Information regarding the popularity of the boulders will be gathered through the website 8a.

Data Processing:

The information provided by Mountain Project will be obtained using a Mountain Project web scraper. This web scraper was old and had not taken into account the design changes that happened to the website. This required moderate modifications to how the web scraper searched, gathered, and processed the data.

Data Cleaning

After scraping the boulder data, it became apparent that a fair amount of data cleaning was required. The data was stored as a nested object, with areas nested within areas, and boulders held within those areas. There was not a consistent structure. One area might hold routes directly, while another area might hold three areas, and each of those areas might hold additional areas, and those areas might hold boulders. Below is a screenshot of the nested area/boulder data.

To handle this, a function was written to flatten the nested object into an array of boulders. The nested object could first be filtered to include only a subset of areas, and this subset could be passed into the funcion to flatten the subset area to boulders within that area. This function was written recursively.

Next, we realized that the boulder grades were not recorded consistently. They had extraneous strings, such as “yds,” indicating that the grading system comes from the “Yosemite Decimal System.” This substring was removed. It then became apparent that many boulders received a plus or minus grade (i.e. V4+ or V4-), indicating that they were classified as a hard or easy V4. Grades with a minus were rounded down while grades with a plus were rounded up. Lastly, many boulders received a slash grade, indicating that consensus held the boulder between 2 grades (i.e. V4-5 indicates that the difficulty lies somewhere between V4 and V5). In these cases, we rounded up. This was done with two python scripts, one that created a list of all of the conversion rules, and another that found and replaced each instance, following the conversion rules. Other problems that are longer had a sport grade associated with it as well (i.e. 5.9v0). The sport grade was removed for these instances manually. The final issue that needed to be handled was aid routes in the canyon. These routes came from a miscategorization on the website, and due to the small number of them, and the scope of our project, they were simply removed.
A screenshot of the Raw Data Nested Object

info.js:5
{url: 'https://www.mountainproject.com/area/106028873/boulders-little-cottonwood', lat: 40.572, long: -111.764, name: 'Boulders - Little Cottonwood', elevation: 5610, …}
children: Array(37)
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1: {url: 'https://www.mountainproject.com/area/121345042/air-jordan-boulder', lat: 40.572, long: -111.747, name: 'Air
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3: {url: 'https://www.mountainproject.com/area/116108530/bush-boulder', lat: 40.573, long: -111.775, name: 'Bush Bould
4:
children: Array(5)
0:
children: Array(3)
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1: {url: 'https://www.mountainproject.com/route/120544970/lil', name: "Lil'", types: Array(1), height: 12, grad
2: {url: 'https://www.mountainproject.com/route/113804432/out-the-barrel', name: 'Out the Barrel', types: Array
length: 3
[[Prototype]]: Array(0)
elevation: 6078
lat: 40.571
long: -111.755
monthlyViews: 62
name: "The Barrel Boulder"
totalViews: 3764
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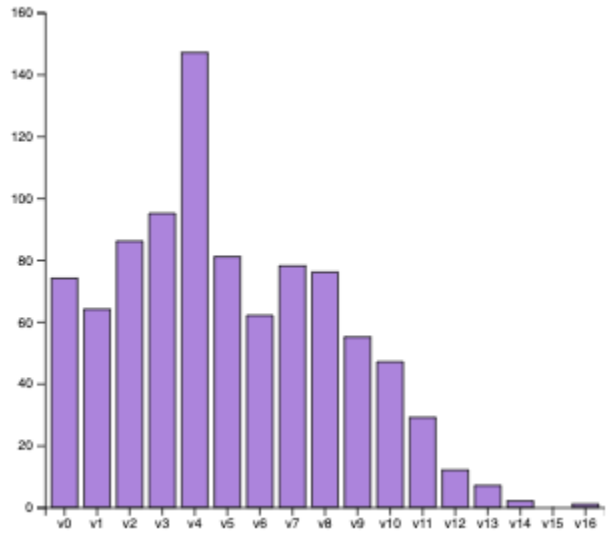
4: {url: 'https://www.mountainproject.com/area/119184744/shothole-boulder', lat: 40.571, long: -111.755, name: 'Sho
length: 5
[[Prototype]]: Array(0)
elevation: 5727
lat: 40.571
long: -111.755
monthlyViews: 213
name: "Buzz Boulders"
totalViews: 19328
url: "https://www.mountainproject.com/area/110530743/buzz-boulders"
[[Prototype]]: Object
5: {url: 'https://www.mountainproject.com/area/105802778/cabbage-patch', lat: 40.572, long: -111.77, name: 'Cabbage Pa
6: {url: 'https://www.mountainproject.com/area/110568280/the-campus-boulder', lat: 40.572, long: -111.73, name: 'The C
7: {url: 'https://www.mountainproject.com/area/121890411/creek-bridge-boulder', lat: 40.571, long: -111.732, name: 'Cr
8: {url: 'https://www.mountainproject.com/area/119993117/everything-boulder', lat: 40.576, long: -111.772, name: 'Ever
9: {url: 'https://www.mountainproject.com/area/107237296/far-side', lat: 40.572, long: -111.76, name: 'Far Side', tota

Boulder Grades to be Cleaned

info.js:148
InternMap(58) {'v10' => Array(36), 'v0' => Array(70), 'v4' => Array(129), '5.9v1 yds' => Array(1), 'v8' => Array(41), …}
[[Entries]]
0: {"v10" => Array(36)}
1: {"v0" => Array(70)}
2: {"v4" => Array(129)}
3: {"5.9v1 yds" => Array(1)}
4: {"v8" => Array(41)}
5: {"v2" => Array(65)}
6: {"v11" => Array(23)}
7: {"v3" => Array(73)}
8: {"v6" => Array(41)}
9: {"v5" => Array(61)}
10: {"v1-" => Array(4)}
11: {"v4-5" => Array(12)}
12: {"v1" => Array(51)}
13: {"v7" => Array(51)}
14: {"v6+" => Array(5)}
15: {"v9-10" => Array(3)}
16: {"v7+" => Array(5)}
17: {"v10-" => Array(8)}
18: {"v7-8" => Array(24)}
19: {"v6-7" => Array(18)}
20: {"v4+" => Array(6)}
21: {"v9-" => Array(2)}
22: {"v1+" => Array(7)}
23: {"v2-3" => Array(15)}
24: {"v12" => Array(8)}
25: {"v-easy" => Array(1)}
26: {"v5-6" => Array(10)}
27: {"v10-11" => Array(2)}
28: {"5.11bv3 yds" => Array(1)}

Exploratory Data Analysis

As a first step, the boulder data was flattened from the nested object of areas and boulders into a list of boulder problems. There are 916 total boulder problems in Little Cottonwood Canyon. A bar chart was made to examine the distribution of boulder problems by grade for all of Little Cottonwood Canyon, shown below. The grade with the highest number of boulder problems is V4, with 147 boulder problems.



