John Wesley Powell West Road Extension Proposal

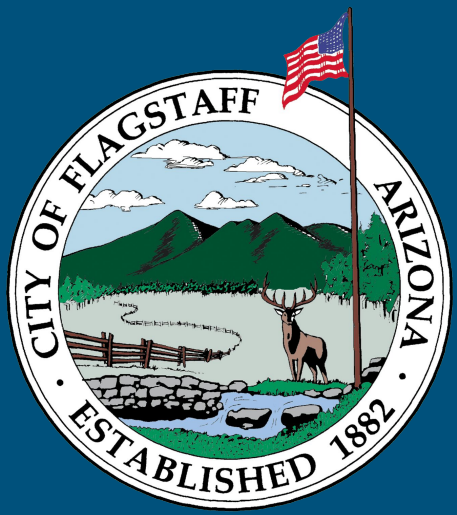
Cristine Aguila, Elijah Begay, Logan McFarland, Steven McKimmey

CENE 476 - 12/8/23

CELS ENGINEERING

Stakeholders

- Client: Jeff Bauman
  - PE, PTOE, Traffic Engineer with City of Flagstaff
- City of Flagstaff
  - Owners/Maintainers
  - Local Residents



City of Flagstaff, *City of Flagstaff Crest*. 2020

Introduction

- Connect South Pulliam Dr. to Lake Mary Road
- Enhance accessibility to local communities and users

Figure 1: View from South Pulliam Dr. *Image from Google Maps*

Figure 2: View from Lake Mary Rd. *Image from Google Maps*

Project Location

Figure 3: State Map of Arizona [1]

