Supervised Classification Analysis & Multi-Date Comparison

El Dorado Hills, CA

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GEOG342 – Spring 2021

Purpose and Goal

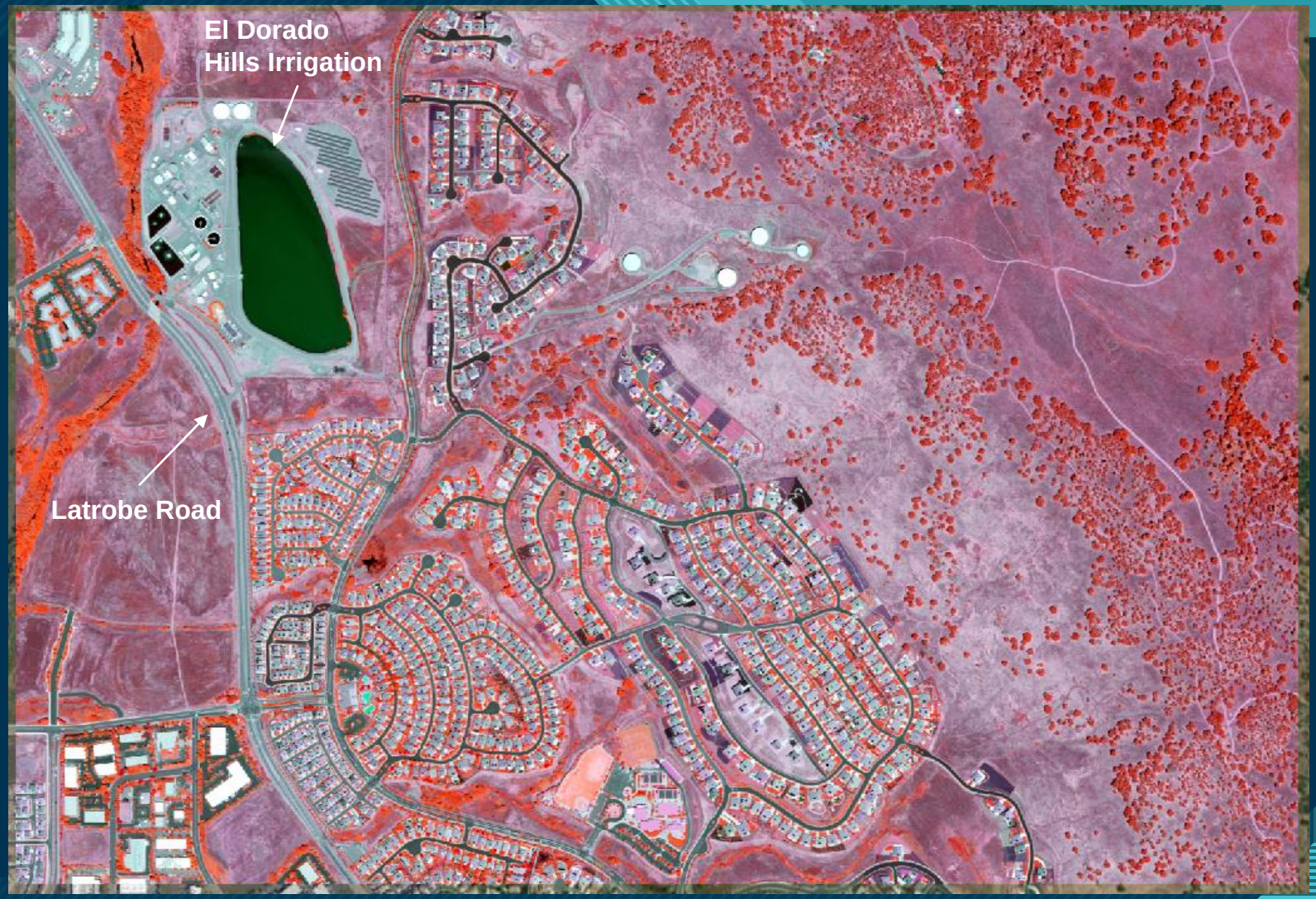
I will be using the Classification Wizard to complete two supervised image classifications, using NAIP imagery from two different years of a developing area of El Dorado Hills, CA. Using imagery from 2016 and 2020 I plan to capture the significant growth of certain areas from barren and herbaceous grassland into developed suburban neighborhoods. Both classifications will go through the reclassification process, with the greater focus being on the 2020 imagery. In addition to basic NLCD2011 classes, I will also include a “Shadow” class to capture shadows created by foliage and buildings. Once I have completed the thorough reclassification of the 2020 image, I will be conducting an Accuracy Assessment to test my results followed by a zonal statistics comparison between both finalized classifications.