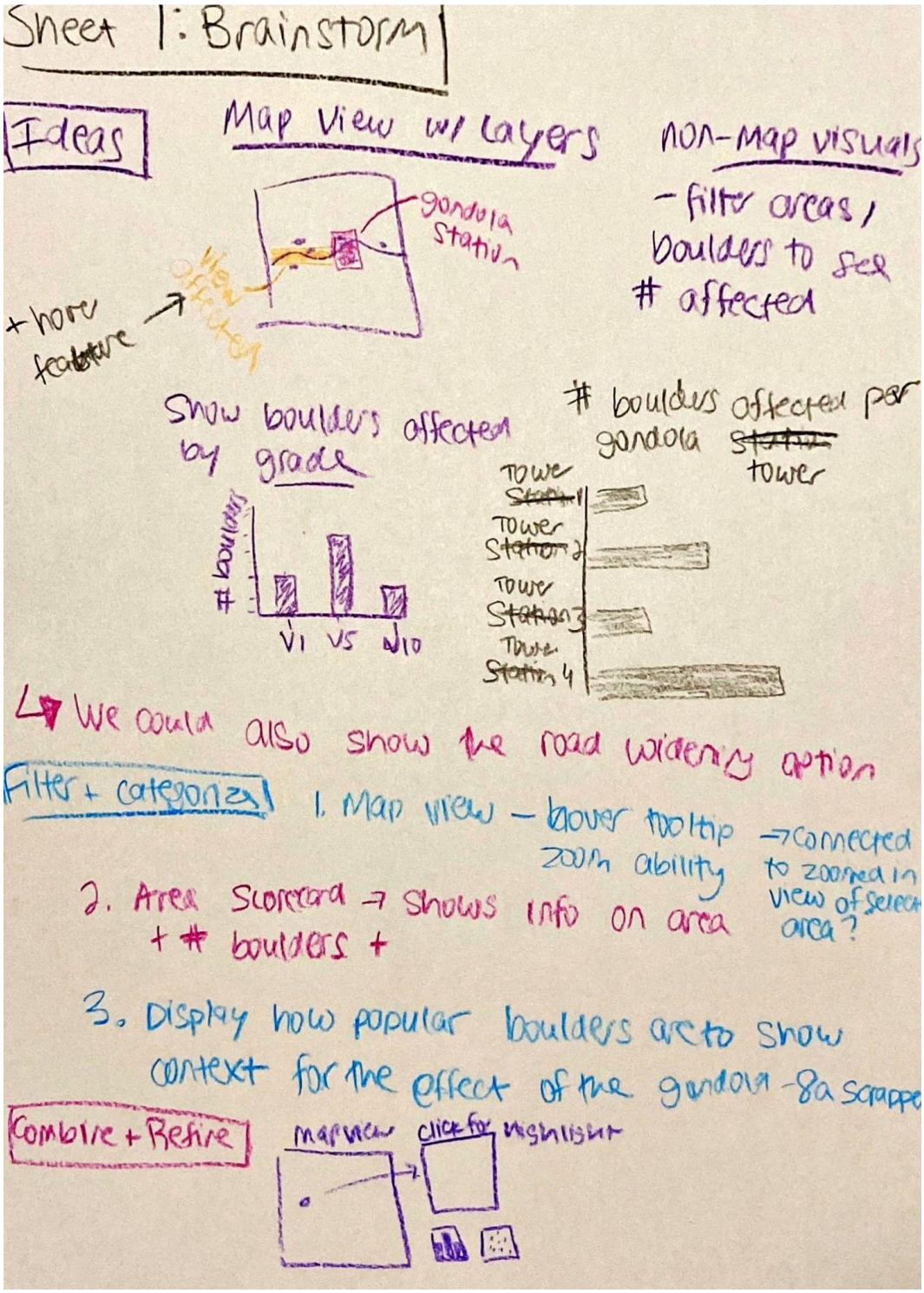
We also pulled gondola tower locations from UDOT's Final EIS. We plotted each point and examined the location. We looked at where the towers sat relative to the road and relative to each other.

We determined which boulders would be affected by the gondola by selecting boulders that were within 0.001 latitude/longitude degrees, which is equivalent to around 100m. We also experimented with a threshold of 0.0001 latitude/longitude degrees, but surprisingly, the number of affected boulders did not change. We believe this to be because of inaccuracies of latitude/longitude data from Mountain Project. For example, some areas contain only a single geographic coordinate for the entire area. Even if multiple boulders exist in that area, we have to assume the same geographic coordinate for all boulders, based on the coordinate for the area pin.

