Yosemite National Park – Meadow Trail Proposal

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University of California – Merced | ENGR 180

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Mission Statement:

The Daniels Engineering Firm is one of the top-rated engineering firms in the country dedicated to a clean, concise, and considerate building process. We employ only the most environmentally friendly and most efficient NSPE approved methods of practice. We are unparalleled in our attention to detail and overall customer satisfaction.

Here is an example of the type of quality we offer:

Costumer Testimonial of the project shown above:
"I was shocked to see the finished product; the Daniels Engineering Firm is so young but offers the same quality offered by Firms 100 years their senior. This new trail has made memories to last a lifetime!" - Client A

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Introduction

This project is designed to actively challenge the students grasp of ArcGIS Pro and various Geological methods of surveying, cartography, and statistics. Students are tasked with the creation and justification for a new trail to be added to Yosemite National Park. The student acts as a third-party contractor (a fake Engineering Firm has been created) who is tasked with creating a trail proposal. The criterion of the project is firmly stated within the final project instructions[1] provided by the instructor.

Necessary Requirements

To summarize the most important parts, a trail of at least 1km in distance must be surveyed and outlined on a map depicting a border of Yosemite and the surrounding areas' elevation statistics. It is important to note that the trail may not be created in the Northern section of Yosemite. The trail must also allow for disabled persons accessibility through the ADA Accessible Parking Standards.

One bigger portion of the criterion is to include 2 different additional data layers (SHPE Files, GBD files, etc..) that will provide more of an insight as to why the location was chosen for the trail. As for the purposes of this proposal, the region chosen is in the lower left section of the Yosemite boundary, between the Old Glacier Point Road and thew Deer Camp Road Trailhead. This region was chosen due to the scenery it provides the visitor.

[1] Instructions in question were developed and provided by Angel Fernandez Bou, Brittany Lopez Barreto during the 2021 Spring Semester.

Guidelines and Specifications

ADA and ABA Compliance Guidelines

In brief, the ABA Accessibility Standards govern the way trail makers must develop and implement trail standards. In specific Chapter 10, Section 1017 "trails" details certain requirements that trails must incorporate. The ADA Accessible Parking Standards doles out requirements every US public space (including parks) must incorporate to allow for equal treatment of disabled persons.

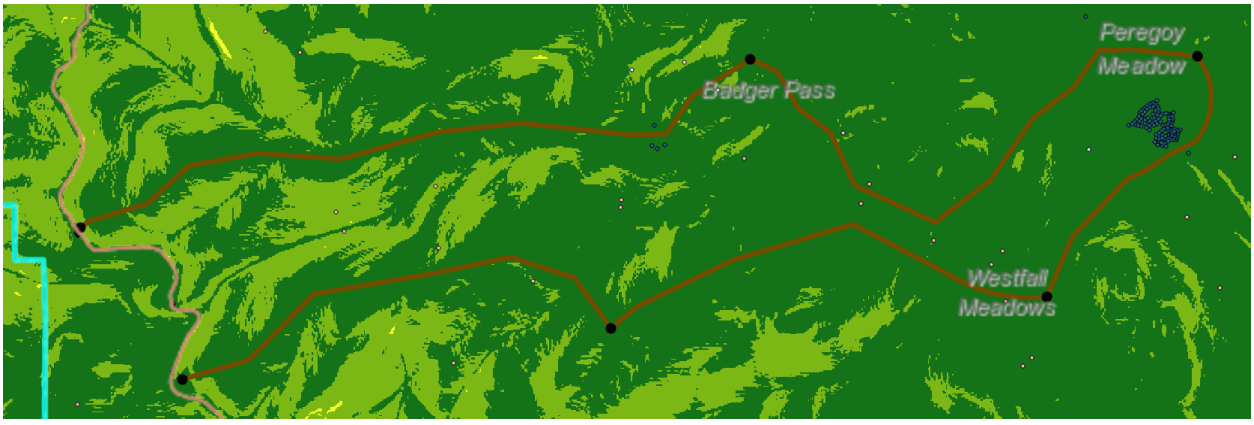
ABA Trail Standards

The [2]ABA Trial standards are specific in topics of elevation, trail length, rest stops and another various trail related issues. One very important rule followed during the creation and production of the trail was the running slope and grading requirements.