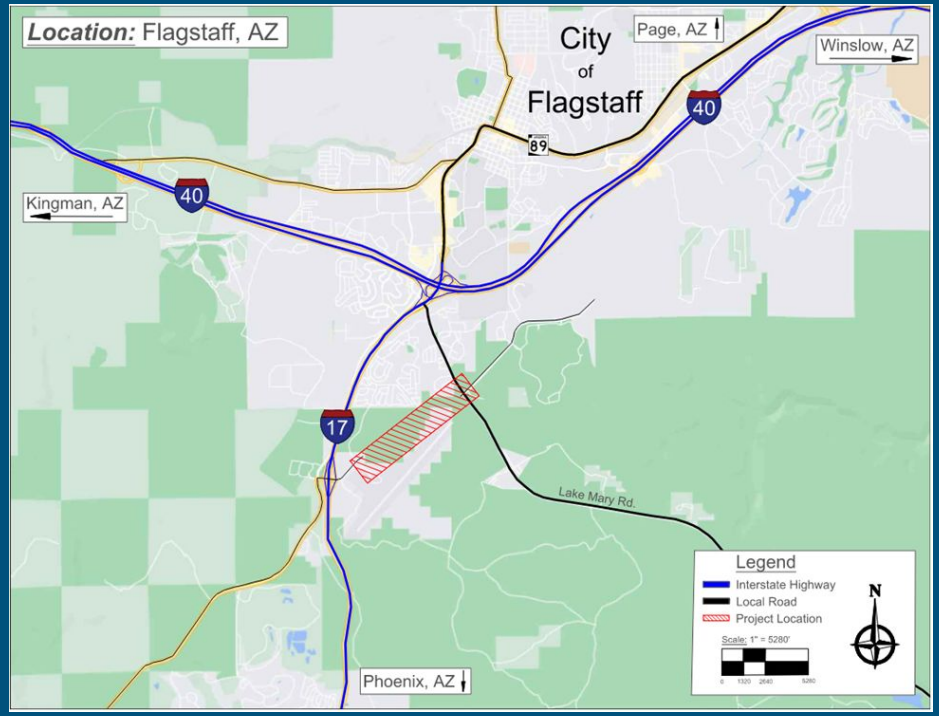


Figure 4: Project Vicinity Map

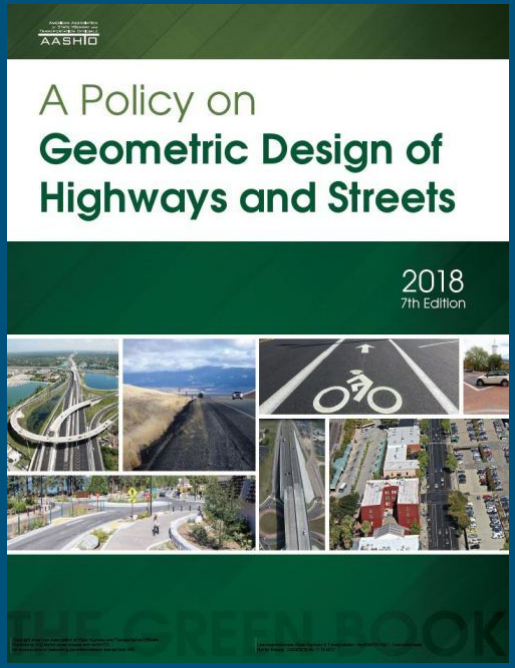
Project Site

- Located between South Pulliam Dr. & Lake Mary Rd
- Approximately 1.5 miles
- Rugged and forested terrain
- Flagstaff Pulliam Airport lies South of site

Figure 5: Project Location Map

Task 1.0: Research and Data Collection

- 1.1 Research and Data Collection
- 1.2 Identify Design Vehicle
- 1.3 Collect Existing Geotechnical Data

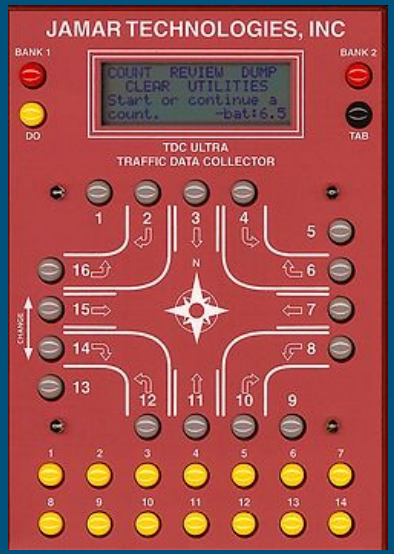


AASHTO Journal, *A Policy on Geometric Design of Highways and Streets.* 2018

Task 2.0: Site Investigation

- 2.1 Site Visit Planning
- 2.2 Land Survey
- 2.3 Traffic Counts
- 2.4 Photographs of Site Features
- 2.5 Collect Existing Hydraulic Structure Data
- 2.6 Geotech Analysis
- 2.7 Topographic Map

J. Peterson, Total Station. 2023



Jamartech, Owl Camera. 2017

Task 3.0: Hydrologic Analysis

- 3.1 Watershed Delineation
- 3.2 Time of Concentration
- 3.3 Storm Intensity
- 3.4 Calculate Peak Flow