2016 NAIP Color Infrared Image

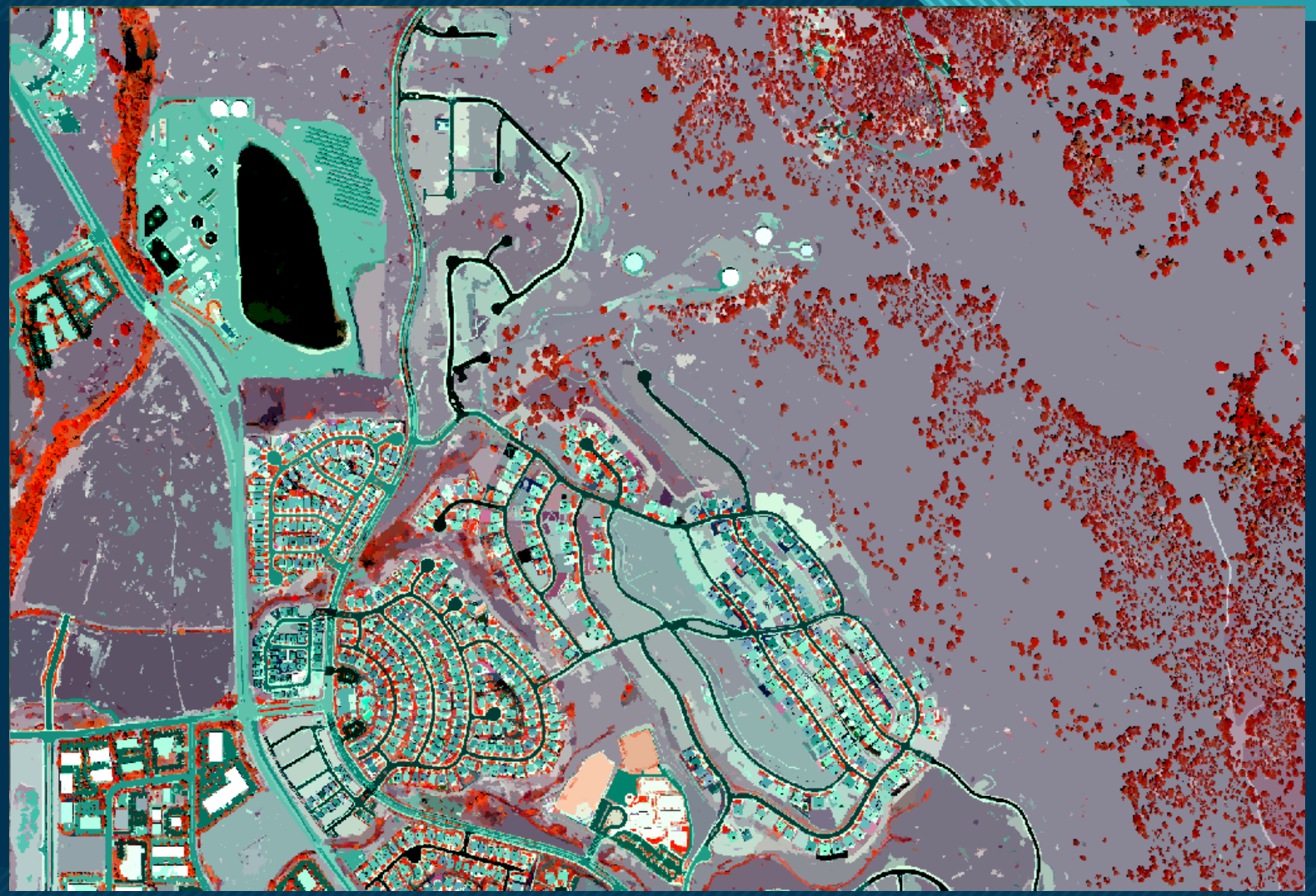
- NAIP 2016 CIR 60-CM resolution aerial imagery of California, limited to a small section of El Dorado Hills, CA.
- Bands updated to:
  - Red: Band_4
  - Green: Band_2
  - Blue: Band_1
- Coordinate System:
  - WGS 1984 Web Mercator (auxiliary sphere)
- Image is created as a .tif file to be segmented for classification