[3]To include: (Figure 1)

Table 2 - Maximum Running Slope and Segment Length		
Running Slope of Trail Segment		Maximum Length of Segment
Steeper Than	But Not Steeper Than	
1:20 (5%)	1:12 (8.33%)	200 feet
1:12 (8.33%)	1:10 (10%)	30 feet
1:10 (10%)	1:8 (12%)	10 feet

As is shown there cannot be a length of a certain distance in between two different sets of slopes. As for the creation of the Meadow Trail, very careful considerations were considered with respect to the slope requirements set by the Access Board. If you look at the map layout in the [4]Visual Components section of this report, you will notice how green the layout is, this is because the region chosen is very flat in nature. Very few slopes greater than 5% were shown to exist in the trail's region. Here is an example of the Elevation Dataset acquired from the given [5]TIFF file. (Early implementation of trail – Figure 2)



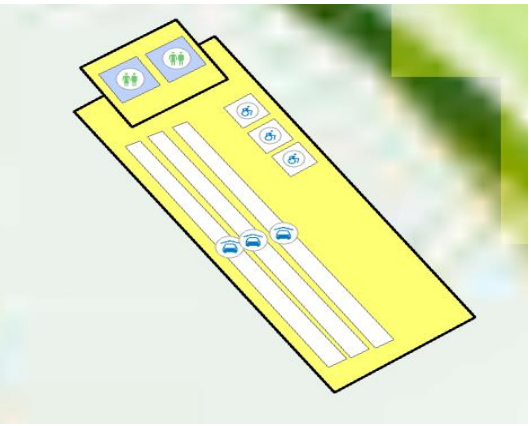
[2] ABA standards are managed by the United States Access Board.
[3] ABA Running Slope Table, from Chapter 10 section 1017 "Trials."
[4] Visual Components features all map layouts.
[5] The TIFF dataset was incorporated into this project to determine elevation.

A screenshot showing the proposed trail and the TIFF dataset elevation output. Lighter green indicates a 5% slope, Darker green features less than 5%. (Figure 2)

In addition to having a mostly flat trail, considerations to the Informational Sign were also made to be in accordance with [6]sections F216 & 1017.10 of ABA Chapter 10. As for the calculation of the Trail Information Sign, many considerations regarding the actual slope of the trail (<5%) and from outside [7]contractor sources. It has been determined that the proposed trail follows common standards, to view the facts about the signs please view the Visual Components section of this report. Resting intervals were also very important to include in the production of this trail. Since the trail is long in nature and has certain intervals of slopes >5%, adding intervals of rest were relatively easy. In fact, the trail was not made to be a difficult trek, its meant to be scenic. If you

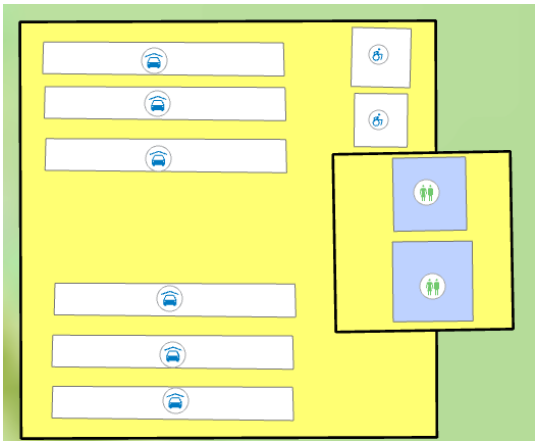
ADA Accessibility Standards

The ADA Accessibility Standards were made to honor the [8]Americans with Disabilities Act of 2010, which set standards public businesses and entities had to abide by. Parks are no different and as a result must also provide accessible services to disabled persons. For instance, for every parking lot with 25 parking spaces (or fewer), must there a spot for a disabled persons vehicle and one for a van. The spots must also be as close to the destination's facility as possible. Considerations for disabled persons were proudly considered and implemented into the final design. Please view the map layout in the Visual Components section to see the accommodations. Here are some examples:



Updated Parking Lot 1 – With ADA Approved Restrooms and Parking Spaces (Figure 3)

[6] Depicts requirements of the Trailhead information signs.
[7] Common Trail production practices provided by the National Parks Service.
[8] An act to provide equal opportunities to disabled Americans.



Updated Parking Lot 2 – With ADA Approved Restrooms and Parking Spaces (Figure 4)

Location Description

Trail Location

As stated in the introduction, the trail is in the lower left section of the Yosemite boundary, between the Old Glacier Point Road and thew Deer Camp Road Trailhead.