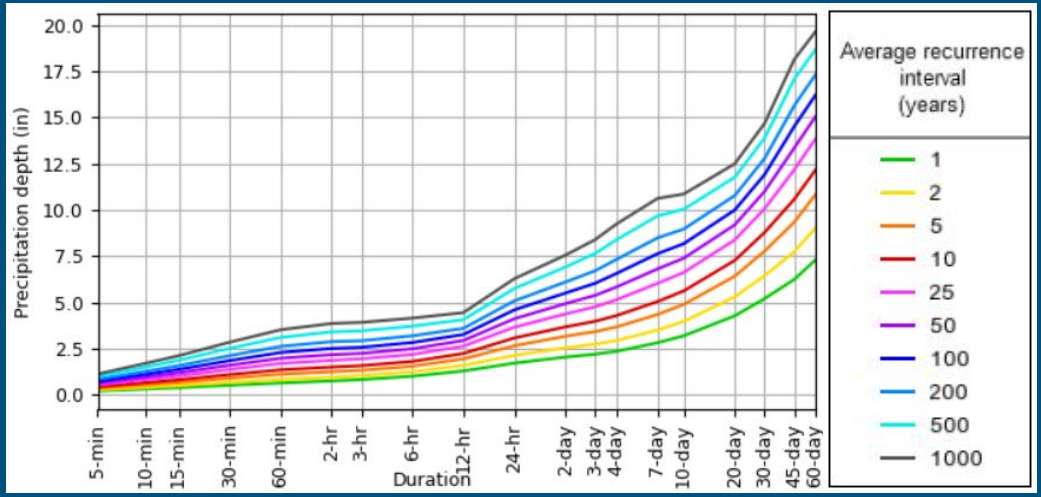
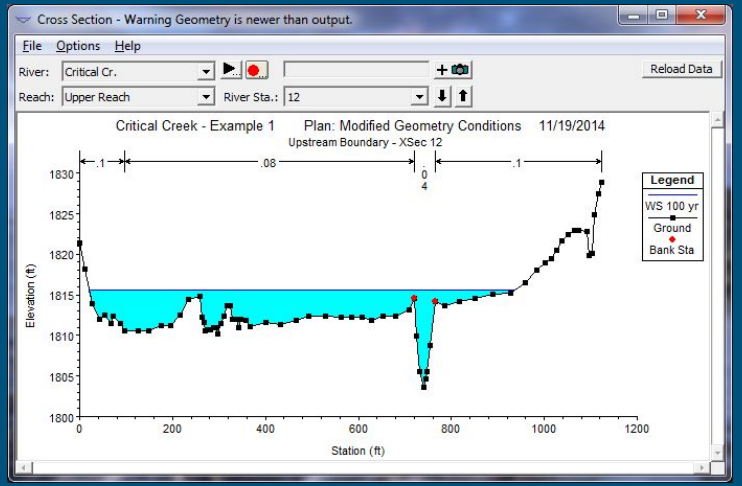


Figure 6: Depth Duration Frequency Curves [2]

Task 4.0: Hydraulic Analysis

- 4.1 Existing Culvert Analysis
- 4.2 Existing Channel Analysis
- 4.3 Post-Improvement Hydrologic Analysis
- 4.4 Proposed Culvert and Channel Design
  - 4.4.1 Determine Criteria
  - 4.4.2 Develop Alternatives
  - 4.4.3 Analyze Alternatives and Select Best



US Corps of Engineers. HEC-RAS. 2016

Task 5.0: Roadway Design

5.1 Roadway Geometry

5.2 Intersection Design

- 5.2.1 Determine Criteria
- 5.2.2 Develop Alternatives
- 5.2.3 Analyze Alternatives and Select Best

5.3 Pavement Design

- 5.3.1 Determine Criteria
- 5.3.2 Develop Alternatives
- 5.3.3 Analyze Alternatives and Select Best

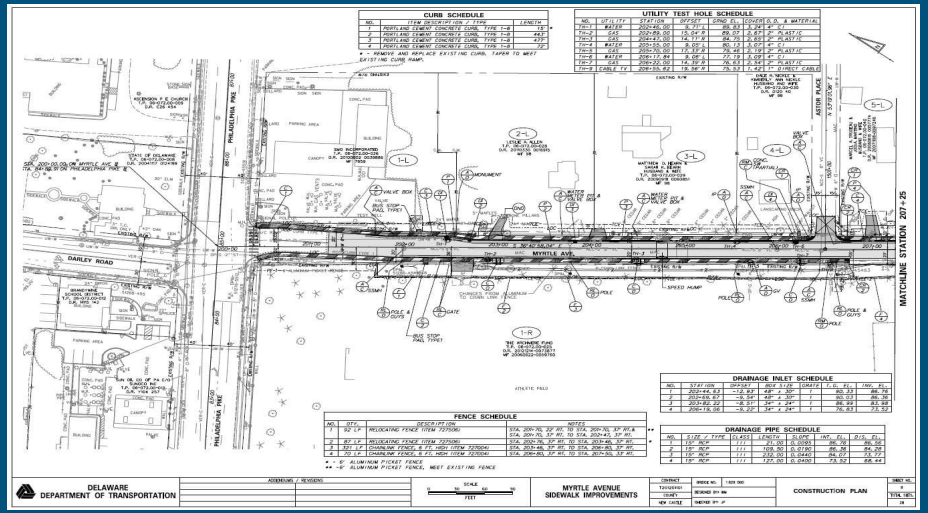
5.4 Sidewalk Design

5.5 Signage and Striping

Kimley Horn, Roadway and Bridge. 2018

Task 6.0: Construction Plans

- 6.1 Cover Sheet
- 6.2 Existing Site Plan
- 6.3 Plans and Profiles
- 6.4 Details Sheets