2020 NAIP Color Infrared Image

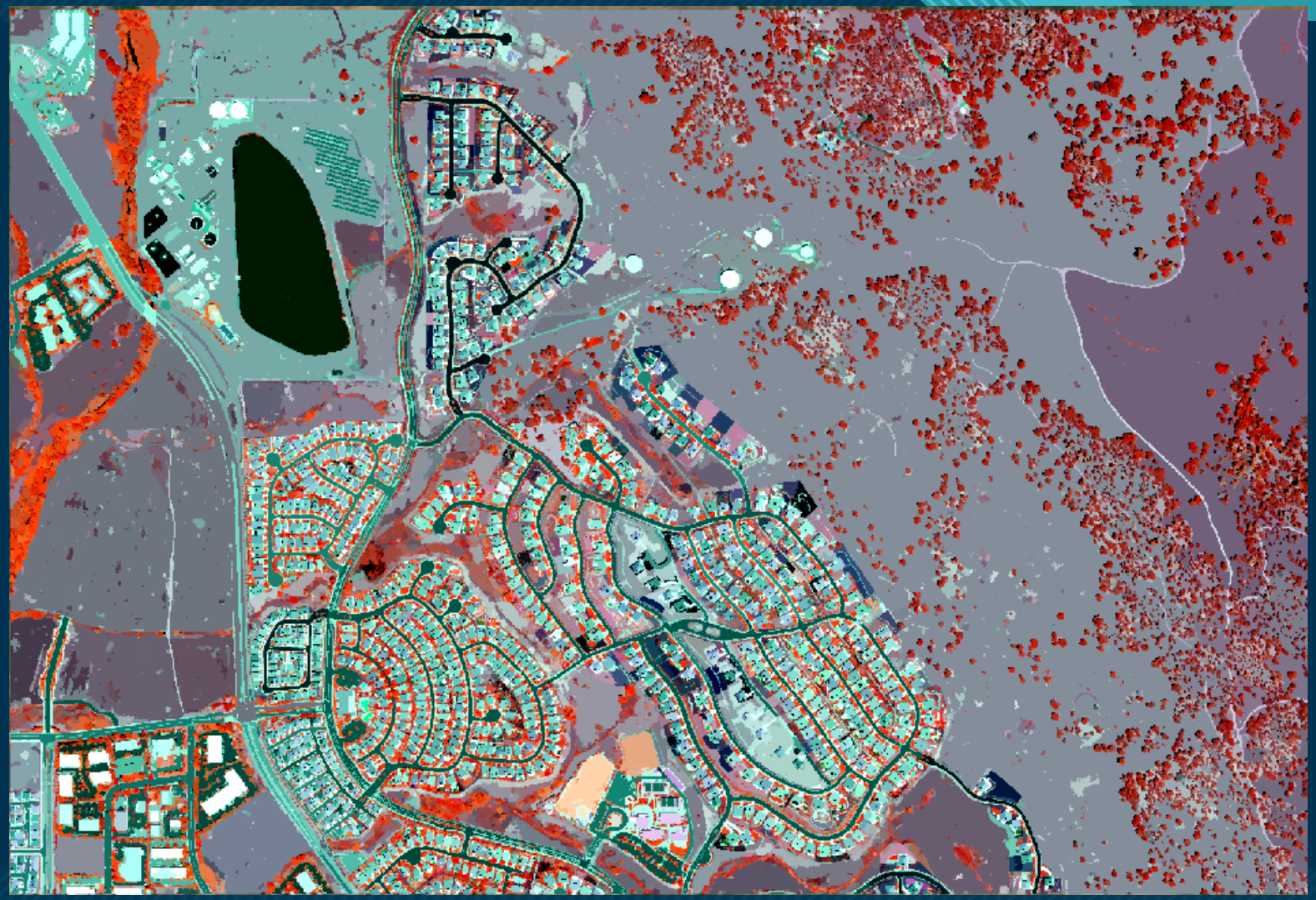
- NAIP 2020 CIR 60-CM resolution aerial imagery of California, limited to a small section of El Dorado Hills, CA.
- Bands updated to:
  - Red: Band_4
  - Green: Band_2
  - Blue: Band_1
- Coordinate System:
  - WGS 1984 Web Mercator (auxiliary sphere)
- Image is created as a .tif file to be segmented for classification