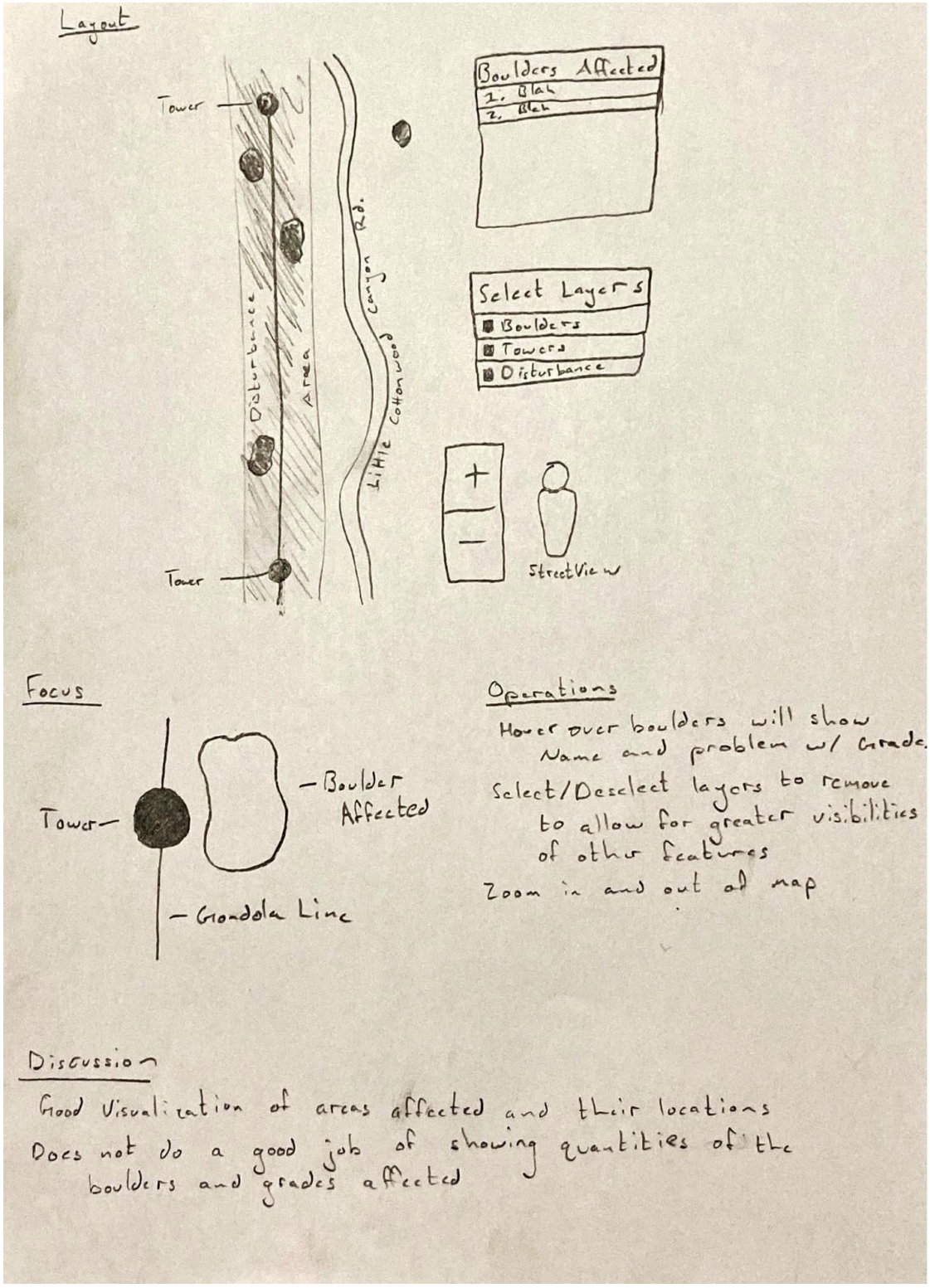
Design Evolution

During our planning phase, we began brainstorming ideas. Then each of the three team members sketched an initial design sheet. We combined the three designs into a realization design.