Elevation, Landscape, and Distance of Trail

The surrounding landscape of the trail is mostly that of a flat land consisting of Meadows, there are 3 located on the trails route. According to the National Parks Service the primary vegetation found in these meadows are Ferns and other [9]herbaceous species of plants. In fact, the Meadow is thought to be its own live ecosystem, that consists of plants, and a filter system offering substance to several species of animals in the area. Water is filtered out by layers of soil sediment creating fresh drinking water for the local wildlife.

The trail itself is more than 19km long, from parking lot 1 located at the Deer Camp Road Trailhead entrance and ending along the Deer Camp Road. It makes up most of its distance navigating across the Rail Creek, Bridalveil Creek, and Indian Creek waterways. The biggest attraction and focal point of the trail is the incorporation of a [10]scenic view by passing the Westfall, Peregoy and the Monroe Meadows. Since Meadows only account for about [11]3% of Yosemite's total area, the decision to choose this region to build a trail was unanimously supported.

Another driving point of the trails soon to be popularity was incorporating the navigation to a campground called the Bridalveli Creek Campground, which for specification's sake will be considered as a set infrastructure. Traffic is sure to ramp up during the camping seasons.

[9] Known as plants that have non woody stems.
[10] View the Map Layout to view the "Scenic" incorporation.
[11] According to the National Parks Service/

Datasets

Vegetation Points of Interest

Description and Acquisition of Dataset

This dataset lays out previously surveyed "High Resolution Polygon Maps" that depict vegetation within the Yosemite Map Boundary. There are hundreds of plots, which are not necessarily specified, across the Yosemite boundary. Labeled "Yosemite Vegetation Points" within the map legend, the primary focus for acquiring this data had to do with the rationale of a Meadow. Since a Meadow is an ecosystem consisting of many different types of plants, it only seemed fitting to gather some data on those plants. After collecting the open-source data, it was applied to the map and almost suddenly could plots be pointed out near the meadows. This serves as a point of attraction for the trail's scenery.

Acquiring of this dataset, was quite simple. We were looking to acquire official NPS datasets (either SHIP files or GDB's). The greatest resource in those efforts was to search up the NPS resource database (which will be properly cited after this section concludes). The search field was specified to Yosemite National Park, and "Vegetation" was entered in the criteria. A GBD download link from 2007 was acquired and promptly applied to the map.

Yosemite Points of Interest

Description and Acquisition of Dataset

This dataset displays, different locations of visitor interest across the Yosemite map border. It spans even across the region of the trail, and may display landmarks, restrooms, stations, parking lots and other visitation locations in Yosemite. The primary focus of the inclusion of this dataset was to reinforce the idea of the trail being popular one day. We had already established that the Meadows would create the scenery, but another driving point was the discovery of the nearby campground. Which in fact spawned more than 30 different plots on the map.

This dataset, like the Vegetation points of interest, was acquired by accessing the NPS resource database. After accessing the database, all that was needed to do was specify the search criteria to Yosemite National Park and typing in "points of interest".

Sources for Datasets:

Source Citations

National parks Service. (2007). *Data Store*. Retrieved from Integrated Resource Managementr Applications: https://irma.nps.gov/DataStore/Reference/Profile/2252295

National Parks Service. (2015). *Data Store*. Retrieved from Integrated Resource Management Applications: https://irma.nps.gov/DataStore/Reference/Profile/2225064

National Parks Service. (2021, May 14). *Data Store* . Retrieved from Integrated Resource Management Applications: https://irma.nps.gov/DataStore/

Original Data

All original data refers to the Datasets Provided to the firm by the Clients; TIFF File (for Elevation and slope), Yosemite Boundaries Feature Class (to depict the region in which building could occur). All data other than the data stated is either created by the firm or retrieved by an online source and properly has been cited.

Methods

Data Management

In the beginning stages of this project, it was important to point out a focus for development. What did the firm want to get out of the trail, what do we want visitors to experience? So as mentioned before, 2 distinct datasets were collected. We applied the sets onto a blank USGS Topo map and there our project took base. We also took the two provided datasets, provided by the client, and analysis the TIFF file to discover our elevation values. Which was key to determining slope and our overall location of the trail. After processing the TIFF file with the Slope analysis tool and applying the later to the USGS Topo map at a transparent setting, we were able to create a new layer to depict steep slopes or flat ones. After collecting that set of data and the 2 NPS provided datasets and applying the Yosemite Boundary layer, could the firm begin to deliberately create the several Feature classes (which allows us to make layers for lines, points, and polygons) to build the trail, the buildings and stylize the map.