2016 NAIP Segmented Image

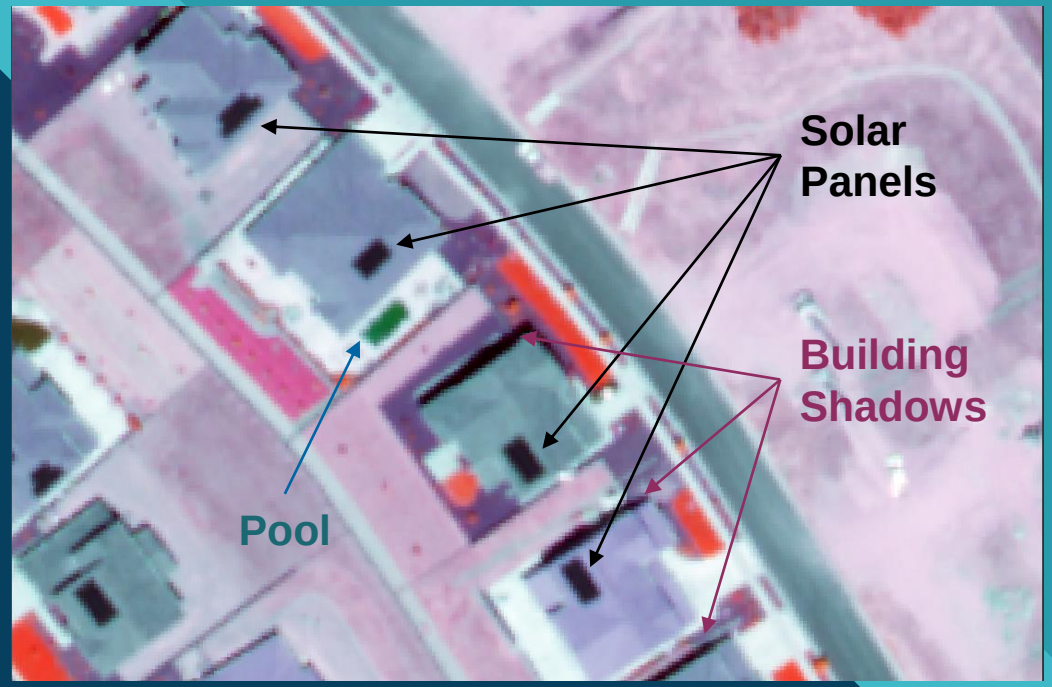


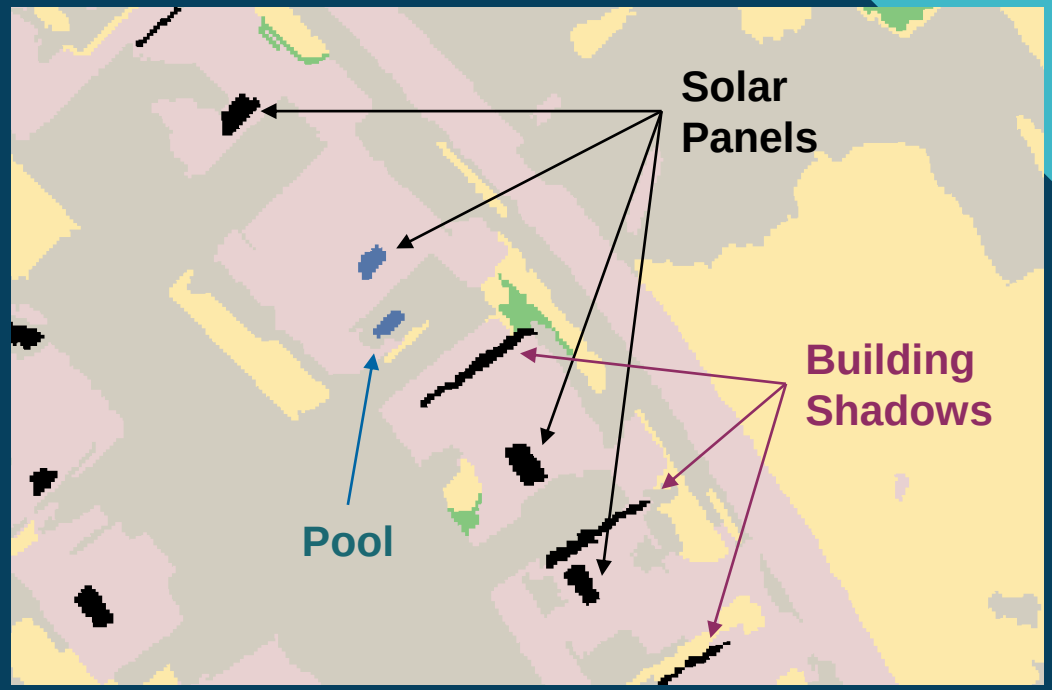
2020 NAIP Segmented Image

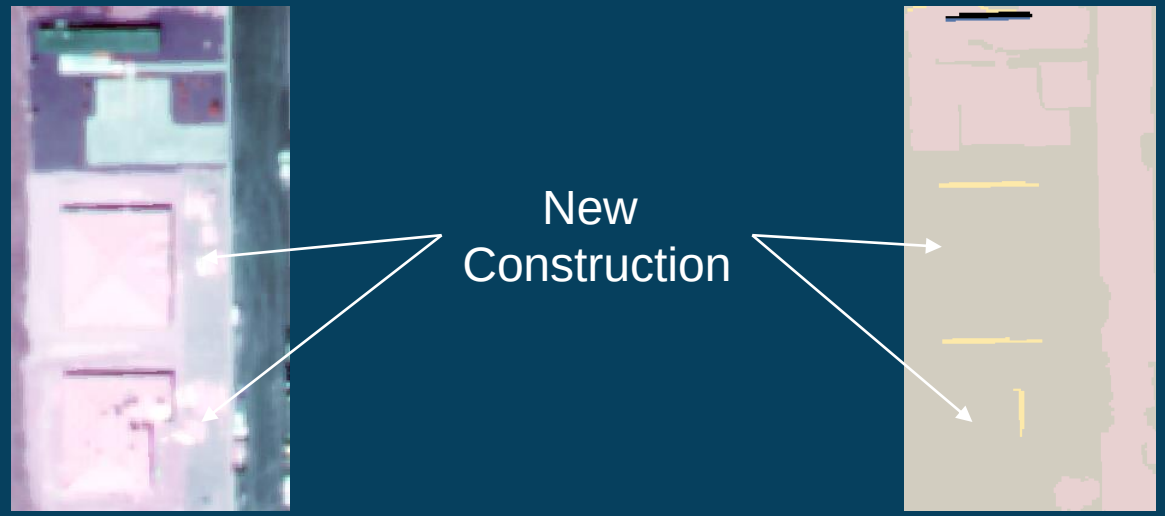


Reclassification Focuses

- Suburban areas required the most focus during reclassification
- Solar Panels were often classified as shadows or water due to closeness of training examples
- Due to the drier climate and the time of year both images were taken, barren land and dry grass were difficult to distinguish between each other
- Plots in the beginning stages of development, with limited construction, constituted a large majority of “Developed” reclassification