University of Delaware, Construction Plan Reading. 2021

Task 7.0: Economic Analysis

- 7.1 Construction Cost
- 7.2 Operation and Maintenance Cost

Classroom Clipart, Dump Truck 2021

Task 8.0: Impact Analysis

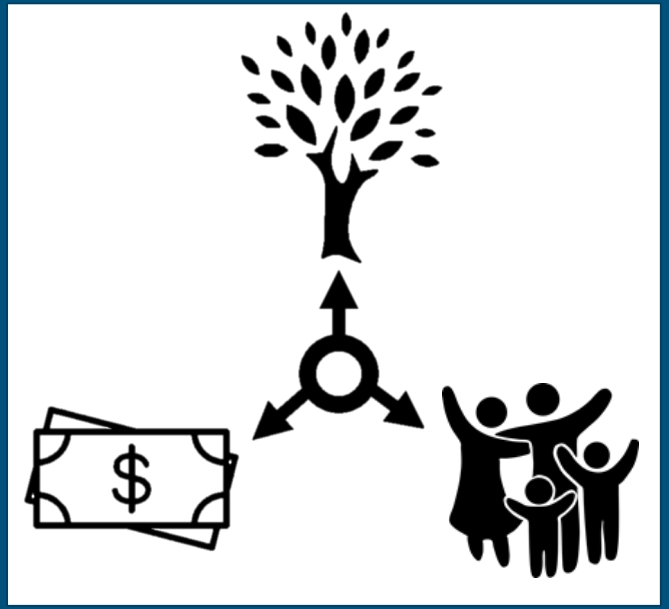


Photo Credit by Elijah Begay

Task 9.0 Deliverables

- 9.1 30% Submittal
- 9.2 60% Submittal
- 9.3 90% Submittal
- 9.4 Final Submittal

Task 10.0 Project Management

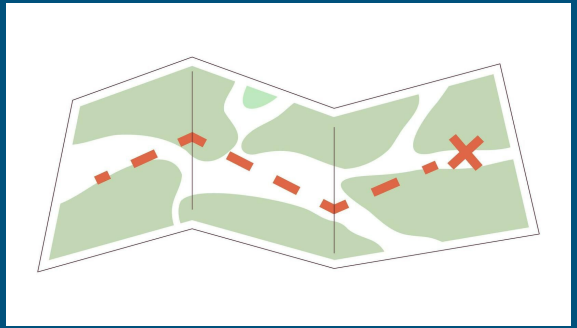
- 10.1 Meetings
- 10.2 Schedule Management
- 10.3 Resource Management