Map Projection

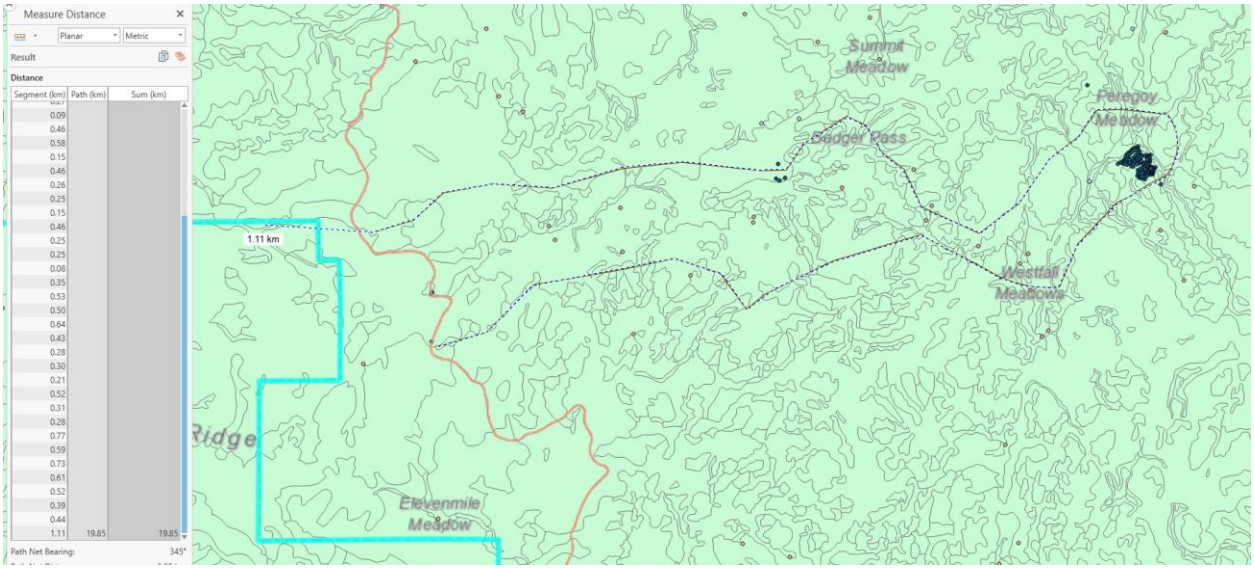
This map, as dictated by the client, had some specifications applied to it. The firm had to take what was essentially a world view map and condense it to one region within the Yosemite Park boundary. On top of doing that, we also had to create new map layers to hold 8.5 x 11in landscape maps, depicting detailed and specific sections of the newly created trail. All the map layers can be seen in the Visualization section of this paper. Each map layer had to include a fitted bookmark of the original map. Once the bookmark was fitted to the map layer, could the layer be stylized to show a legend, compass, etc.…

Geoprocessing Tasks

There were not much advanced geoprocessing tasks going on in the creation of this trail. One big tool task was analyzing the TIFF file given to us to depict slopes and elevation. That implementation was crucial if we wanted the trail to stay within ABA standards. Individual modeling was the primary method of creating our 2D models of the buildings, parking spots, the trail and various other models included in the map. Another big tool used in the creation of our distance accuracies, was the “measure” tool, where models were abled to be measured for their sizes in Sqft of course. Here is a table of data created with the measure tool.

	A	B
1	Measurements	
2		
3	Parking Lot 1	
4	Area ft^2	6,600.48
5	Bathroom Area	
6		1,168.00
7	Parking Lot 2	
8	Area ft^2	5,933.30
9	Bathroom Area	
10		820.63
11		
12	Rest Area 1	
13	3,819.56	
14	Rest Area 2	
15	1,208.61	
16	Rest Area 3	
17	2,688.56	
18	Rest Area 4	
19	2,506.78	
20		
21	ADA Spot Size	
22	102.51	
23	Restroom Sizes	
24	245.52	
25		
26	ABA Signs	
27	120	
28		
29		
30	All in Square Feet	
31		
32		
33		
34		

Data table including all measurements in sqft. (Figure 5)



A photo showing the measurement process, using the measure tool. (Figure 6)