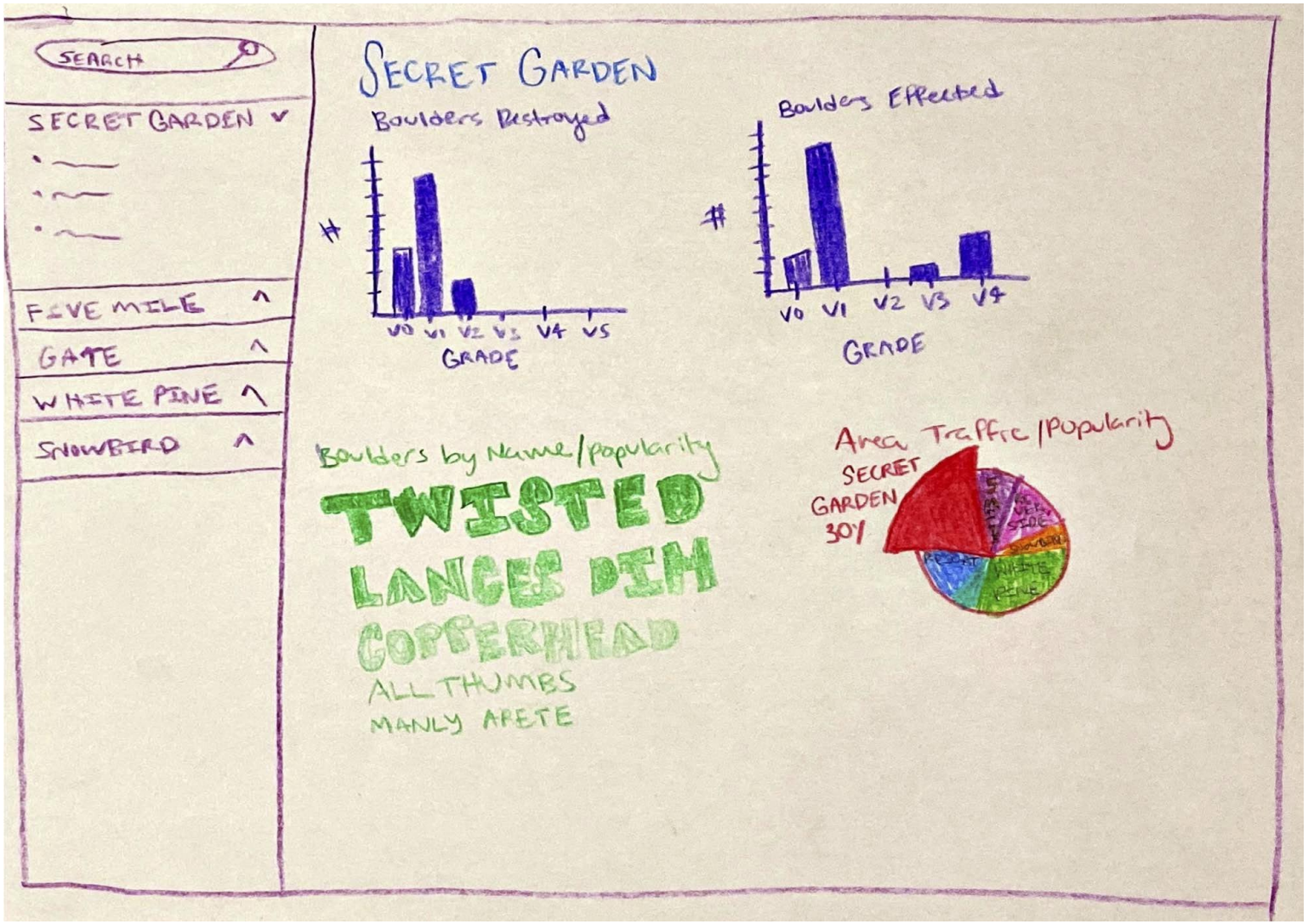
Brainstorm


Sheet 1: Brainstorm
Ideas
Map View w/ Layers
Non-Map visuals
- filter areas, boulders to see # affected
Gondola Station
+ hover feature
Show boulders affected by grade
boulders
V1 V5 V10
boulders affected per gondola station tower
Tower Station 1
Tower Station 2
Tower Station 3
Tower Station 4
We could also show the road widening option
Filter + categorize
1. Map view - hover tooltip zoom ability → connected to zoomed in view of select area?
2. Area Scorecard → shows info on area + # boulders +
3. Display how popular boulders are to show context for the effect of the gondola & scrapp
Combine + Refine
map view
click for highlight