P. Lawson, Professional Business Meetings. 2021

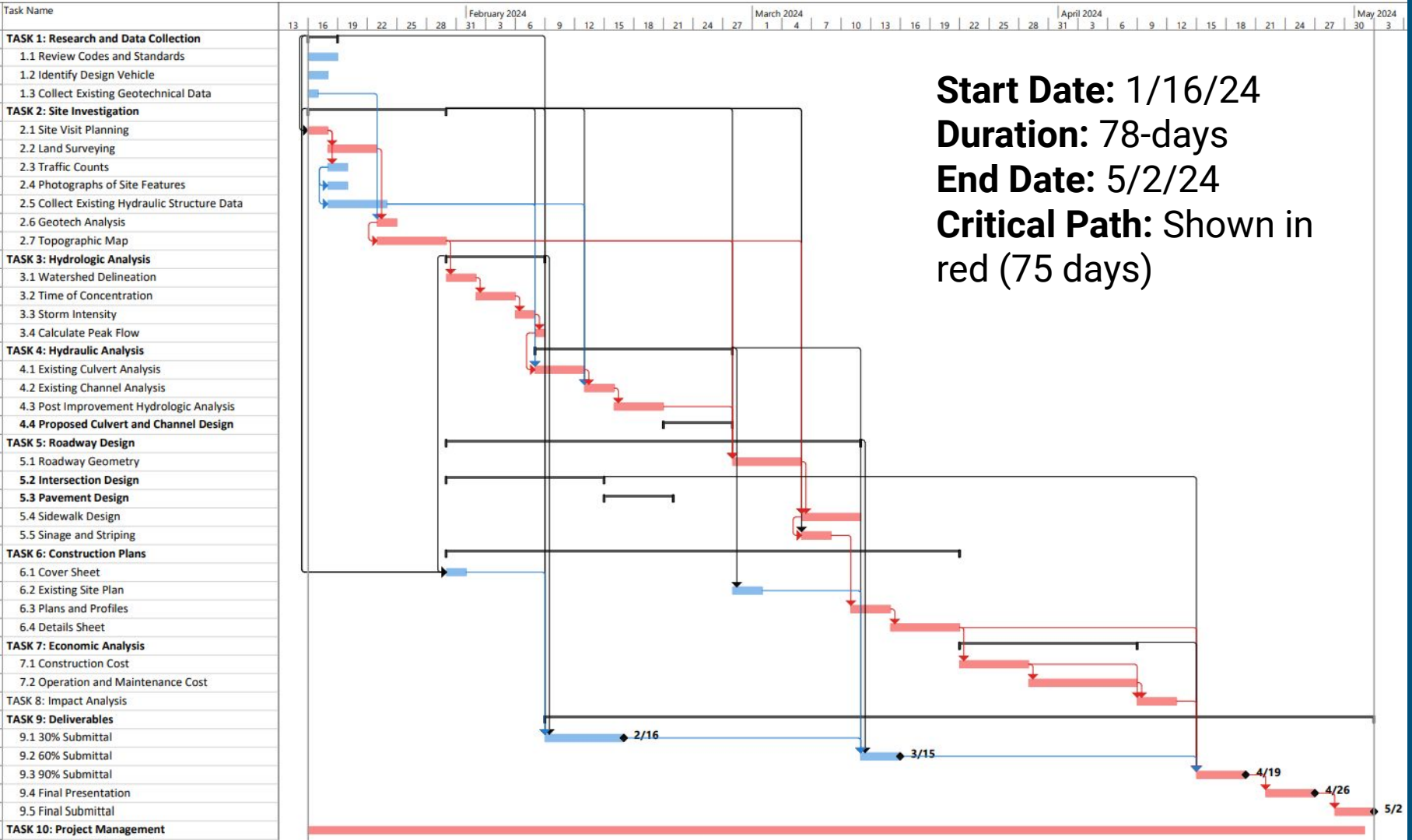
Exclusions

- Utilities
  - Sanitary Sewer, Water, Storm, Gas, Electrical, etc.
- Geotech Sampling
- Flagstaff Urban Trail System (FUTS)

Techno, Home Utilities, 2013



Vecteezy, Trail Maps. 2017



Start Date: 1/16/24
Duration: 78-days
End Date: 5/2/24
Critical Path: Shown in red (75 days)

Staffing Plan

Senior Engineer (SENG)

- Civil Engineering Degree (Master's preferred)
- Licensed PE
- 10+ years of experience

Engineer (ENG)

- Civil Engineering Bachelor's Degree
- EIT Certification
- 5+ years of experience

Lab Technician (TECH)

- Civil/Environmental Bachelor's Degree
- Prior experience in similar fields

Intern (INT)