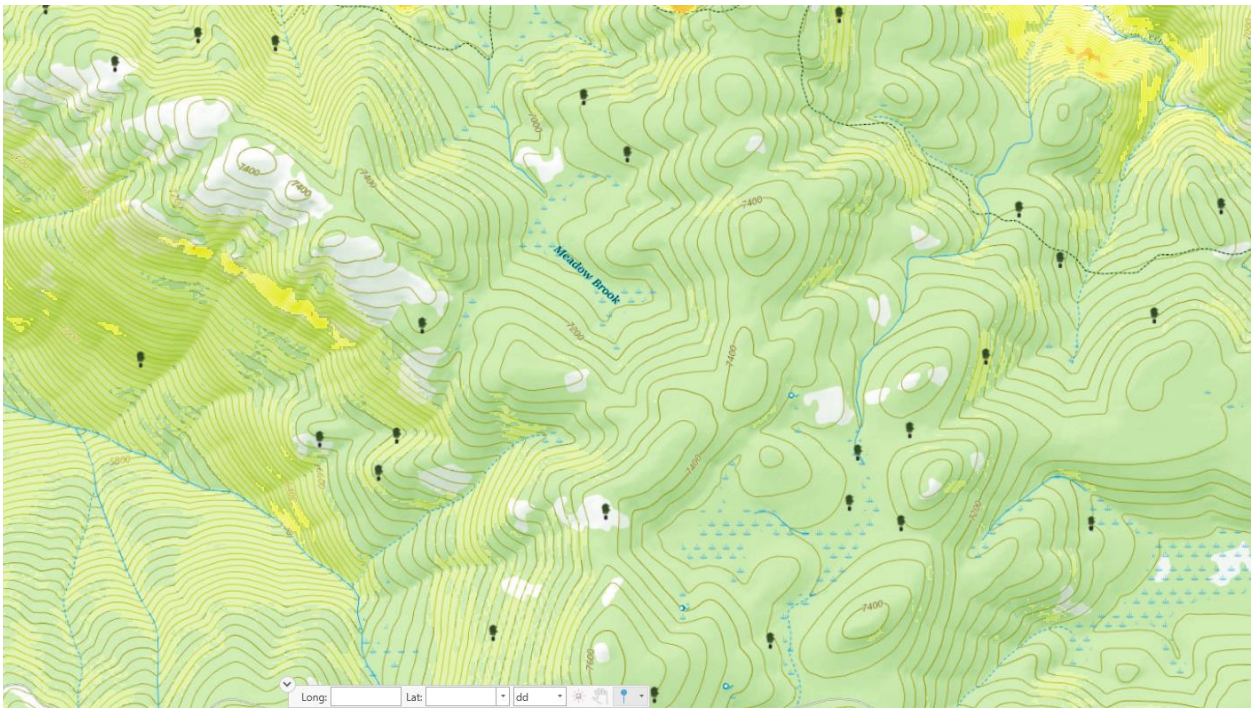
Selection of Suitable Sites

Errors before final selection

The selection process that ultimately led to the decision to create the Meadow trail, came from a huge error in part of the firm. We initially wanted to go around another set of meadows, and while we had a preliminary set of lines drawn to represent the trail, unfortunately it was all lost die to a computer issue. While in the moment this was devastating to the firm, it turned out to be our saving grace, we relocated to Deer Camp road and found the region in which the current trail was developed in.

Selection Process and Ranking Scheme

The selection process was limited to a flat open area, which in turn made the firm become more creative in the cultivation of a trail. As development continued, we were graced with a dataset including all the existing Yosemite routes, and in fact they were all condensed to the Merced River. Part of our search criteria was going to be scenery, if the route includes nothing to be considered scenic, it would not be considered at all. All these criteria pointed to the meadows as discussed before, then the laborious process of developing a trial while keeping with ABA standards began. One very suitable site included Meadow Brook, which offered all we wanted except for much in scenery. This is an example of the region in question:



As you may see, it is rather flat, but lacks in scenic views or landmarks. (Figure 7)

Ranking System

Contrary to most firms, the engineering staff did not incorporate a ranking system, we wanted to be as open in any suggestion made by the team. We only stuck to a set of criteria and kept scouting the map to find a region that would fill all the criteria spots.

Final Recommendations

Final Plans for the Meadow Trail

While development has been going smoothly, regarding having selected a region and a premise to the trail. We also had to consider "comfortability" of the trail. Will visitors really want to walk 19 kilometers, the answer is yes but only if they are helped along the way. For that reason, the firm has decided to not only do the minimum of including a parking lot with ADA accessibility, but we also went above and beyond to incorporate comfort with our trail.

We added an additional 4 rest stops along the length of the trail, all of which abided by ABA standards for [12]resting intervals. The 4 stops will all include restrooms, a water station, and an informational sign. In fact, while determining where to place our stops, we strategically placed each stop at a distinct location along the trail. For example, stop 2 is set right outside Peregoy Meadow, which not only offers a point of rest but also that of a scenic view. Who would not want to rest with a view?