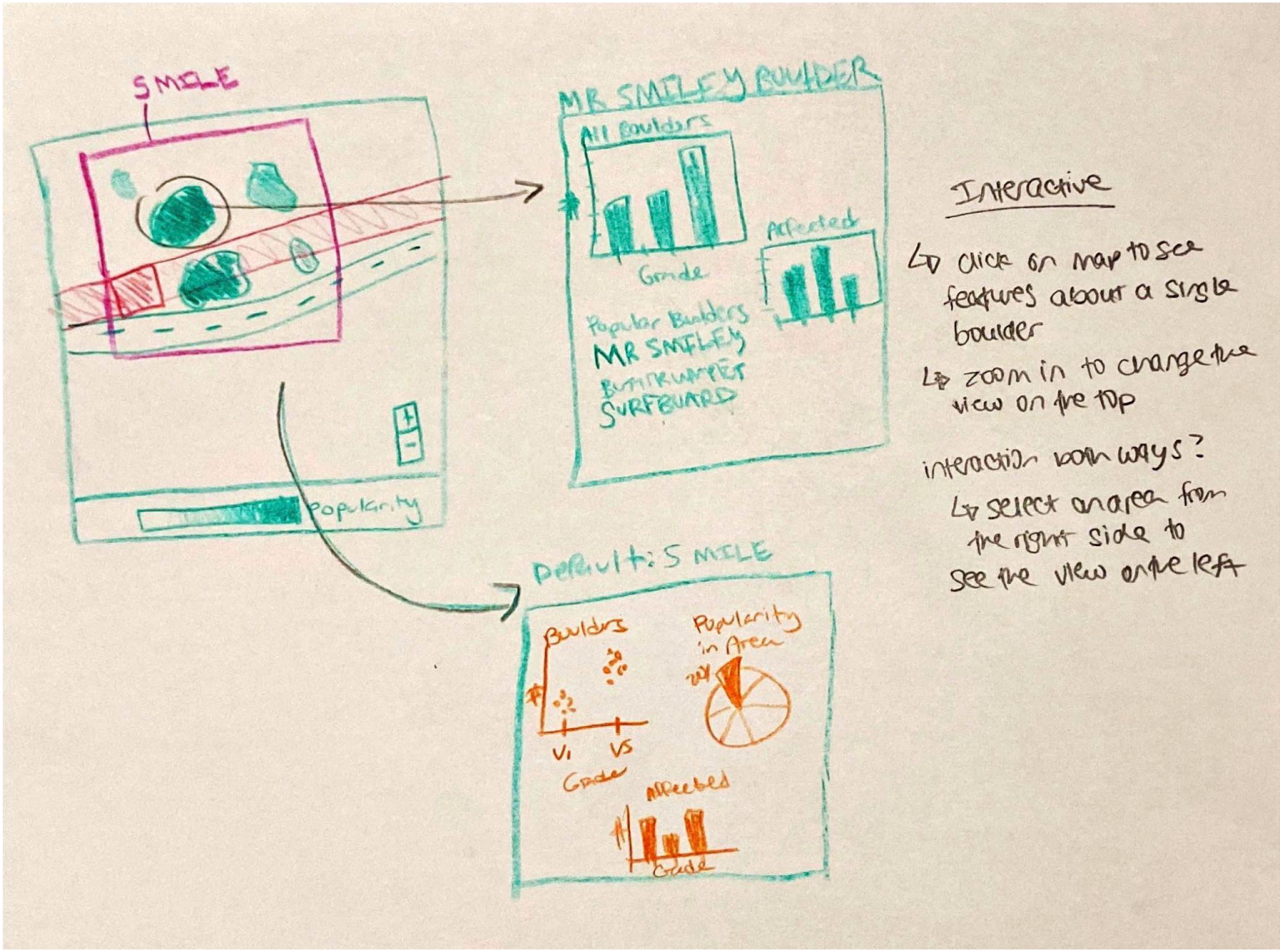
Initial Design 1



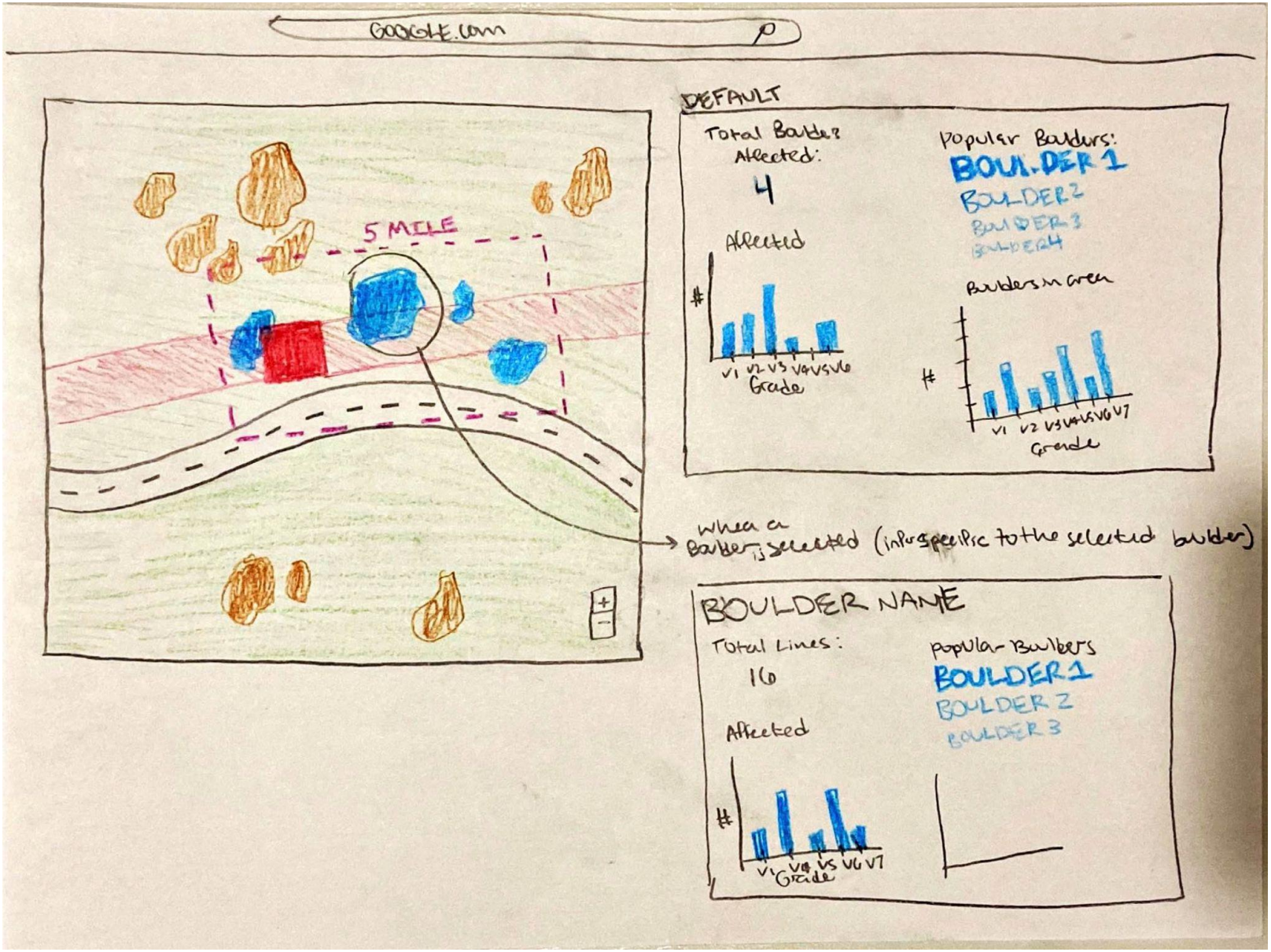
Initial Design 2



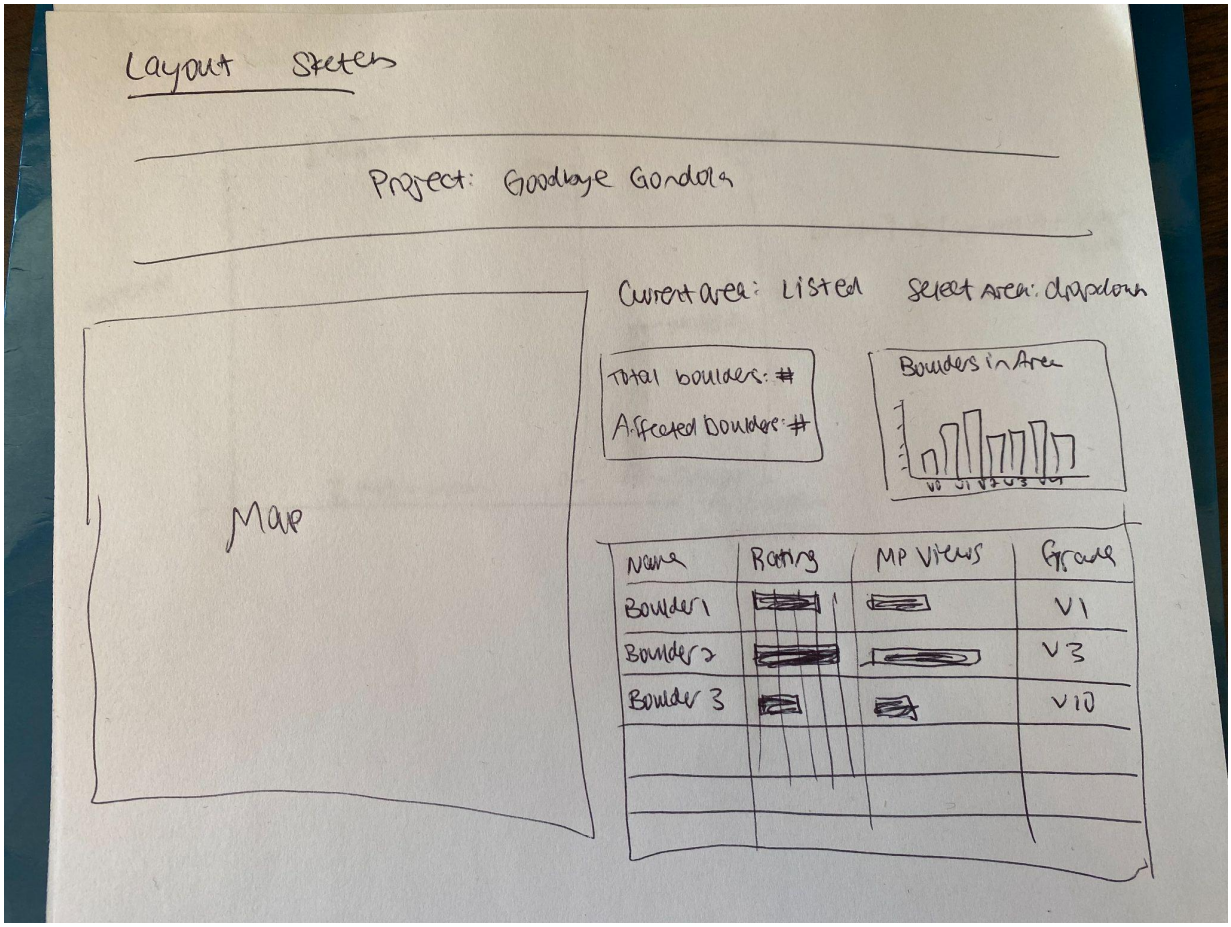
Initial Design 3



Realization Design

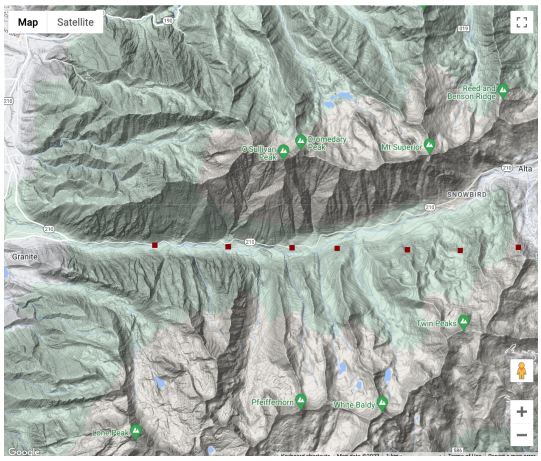


After adding in the bar chart and numbers highlighting the total boulders, we reconsidered how we wanted to visualize the popular boulders that would be affected. We decided to convert the popular boulder visual to a table. The table would show the boulder problem name, grade, and rating and Mountain Project views as rectangles.

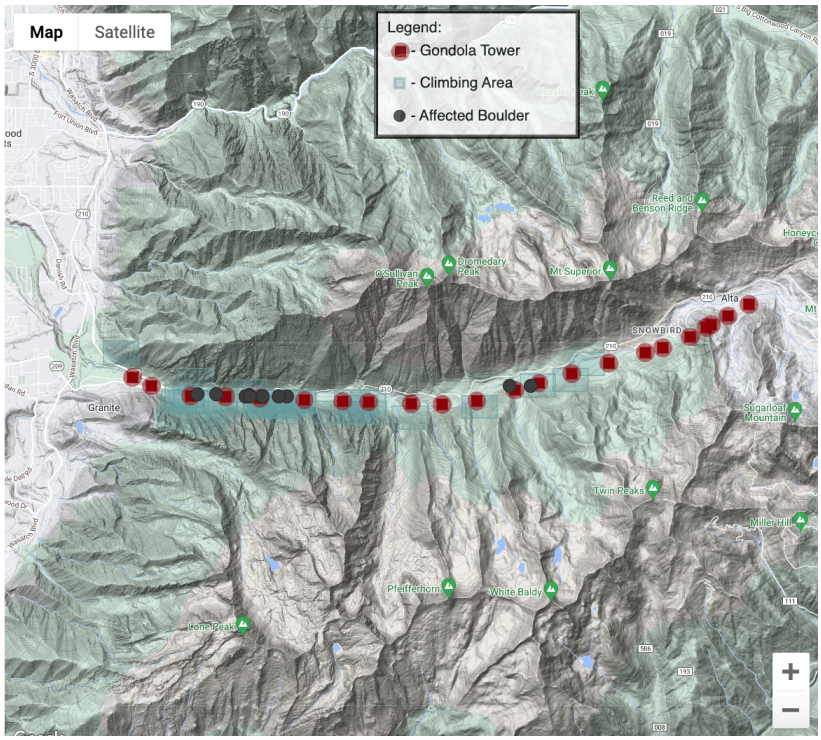


We developed the visualizations in two parts. The left side contained a map and the right side contained an infocard with a few visualizations.

