# CENE 476 PROPOSAL

## ADOT ROAD SAFETY ASSESMENT
## (RSA)

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## List of Abbreviations

RSA – Road Safety Assessment
ADOT – Arizona Department of Transportation
NAU – Northern Arizona University
PL1 – Project Location 1 (Intersection of S Milton Rd and W University Ave)
PL2 – Project Location 2 (Intersection of S Milton Rd and Route 66)
SE – Senior Engineer
PM – Project Manager
TE – Traffic Engineer
RE – Roadway Engineer
EIT – Engineer In Training
PE – Professional Engineer
PMP - Project Management Professional
FHWA – Federal Highway Administration
MUTCD - Manual on Uniform Traffic Control Devices
AASHTO - The American Association of State Highway and Transportation Officials

## Appendices

# SECTION 1.0: PROJECT UNDERSTANDING

## 1.1 PROJECT PURPOSE

The purpose of this project is to evaluate and improve user safety at two of Flagstaff's major intersections: S Milton Rd/W University Ave and S Milton Rd/Route 66. This project will be worked on in accordance with the Arizona Department of Transportation (ADOT) who deemed both intersections as "hotspots" through statewide network screening. These locations see a high volume of vehicle, pedestrian, and bicycle traffic everyday due to their specific locations in Flagstaff (nearness to Northern Arizona University and to the downtown area) and major transportation pathways. As a result, these intersections have been identified as high-risk areas for pedestrian and bicyclist crashes.

Although recent roadway improvements have been made to these intersections (specifically with the addition of the pedestrian underpass at S Milton Rd and W University Ave), the frequency of incidents involving road users indicates that additional safety measures are needed. The problem occurs in the current roadway design and operational conditions, which contributes to issues between vehicles, pedestrians, and bicyclists. Without further assessment, these risks will continue to compromise the safety and mobility for all users.

This project is needed to identify practical solutions and improvements that can reduce crash risk while maintaining efficient traffic flow. By conducting a thorough site investigation, traffic and roadway analysis, ADA compliance review, and design evaluation, this project will provide ADOT with recommendations for infrastructure and operational changes that will help improve overall roadway safety at these locations. The main goal of the Road Safety Assessment (RSA) is to propose solutions that will reduce pedestrian and bicycle crashes, prioritize accessibility, and support safer multimodal transportation in the area.

## 1.2 PROJECT BACKGROUND

The Road Safety Assessment Report focuses on the following intersections: S Milton Rd/W University Ave and S Milton Rd/Route 66. These sites were selected due to a high amount of vehicle, pedestrian, and bicycle safety-related incidents occurring at the intersections, as identified by the statewide network screening.

Figure 1-1 below is the project location map, showing the location of the two intersections in relation to the state. The intersections are located in the city of Flagstaff, Arizona. All maps were created using AutoCAD [1].

FIGURE 1-1: LOCATION MAP

Figure 1-2 is a vicinity map, showing the locations of the intersections in relation to the city of Flagstaff. Notably, the selected intersections have been abbreviated as Project Location 1 (PL1) and Project Location 2 (PL2). PL1 relates to the intersection of S Milton Rd and W University Ave. PL2 relates to the intersection of S Milton Rd and Route 66.

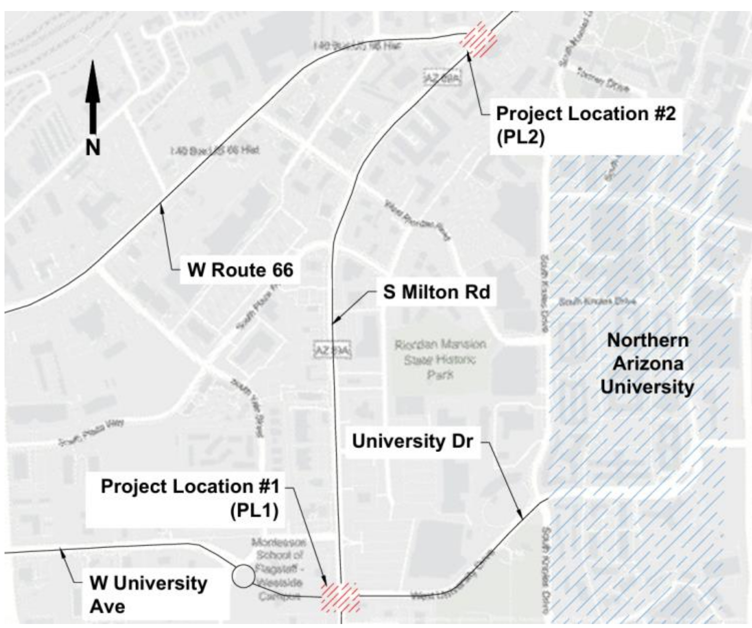

FIGURE 1-2: VICINITY MAP

Figure 1-3 is the Project Location 1 (PL1) Map, showing the exact location of the S Milton Rd and W University Ave intersection. The intersection currently has three existing crosswalks with a pedestrian underpass. The map shows surrounding roads in the area for guidance. The aerial image used for the S Milton Rd and W University Dr intersection are not up to date and will be subject to change once the complete site visit and drone survey are conducted.