As for the information depicted on the informational sign, we must disclose the locations of the 6 different signs we have built. There are 2 at the parking lots, and 4 for the rest stops (1 at each stop) and to make things even more simplistic, we have decided to keep them all exactly at ABA standard. An example of what the sign depicts is found on the main map layer in the visualization section at the end of the report.

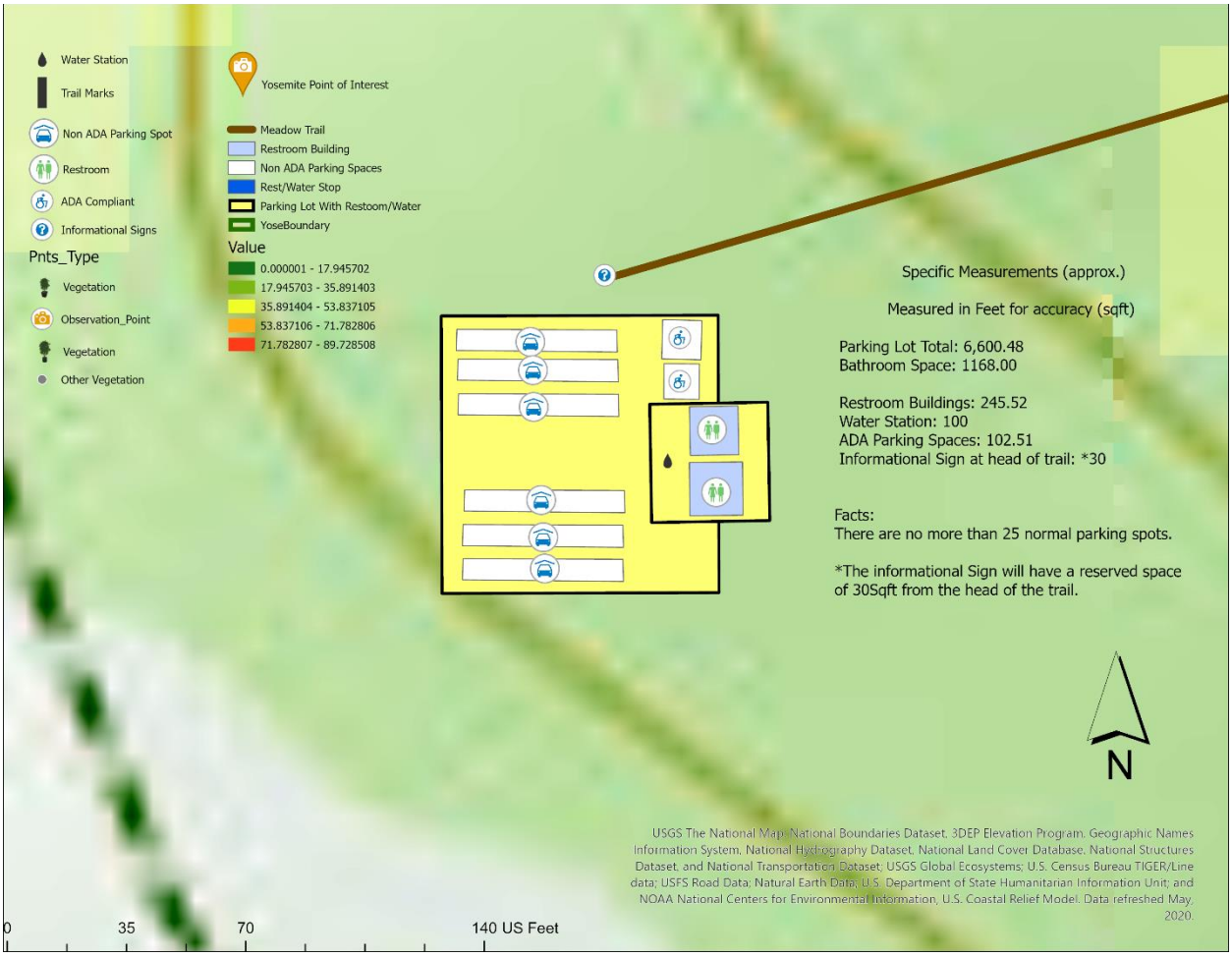
The most frustrating process of creating this trail was to decide upon adding more stops than the 4 we already created. That is because of 2 reasons, inclusion, and safety. We wanted to make sure anyone could embark on an adventure on our trail, adding more stops would facilitate that and safety is very important. What if it gets to hot and a visitor who is missing water is 10 kilometers out on the trail, the stop could be that person's lifesaver. The ultimate decision to create 4 instead of more rest stops ended upon the realization of probable funds being allocated to the creation of a stop. We believe the biggest cost to creating the trail would be the facilities created at these stops, including the parking lots.