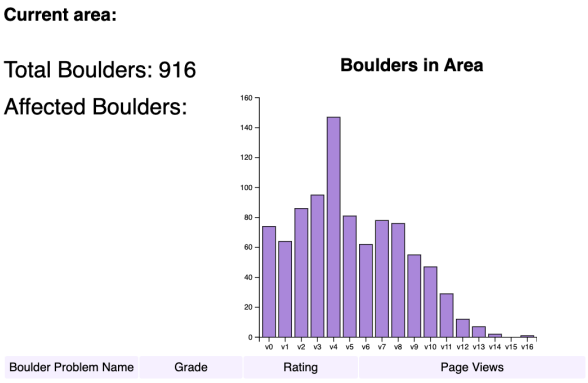
On the left we created a map display of Little Cottonwood Canyon. The map shows the gondola tower locations and boulder area locations. We started by plotting the tower locations.



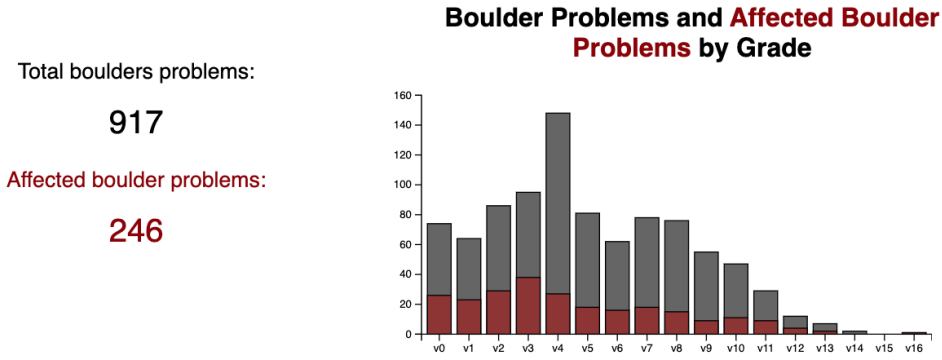
We then added in other layers to the map. We added climbing areas as rectangular areas and affected boulders as gray circles. We changed the tower representation to a square with a circle around it. We hope that this conveys the radius around the tower. We also chose this to differentiate the tower from the rectangles and circles used by by the other layers.