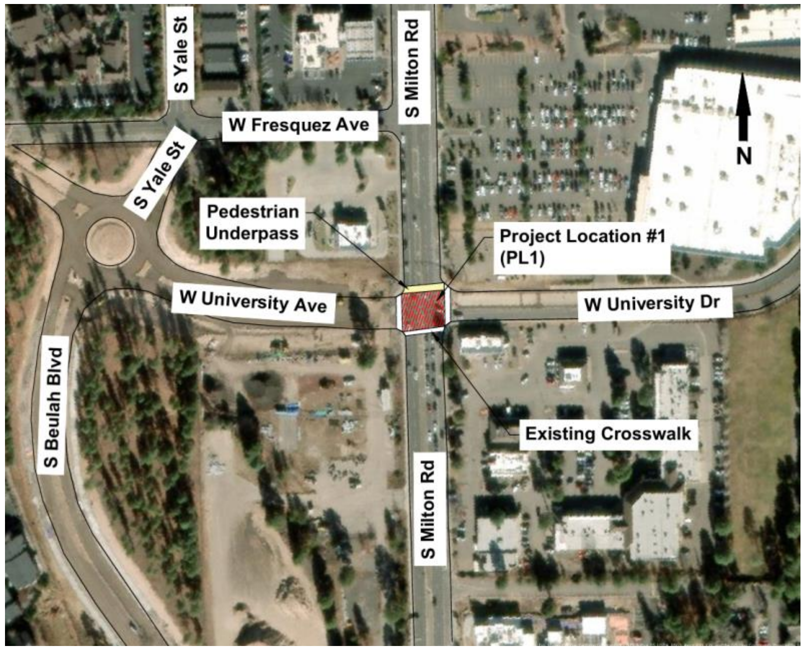


FIGURE 1-3: PROJECT LOCATION 1 (PL1) MAP

Figure 1-4 is the Project Location 2 (PL2) Map, showing the exact location of the S Milton Rd and Route 66 intersection. There are currently two existing crosswalks in the intersection. Surrounding roads are also indicated for guidance.

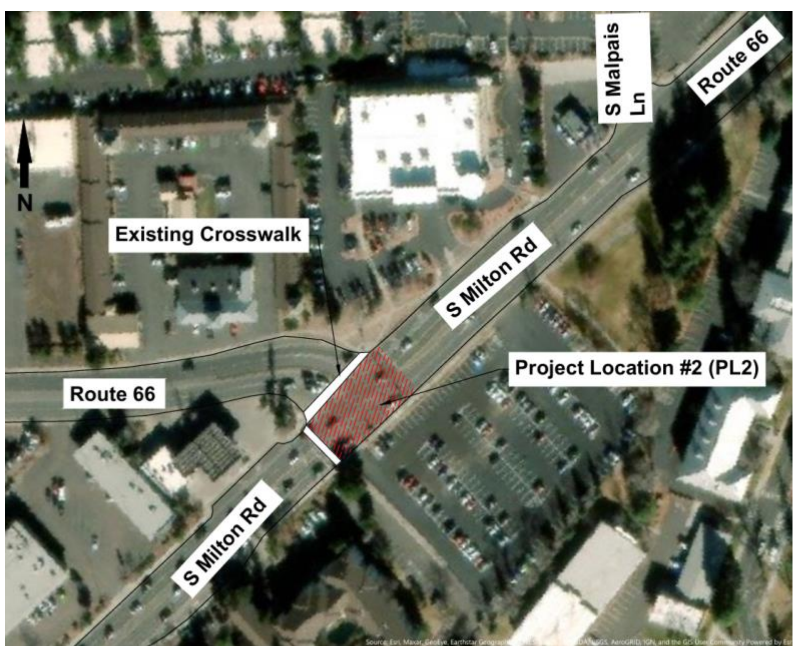


FIGURE 1-4: PROJECT LOCATION 2 (PL2) MAP

## 1.3 TECHNICAL CONSIDERATIONS

The technical work required for this project includes various traffic studies and data collection techniques to fully assess the project intersections for safety and efficiency. Vehicular, pedestrian, and multi-modal traffic counts must be collected at each intersection during specified peak hours. At the W University Ave and S Milton Rd intersection specifically, a separate pedestrian and bicycle count will need to be conducted simultaneously with the main study in the newly constructed underpass on the north side of the intersection. Along with these traffic and pedestrian counts, traffic impact studies, crash analysis studies, intersection geometry analyses, and site evaluations are also necessary to meet the demands of the project.