- Senior studying Civil/Environmental Engineering
- Good academic standing

Vecteezy. 2023

Task	SENG	ENG	TECH	INT	Total Hours
1.0 Research and Data Collection					**9**
1.1 Review Codes and Standards	0	3	0	1	4
1.2 Identify Design Vehicle	0	1	0	1	2
1.3 Collect Existing Geotechnical Data	0	0	3	0	3
2.0 Site Investigation					**68**
2.1 Site Visit Planning	1	2	1	0	4
2.2 Land Survey	0	2	6	6	14
2.3 Traffic Counts	0	2	6	6	14
2.4 Photographs of Site Features	0	0	0	3	3
2.5 Collect Existing Hydraulic Structure Data	0	3	5	6	14
2.6 Geotech Analysis	0	2	2	0	4
2.7 Topographic Map	0	2	10	3	15
3.0 Hydrologic Analysis					**18**
3.1 Watershed Delineation	0	3	2	1	6
3.2 Time of Concentration	0	4	0	1	5
3.3 Storm Intensity	0	2	1	1	4
3.4 Calculate Peak Flow	0	3	0	0	3
4.0 Hydraulic Analysis					**93**
4.1 Existing Culvert Analysis	1	5	12	2	20
4.2 Existing Channel Analysis	1	5	10	1	17
4.3 Post-Improvement Hydrologic Analysis	1	3	6	1	11
4.4 Proposed Culvert and Channel Design	4	10	5	3	22
4.4.1 Determine Criteria	1	4	0	1	6
4.4.2 Develop Alternatives	0	3	5	1	9
4.4.3 Analyze Alternatives and Select Best	3	4	0	1	8
5.0 Roadway Design					**234**
5.1 Roadway Geometry	0	14	2	12	28
5.2 Intersection Design	0	25	0	5	30
5.2.1 Determine Criteria	1	4	0	1	6
5.2.2 Develop Alternatives	0	12	14	3	29
5.2.3 Analyze Alternatives and Select Best	3	10	0	1	14
5.3 Pavement Design	3	20	8	5	36
5.3.1 Determine Criteria	1	2	0	1	4
5.3.2 Develop Alternatives	0	8	8	3	19
5.3.3 Analyze Alternatives and Select Best	2	10	0	1	13
5.4 Sidewalk Design	1	5	3	1	10
5.5 Signage and Striping	3	10	12	2	27
6.0 Construction Plans					**49**
6.1 Cover Sheet	2	3	0	3	8
6.2 Existing Site Plan	2	5	0	5	12
6.3 Plans and Profiles	2	10	0	7	19
6.4 Details Sheets	2	5	0	3	10
7.0 Economic Analysis					**31**
7.1 Construcion Cost	4	8	0	5	17
7.2 Operation and Maintenance Cost	2	10	0	2	14
8.0 Impact Analysis	1	6	0	5	**12**
9.0 Deliverables					**111**
9.1 30% Submittal	2	18	4	6	30
9.2 60% Submittal	2	20	5	6	33
9.3 90% Submittal	2	15	3	6	26
9.4 Final Submittal	2	12	2	6	22
10.0 Project Management					**177**
10.1 Meetings	26	52	26	52	156
10.2 Schedule Management	2	4	1	4	11
10.3 Resource Management	3	3	1	3	10
Summary					
Total Hours	84	354	177	187	**802**

Cost of Engineering Services

Cost of Engineering Services				
1.0 Personnel	**Classification**	**Hours**	**Rate, $/hour**	**Cost**
	SENG	84	$ 200	$ 16,800
	ENG	354	$ 120	$ 42,480
	LAB	177	$ 75	$ 13,275
	INT	187	$ 25	$ 4,675
	Total	802		$ 77,230
2.0 Travel	**Classification**	**Miles/Trip**	**Rate, $/Mile**	**Cost**
	5 1-Day Trips	7	$ 0.40	$ 14
3.0 Supplies	**Classification**	**Days**	**Rate, $/Day**	**Cost**
	Surveying	3	$ 100	$ 300
	JAMAR Board	2	$ 75	$ 150
	Camera	2	$ 50	$ 100
	Computer Lab	20	$ 100	$ 2,000
Total				$ 79,794

References

[1] B. Jones, "Arizona US State PowerPoint Map," Maps for Design, 1 January 2023. [Online]. Available: https://www.mapsfordesign.com/product/arizona-us-state-powerpoint-map-highways-waterways-capital-and-major-cities/. [Accessed 26 September 2023].

[2] N. N. W. Service, "NOAA Atlas 12 Point Precipitation Frequency Estimates: AZ," HDSC webmaster, Silver Spring, MD, 2017.