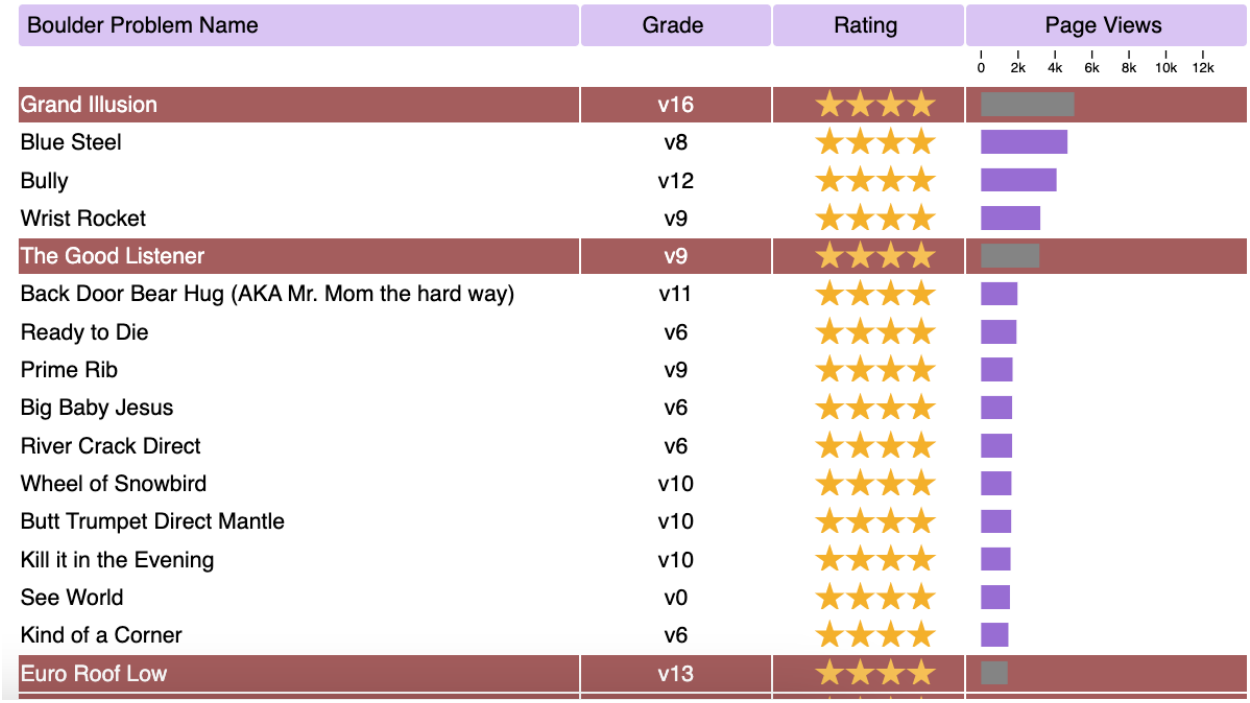
For the infocard, the first iteration showed a bar chart displaying the total number of boulders in the area. We also displayed the total number of boulders in the area.



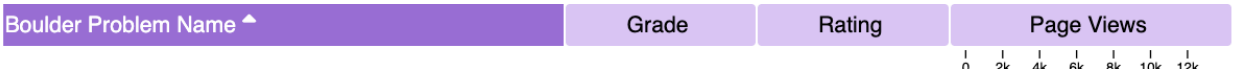
Later in the analysis, we separated the boulders into those affected and those unaffected. We changed the barchart to be a stacked bar chart. The bottom, red bar, shows the number of boulders affected by the gondola, and the gray bar shows all boulders in the area.



We then decided that it would be good to add in a visual that displayed the data in matrix form, allowing users to see individual boulder problems and attributes about them. We added in a table that displays boulder problems, their grade (rated on the V-scale, which ranges from V-0, the easiest, to V16, the hardest offered in LCC), their rating based on 0-4 stars, and the number of views on the boulder problems' Mountain Project page. We tried a few different ways to display this data. We initially used a bar chart for the rating, and then a lollipop chart, and lastly changed it to show 0-4 stars, rounding the rating to the nearest whole number.



We added in the ability to sort by each of the headers, both ascending and descending. Each column sorts on the primary column and a secondary column. For example, when you sort by the rating, rows are then sorted by page views within each rating. We also added in a triangle next to the header that the table is sorted one, pointing up or down, to indicate the column and direction of sorting. We added a tooltip to the column headers to provide explanations of what each column means. Lastly, we added a red highlight to each row that contains an affected boulder.