All eventual designs and/or recommendations need to comply with local and federal regulations and standards. Listed below are the relevant agencies and documents that will be referenced within the project.

- AASHTO Green Book [1]
- ADOT Roadway Design Guidelines [2]
- Manual on Uniform Traffic Control Devices (MUTCD) [3]
- Highway Capacity Manual [4]

## 1.4 POTENTIAL CHALLENGES

Multiple potential challenges to the completion of this project have been identified. The identified challenges have been consolidated into two primary categories: data collection and project location.

Regarding data collection, the main issue is the lack of existing data for PL1. Recently, a pedestrian and multi-modal underpass under S Milton Rd was completed. This project began on August 19, 2024, and was completed on July 15, 2025. This means that any existing data at PL1 throughout this period does not accurately reflect the standard operation of the intersection as the intersection was under construction conditions. Additionally, there is a lack of an existing aerial map, accurate traffic counts (including vehicle, pedestrian, and multi-modal users), and relevant traffic accident records following the recent completion of the underpass. To address the issue of a lack of data, SERJ plans to complete a drone survey of PL1 to generate an up-to-date aerial map, inquire local institutions for recent crash and other relevant data, and manually record at least two sets of traffic count data during different times of the year using JAMAR Boards.

Ensuring that traffic count data is collected during different times of the year is necessary because both project intersections will perform differently based on the season. The seasons in Flagstaff present snowy, windy, and rainy conditions. In general, there are fewer pedestrians and multi-modal users during these weather events. Additionally, vehicles users behave differently in these conditions. The issue of seasonal demand is especially important for PL1, which has yet to be observed or used during such weather conditions. There is a possibility that the pedestrian underpass may be out of commission due to the presence of snow and ice. This scenario would likely cause an increase in crosswalk usage by pedestrian and multi-modal users, resulting in a decrease in general efficiency and safety at the intersection. Therefore, SERJ will collect data during the late Fall and middle of Winter, ensuring that all relevant seasonal conditions and their corresponding demands are considered in this RSA.

Regarding the project location, it is important to consider the possible effects of introducing a change to an intersection. Both project intersections are located on S Milton Rd, which is the only principal North-South arterial road in Flagstaff. This means that the effective operation of the corridor is vital to traffic operations throughout a significant portion of Flagstaff. Any substantive changes to the corridor or nearby intersections that reduce vehicle efficiency may cause a “snowball effect” of service issues at other intersections throughout the City of Flagstaff. The project intersections also border NAU campus, which means that there are a greater number of pedestrian and multi-modal users than an average intersection in Flagstaff. These users also exhibit greater demand between class periods as students enter and exit campus, creating irregular peaks that must be accounted for. To address these problems, SERJ will focus on close-term changes that are simple to implement, collect data during student user peaks, and will verify the integrity of the system with proposed changes through programs like Synchro.

## 1.5 STAKEHOLDERS

The primary stakeholder for this project is the client, Brent Allman, who this project and resulting RSA are being developed for. Brent is the ADOT Assistant Regional Traffic Engineer for the Northern Region of Arizona. Brent is requesting this report for ADOT, who is another significant stakeholder, as they manage portions of S Milton Rd and I-17, which are connected. The City of Flagstaff is another significant stakeholder as they share ownership of S Milton Rd with ADOT. Both organizations also develop the criteria for safe and efficient roadways in the area. The Coconino County Traffic Engineering Department also likely has a stake in this project, as they oversee all projects within their jurisdiction.

Another significant stakeholder to consider is the road users who utilize this infrastructure every day. These people are the primary focus and therefore the recipients of the efforts of this project. Other stakeholders who can be considered are NAU students who utilize the pedestrian/bicycle facilities at the project intersections when traveling to and from campus. These students account for most of the pedestrian/bicycle traffic traveling through these intersections, which makes them an important stakeholder. Additional stakeholders to be considered for this intersection are the Flagstaff and NAU Police Department who are responsible for enforcing traffic laws at the project intersections, and emergency services (EMT, Firetrucks) whose efficiency and safety can be affected by the project. Finally, some minor stakeholders who could be affected by the project are businesses and residential areas close to the project intersections who might experience a small change in their normal operations.