Our final product stands at 19.85km, with 4 rest stops, 2 parking lots, 6 informational signs, and a scene that will last a lifetime.

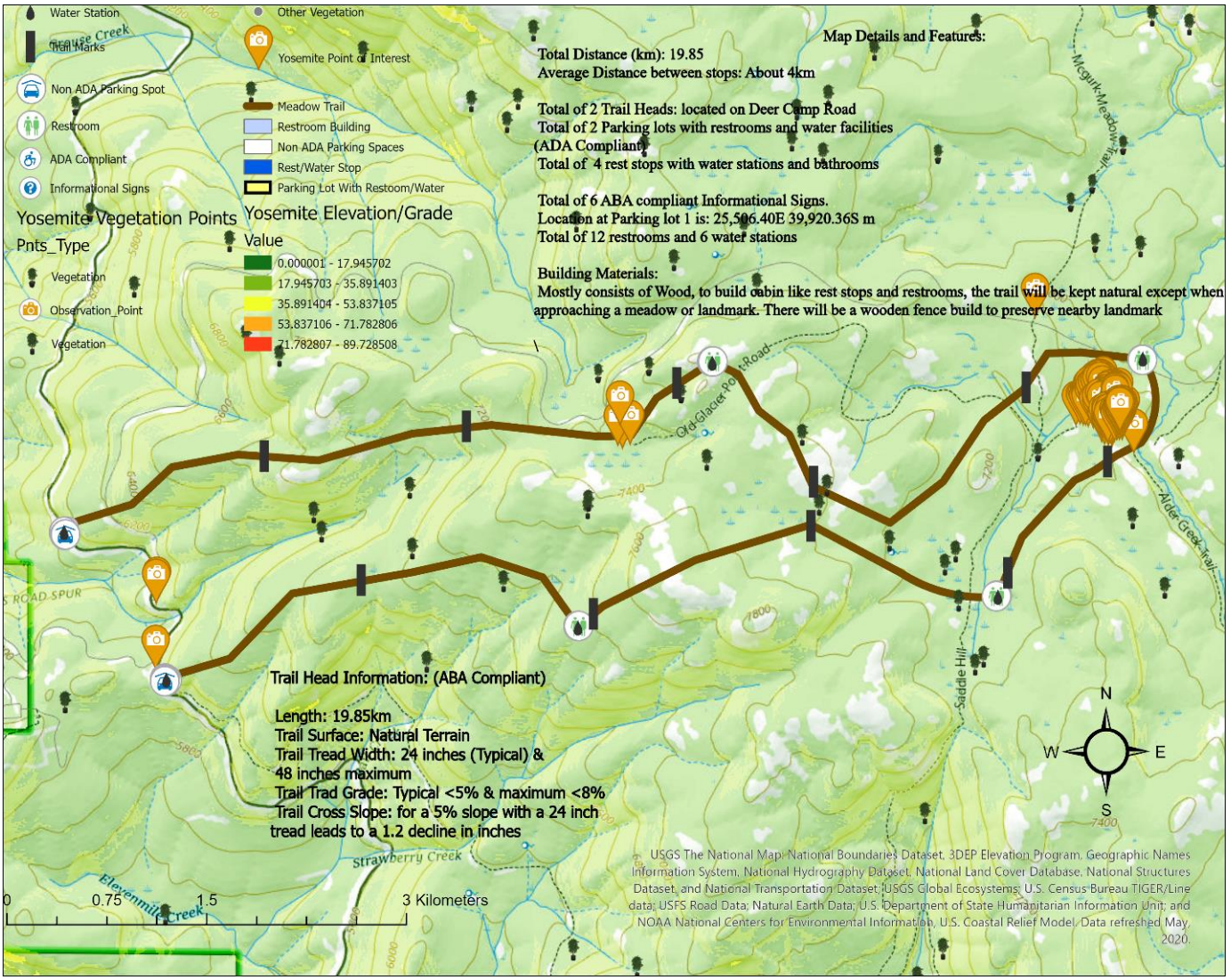
[12] A necessary interval where there are no steep climbs for a distance.