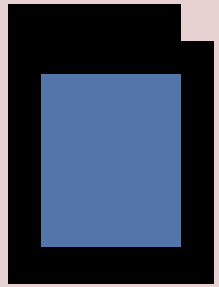




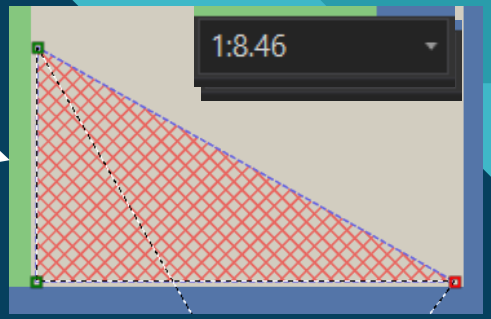


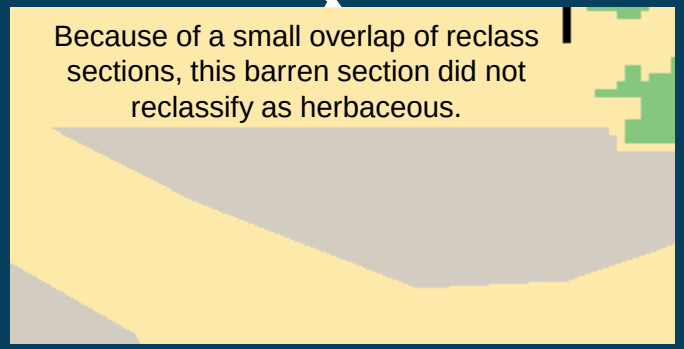
Reclassification Difficulties

- Multiple areas had classifications within one and other making it difficult to reclassify
- While reclassifying I had to fully zoom in on certain areas in order to prevent inaccurate reclassification
- I had to pause between reclassifications over time as the count increased due to slower performance
- Too many reclassifications eventually began switching “New Class” outputs from what was selected
- Small overlapping reclass sections prevented larger areas from reclassifying