# SECTION 2.0: SCOPE OF SERVICES

## 2.1 TASK 1.0: CONDUCT BACKGROUND RESEARCH

This task will involve researching and reviewing previous Road Safety Assessments and the various agency regulations that are currently in place. The understanding of previous Road Safety Assessments and agency regulations will ensure that a feasible solution is determined and that it meets the necessary requirements. This task will be conducted by completing the following subtasks.

### 2.1.1 TASK 1.1: REVIEW PREVIOUS RSAS

Previous Road Safety Assessments for similar intersections will be analyzed to evaluate potential solutions or ideas for the project. Previous Road Safety Assessments may be obtained from ADOT.

### 2.1.2 TASK 1.2: OBTAIN PREVIOUS CRASH DATA

The existing crash data for both project intersections will be obtained from ADOT. This data will contain the previous 5-year crash data at both intersections. This data will be used as a baseline to understand existing conditions and also in later analysis.

## 2.2 TASK 2.0: SITE VISIT

This task will involve visiting both project intersections to understand the current up-to-date conditions of the intersections. An assessment and analysis of the existing infrastructure of the project sites will be conducted by completing the following subtasks.

### 2.2.1 TASK 2.1: DRONE SURVEY

A drone survey of the intersection of S Milton Rd and W University Ave will be conducted to determine the most current conditions of the intersection. The current conditions of the intersections will be necessary for future analysis. An up-to-date arial image of the intersection will also be taken with the drone.

### 2.2.2 TASK 2.2: EXISTING GEOMETRY

The existing geometry and roadway alignments will be measured at both locations. The drone map and images will be used to obtain the necessary information. This information will be used to determine feasible design alternatives and check that the intersections meet specified regulations.

### 2.2.3 TASK 2.3: IDENTIFY PEDESTRIAN AND BIKE FACILITIES

Pedestrian and Bicycle facilities will be identified and analyzed by visiting the intersections and writing down observations. This will be conducted to determine current safety hazards and potential improvements at the intersections. This also includes the newly implemented pedestrian underpass at PL1.

#### 2.2.4 TASK 2.4: OVERALL SAFETY ANALYSIS

The existing infrastructure will be analyzed by visiting the site and writing down observations to determine any potential safety concerns for road users. This mainly focuses on passenger vehicles and bicycles using the multi-use shoulders.

#### 2.2.5 TASK 2.5: SIGNAL TIMING ANALYSIS

The newly implemented signal timing at PL1 and existing timing at PL2 will be observed and analyzed by visiting the site. ADOT will also provide the signal timing of both intersections. This will be conducted to identify any inefficiencies or apparent safety concerns within the existing timing and phasing.

### 2.3 TASK 3.0: TRAFFIC STUDIES

In this task, a series of traffic studies will be conducted to collect traffic-related data at the project intersections. This data will be used to assess the current peak-hour operations of the intersections and identify potential safety risks. The task will be conducted by completing the following subtasks.

#### 2.3.1 TASK 3.1: TRAFFIC VOLUME STUDY (FALL)

Vehicle traffic volume data will be collected at both intersections during the fall season. The traffic volume data will be collected using a JAMAR board which will count the movements of vehicles at the intersections of study. The traffic volume data will be obtained during specified peak hours. The demand may also vary by season. This data will be used to identify potential conflicts with pedestrian movements and identify traffic patterns.

#### 2.3.2 TASK 3.2: PEDESTRIAN COUNT STUDY (FALL)

Pedestrian counts will be collected at both intersections using JAMAR boards in the Fall. This will include pedestrian crossing volumes at the intersections during peak hours. The pedestrian count will be used to identify potential conflicts with vehicular movements and to identify patterns. The Fall data is required as the pedestrian underpass may function differently than in the Winter. The demand may also vary by season.

#### 2.3.3 TASK 3.3: BICYCLE AND MULTIMODAL USE STUDY (FALL)

Documentation of bicycle and multimodal usage at both intersections will also be required. Bicycle and multimodal counts will be collected using JAMAR boards at the intersections during peak hours to determine potential conflicts with vehicles and pedestrians. The Fall data is required as the pedestrian underpass, which is also utilized by multimodal users, may function differently than in the Winter. The demand may also vary by season.

#### 2.3.4 TASK 3.4: TRAFFIC VOLUME STUDY (WINTER)

A second round of vehicle traffic volume data will be collected during the winter season to capture the influence of factors like weather at both intersections. The traffic volume data will be collected using a JAMAR board which will count the movements of vehicles at the intersections of study. The traffic volume data will be obtained during peak hours. The demand may also vary by season.