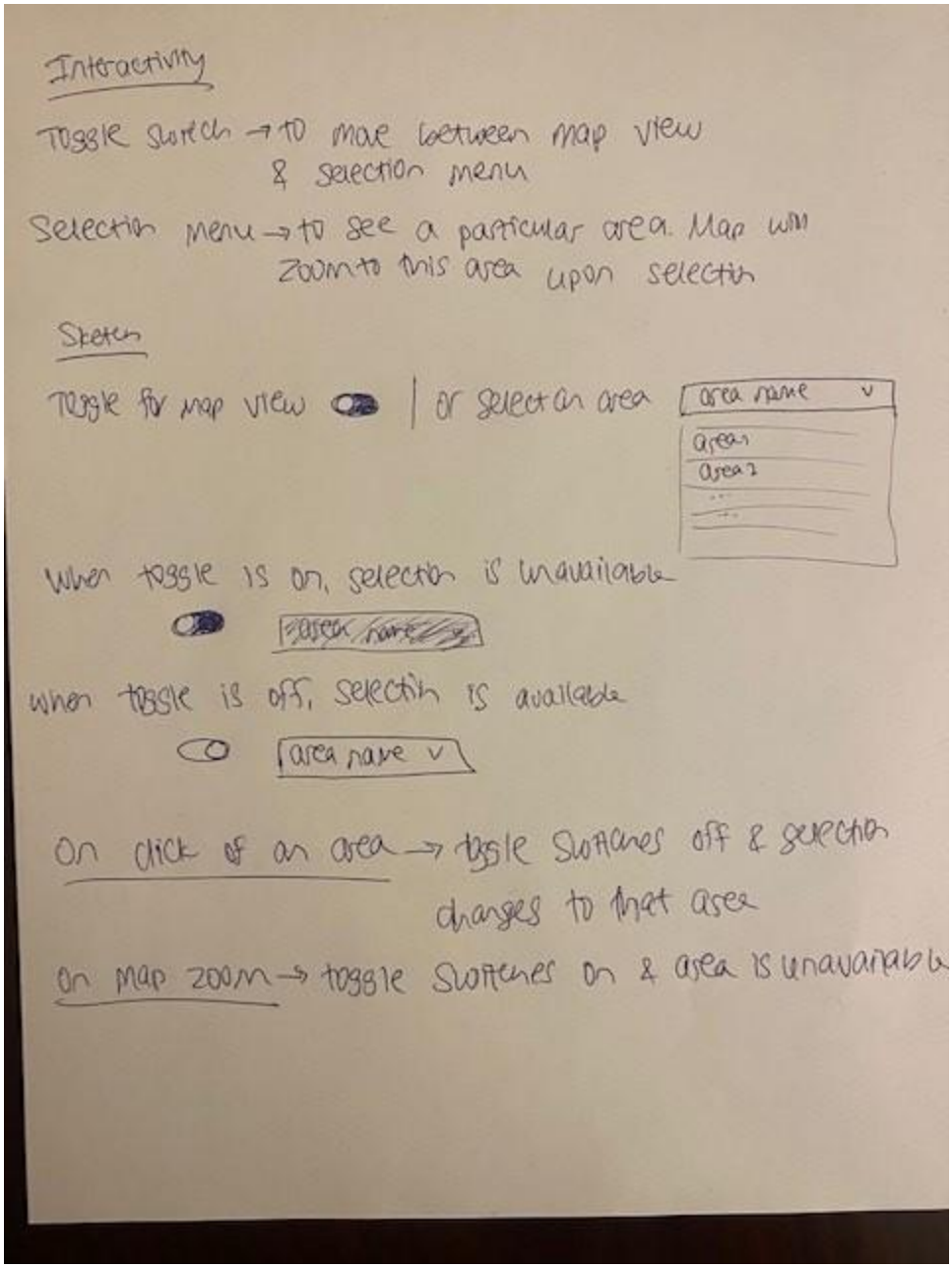


In summary, in the final version the right side infocard contains three visualizations displaying information about the selected areas. There are summary numbers of the total number of boulders and the number of affected boulders. We also have a stacked bar chart showing the total boulder problems and affected boulder problems by grade. Lastly, we have a table displaying each boulder problem and several measures about it, such as the grade, the rating, displayed as 0 to 4 stars, and the number of views on the Mountain Project page. The table allows for sorting by the different columns.

Implementation

We added interaction in a few places. First, we added interaction from the map to the visuals. When you click on an area, the right side infocard data changes to display data from that area and the map zooms in to that area. Secondly, we added interaction so that as you zoom on the map, the bar chart and table will update with the boulders included in the map view.
Next, we added in a toggle switch and a drop down menu. First we designed the drop down menu so that the user could select an area. When an area is selected from the menu, the map zooms in to that area and the right side info card updates with the area's data, same as if you had clicked on that area.

We wanted to be able to differentiate between when the visual is on map view and when an area was selected. We sketched out the idea to use a toggle switch to allow users to switch between these two modes and to make it obvious which mode they were in.

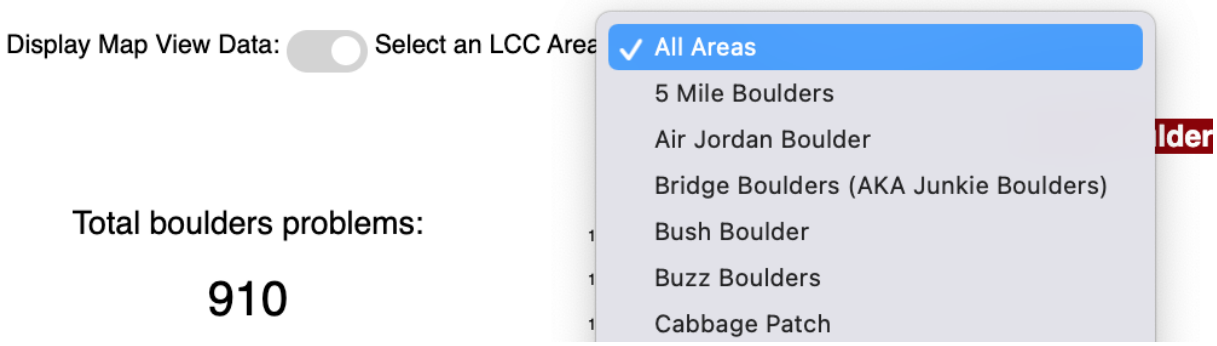


We decided to gray out the selection bar when the toggle switch is on to make it obvious that the visual is in map view. When the map view toggle is turned off, the selection bar text is turned back on to black.

Toggle switch on, map view mode:

Display Map View Data: Select an LCC Area: All Areas

Toggle switch off, area selection mode:



We hope that this user interface makes it clear what data the visuals are displaying. We considered interaction from the right side visuals to the map. We discussed adding a feature so that if you click on a boulder in the table it would highlight on the map. We tried to do this but were unable to add this feature within our timeline.

Evaluation

This visualization brings to light the large impact that the gondola would have on Little Cottonwood Canyon. While we believed the impact to be large, this visualization confirms just how destructive the impact would be.

Across all of Little Cottonwood Canyon, 426 out of 917 boulder problems would be affected by the gondola towers. We hope that this number alone shows the enormous and detrimental effect that the gondola would have on LCC boulderings. The sort feature of the map makes evident how many popular boulders would be affected. Sorting by rating shows that 33 4-star boulders would be affected. Many of the boulders with the highest views on Mountain Project, which indicates their popularity, would be affected.

The ability to display data for specific areas highlights which areas would be most heavily affected. For example, 107 out of 321 boulders in the 5 Mile area would be affected. 125 out of 210 boulders in the White Pine Boulders area would be affected.

We knew that the gondola would have a large impact on LCC bouldering, but we didn't know the extent of the damage. This visualization makes the scale of the impact evident. We hope that this visualization helps convince Salt Lake residents to oppose the gondola. We also hope it is a useful tool for advocacy organizations, such as the Salt Lake Climbers Alliance, to use to advocate against the gondola.