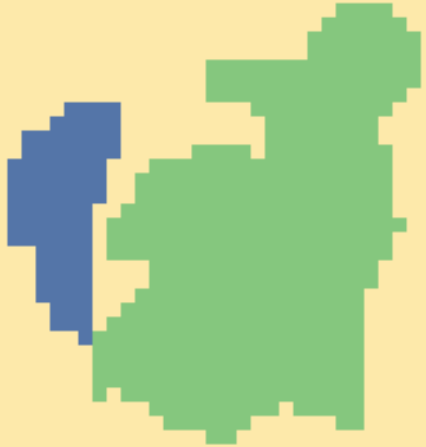


A solar panel was classified as both Shadow and Water instead of Developed.



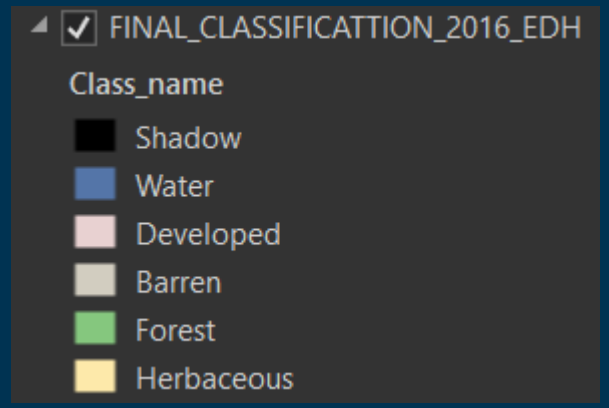


Because of a small overlap of reclass sections, this barren section did not reclassify as herbaceous.



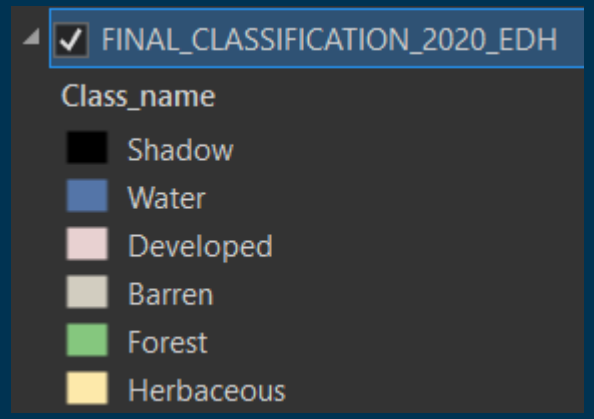
Shadow was changed to water while working on herbaceous.

2016 NAIP CIR Image Final Classification



- Supervised Classification Method
- NLCD2011 Classification Schema
- “Shadow” class created to capture shadows created by foliage or buildings
- Fifteen training samples collected from the segmented image each class