Visual Components

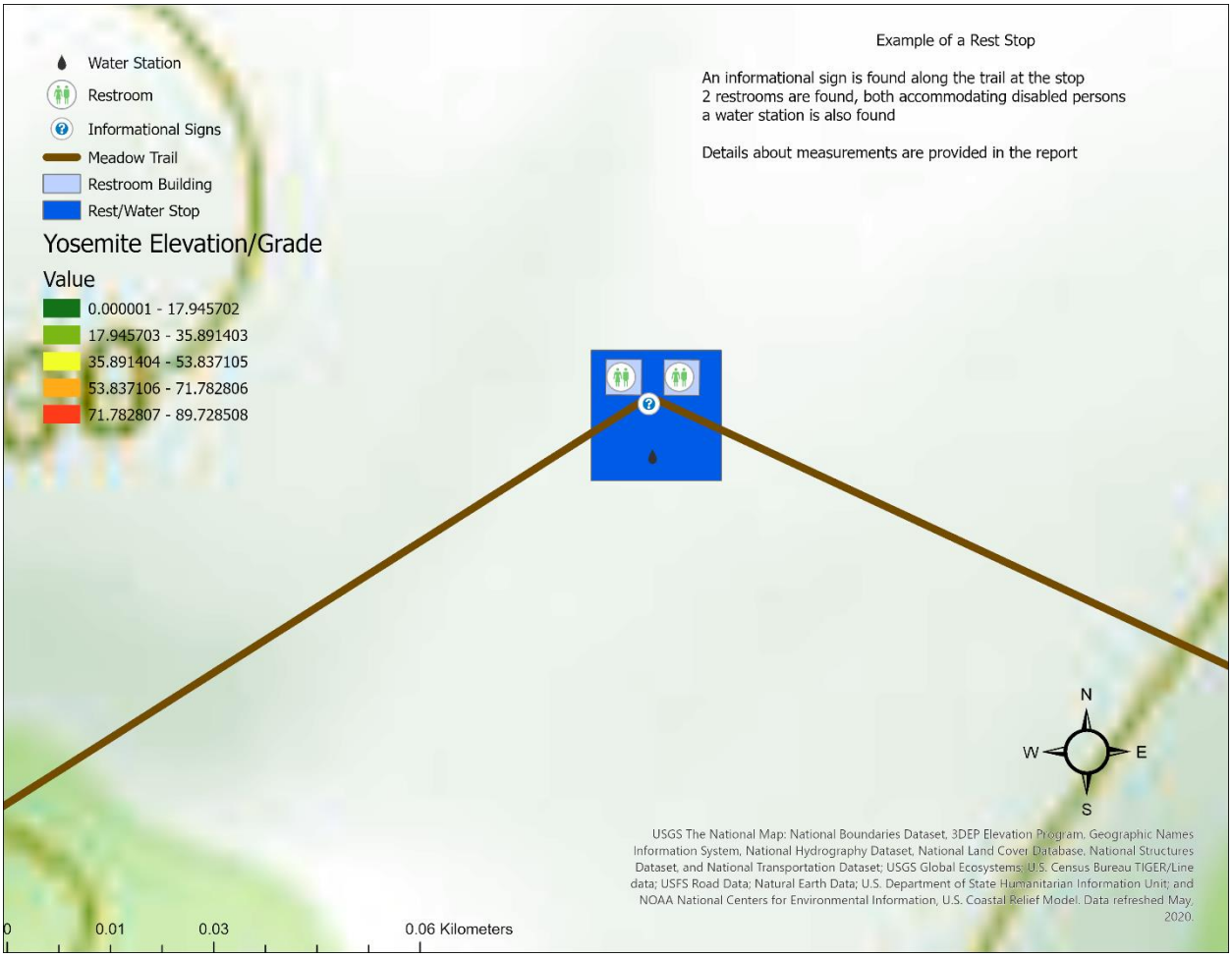
Maps and Explanations



A Map Layer depicting how the ABA parking lot and restroom system works. (Figure 8)



The Main Map Layer, depicting the trail in its final status. (Figure 9)



A Map layer depicting one of the 4 distinct rest stops. (Figure 10)

Bibliography

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U.S Access Board . (2021, May 14). *Guide to the ABA.* Retrieved from U.S Access Board: https://www.access-board.gov/aba/guides/chapter-10-outdoor/#trails

Footnotes List

1. Instructions in question were developed and provided by Angel Fernandez Bou, Brittany Lopez Barreto during the 2021 Spring Semester.
2. ABA standards are managed by the United States Access Board.
3. ABA Running Slope Table, from Chapter 10 section 1017 “Trials.”
4. Visual Components features all map layouts.
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