2020 NAIP CIR Image Final Classification



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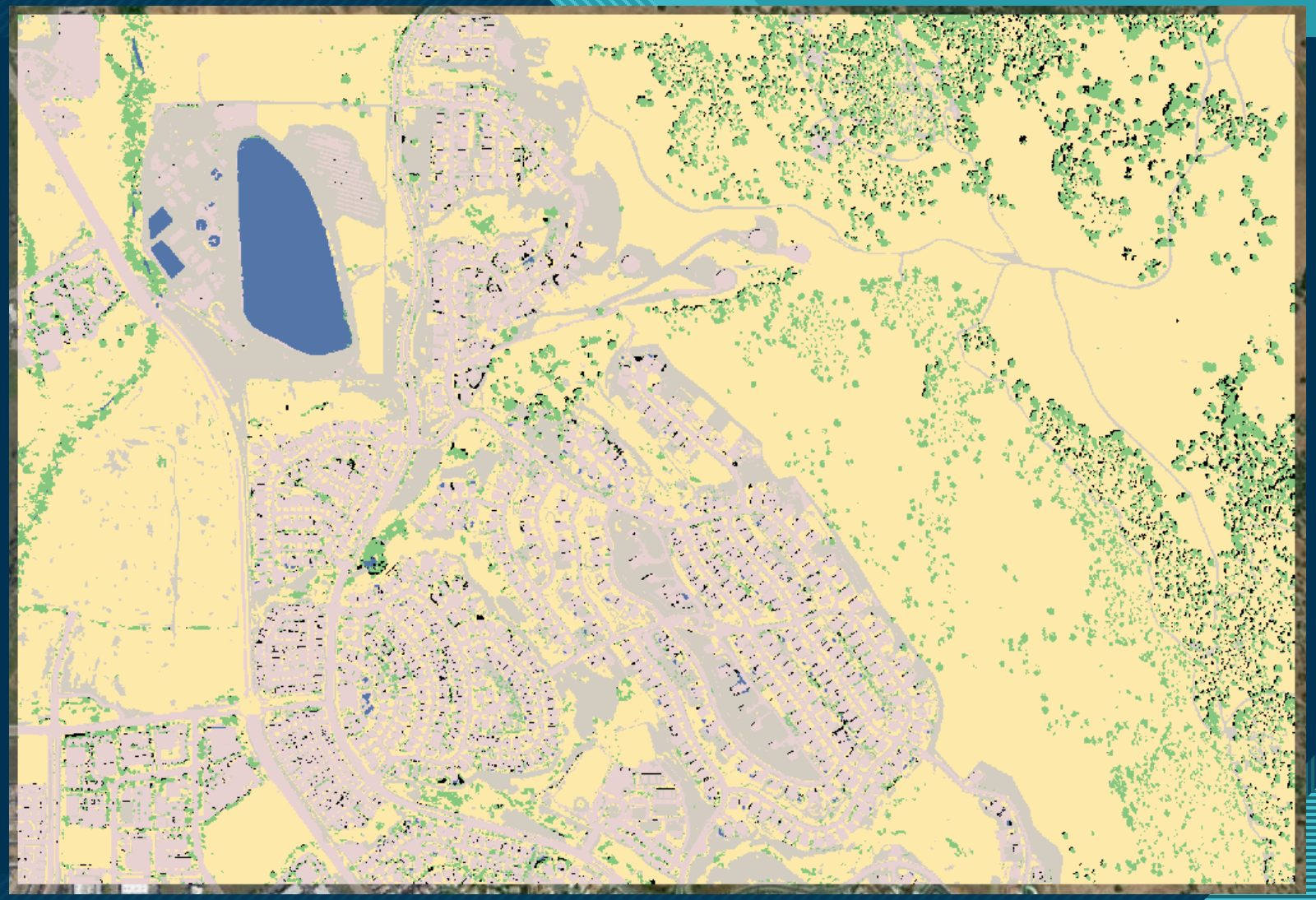
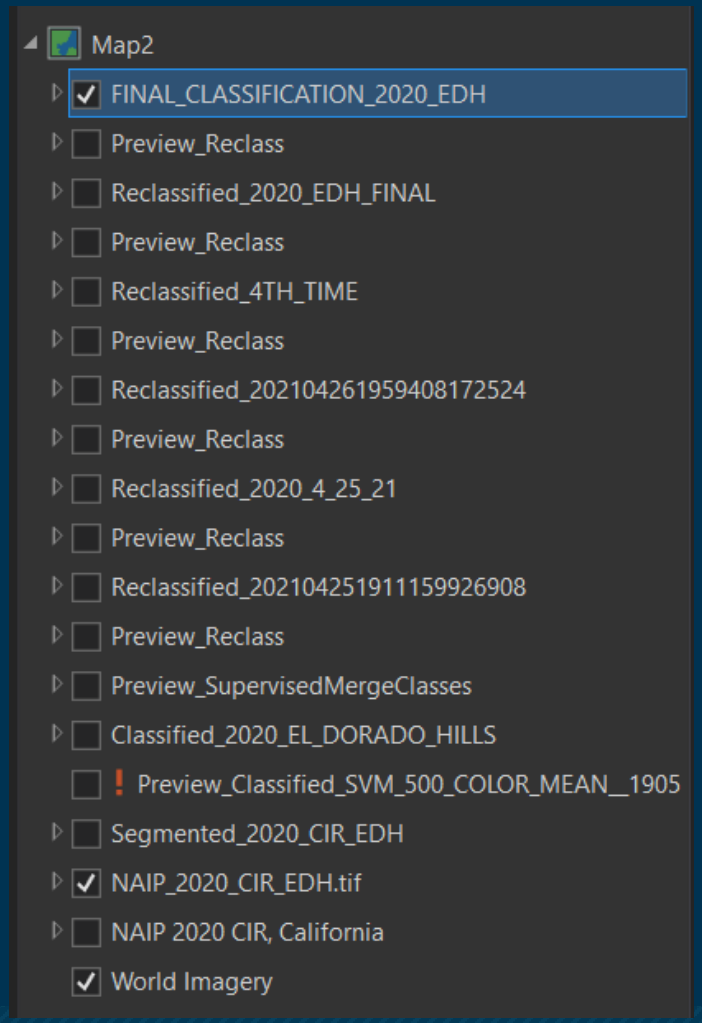


Resolution Methods



- For larger areas that had been incorrectly reclassified, either by technical or human error, I reverted to an older classification to start over from (I only did this a few times because of so many reclasses done in certain sessions)
- Limited reclassification sessions to roughly twenty or so areas/features in order to avoid errors and slower performance
- Focused on one class, area, and feature per session (solar panels, artificial grass, bark, etc.)
- Areas that were too small to be of significant value, I left as is to focus on larger areas
- In all, I performed one reclassification on the 2016 imagery, and six reclassifications on the 2020 imagery with the possibility for more

Accuracy Assessment on 2020 Classification

Shadow
Water
Developed
Barren
Forest
Herbaceous

ConfusionMatrix_Accu...essment_Results

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OBJECTID *	ClassValue	C_0	C_10	C_20	C_30	C_40	C_70	Total	U_Accuracy	Kappa
1	C_0	6	0	0	0	0	6	12	0.5	0
2	C_10	0	107	0	0	0	0	107	1	0
3	C_20	2	1	13	5	0	2	23	0.565217	0
4	C_30	0	1	2	33	0	27	63	0.52381	0
5	C_40	0	0	0	0	9	0	9	1	0
6	C_70	2	1	0	2	1	298	304	0.980263	0
7	Total	10	110	15	40	10	333	518	0	0
8	P_Accuracy	0.6	0.972727	0.866667	0.825	0.9	0.894895	0	0.899614	0
9	Kappa	0	0	0	0	0	0	0	0	0.823077

- 15 Training Samples collected for each class
- Both User and Producer's accuracy for the Shadow class were lower than expected
- Water was the most accurate class, for both Producer's and User accuracy
- Both Forest and Herbaceous scored high in both Producer's and User accuracy
- Kappa Percentage of 82.31% was higher than I expected

2016 and 2020 Zonal Statistics Comparison

Zonal Statistics 2016				
Class_name	ZONE_CODE	COUNT	AREA	ACRES
Shadow	1	316155	113815.8	28.12445326
Water	2	369198	132911.28	32.84304184
Developed	3	2069893	745161.48	184.1331275
Barren	4	4990249	1796489.64	443.9215725
Forest	5	1985400	714744	176.6168161
Herbaceous	6	14961481	5386133.16	1330.940435

Zonal Statistics 2020					
Class_name	ZONE_CODE	COUNT	AREA	ACRES	Percentage Difference to 2016
Shadow	1	379397	136582.92	33.75032245	20%
Water	2	441543	158955.48	39.27869389	20%
Developed	3	4024199	1448711.64	357.9838898	94%
Barren	4	3503023	1261088.28	311.6212194	-30%
Forest	5	2052640	738950.4	182.5983386	3%
Herbaceous	6	14301698	5148611.28	1272.24759	-4%

Comparison Notes:

- Greater Shadow acreage recorded in 2020 due to further foliage growth and building development over four years
- Water level is higher in El Dorado Hills Irrigation reservoir and more pools in 2020 then there were in 2016
- Significant neighborhood development growth over four years, which replaced previously barren and herbaceous areas
- Majority of barren acreage in 2016 was eventually developed or taken over by herbaceous grass growing into previously barren areas
- Limited Forest growth due to only a little expansion of trees into new developments and tree growth over time
- Producer’s error of misclassifying pixels during reclassification process could also have contributed to the percentage differences of the classes

Data Used for Project

- **California Department of Fish and Wildlife 2016 NAIP raster from ArcGIS Online Portal.** https://map.dfg.ca.gov/arcgis/services/Base_Remote_Sensing/NAIP_2016_CIR/ImageServer
- **California Department of Fish and Wildlife 2020 NAIP raster from ArcGIS Online Portal.** https://map.dfg.ca.gov/arcgis/services/Base_Remote_Sensing/NAIP_2020_CIR/ImageServer
- **Professor Jennings' Image Classification Wizard Document provided during the course.**

I really enjoyed learning and performing classifications in this course and throughout this project. I have gained a greater appreciation for the overall reclassification process and the attention to detail necessary to complete them. I hope this project provided a truthful representation of the Classification processes, struggles, and resolutions.

Thank You!

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