### 2.3.5 TASK 3.5: PEDESTRIAN COUNT STUDY (WINTER)

Pedestrian counts will be collected at both intersections using JAMAR boards in the Winter. This will include pedestrian crossing volumes at the intersections during peak hours. The pedestrian count will be used to identify potential conflicts with vehicular movements and to identify patterns. The Winter data is required as the pedestrian underpass may function differently than in the Fall. The demand may also vary by season.

### 2.3.6 TASK 3.6: BICYCLE AND MULTIMODAL USE STUDY (WINTER)

Documentation of bicycle and multimodal usage at both intersections will also be required. Bicycle and multimodal counts will be collected using JAMAR boards at the intersections during peak hours to determine potential conflicts with vehicles and pedestrians. The Winter data is required as the pedestrian underpass, which is also utilized by multimodal users, may function differently than in the Fall. The demand may also vary by season.

### 2.3.7 TASK 3.7: CRASH DATA ANALYSIS

The analysis of the last five years of crash history at both intersections will be conducted. This data will be obtained from ADOT and will be used to identify the primary causes of those crashes. This analysis will also be performed to determine patterns and trends at the intersections.

## 2.4 TASK 4.0: GENERATE ALTERNATIVES

This task will consist of compiling results from completed research and traffic studies at the project intersections to generate proposed safety alternatives that could be implemented. This task will be conducted by completing the following subtasks.

### 2.4.1 TASK 4.1: ANALYZE TRAFFIC STUDY RESULTS

The obtained data from the previously completed traffic studies will be analyzed to understand the main areas for improvement at the project intersections. This analysis will focus on safety and efficiency issues that were identified.

### 2.4.2 TASK 4.2: BRAINSTORM POTENTIAL ALTERNATIVES

Potential alternatives for the project intersections will be generated and considered based upon the previously completed analysis. Both the site visit and traffic study results will be considered in choosing potential alternatives.

### 2.4.3 TASK 4.3: CRASH MODIFICATION FACTORS

The Crash Modification Factors Clearinghouse will be used to assess potential countermeasures, ensuring that the most effective strategies are selected to reduce crash frequency and severity. This tool will be used to compute the expected number of crashes after implementing a countermeasure at the intersections.

### 2.4.4 TASK 4.4: DECISION MATRIX

A decision matrix will be created to assess the effectiveness of each proposed alternative. This matrix will score the alternatives with a scoring system developed based on factors which will influence the outcome of the project.

### 2.4.5 TASK 4.5: SHORT/MEDIUM/LONG TERM RECOMMENDATIONS

This task will focus on separating the proposed alternatives into short-, medium-, and long-term categories to get a better idea on the timeframe to complete and implement each of them. This will allow the final RSA to be better suited to address the specific needs at each intersection by describing shorter-term quick solutions and longer-term projects.

## 2.5 TASK 5.0: RSA REPORT

This task will consist of compiling the previously completed work to build a complete Road Safety Assessment Report. This will be done by combining the following subtasks described below.

### 2.5.1 TASK 5.1: FINALIZE RECOMMENDATIONS

Before creating the RSA report, the scored alternatives will be accepted or rejected on their overall impact based on the scoring system described previously. The accepted alternatives will be organized into a table and used in the next task.

### 2.5.2 TASK 5.2: COMPILE ALL STUDIES, DATA, AND ALTERNATIVES

All previously completed research and traffic studies will be collected and organized to build out the body of the RSA. The sections included will be:

- Project Background
- Site Visit Results: Roadway Characteristics, Safety Concerns
- Traffic Volume Data
- Turning Movement Volumes
- Crash Data Analysis
- Regulatory Compliance
- Engineering
- Enforcement
- Educations
- EMS
- Alternatives/Recommendations

## 2.6 TASK 6.0: PROJECT IMPACTS

This task will consist of identifying and analyzing the impacts this project will have on the world around us including the Environmental, Economic, and Social Impacts that are likely to be seen.

### 2.6.1 TASK 6.1: ENVIRONMENTAL

Based on the alternatives provided in the RSA, some projects suggested would involve new construction which would need building materials. Depending on the selected materials, there could be a positive or negative impact on for environmental pollution. Also, depending on the outcome of the proposed alternatives, there could be an incentive for increased biking or other modes of transport which would decrease overall vehicle pollution.

### 2.6.2 TASK 6.2: ECONOMIC

The economic impact of this project would be based on both the cost/benefit of the proposed alternatives and the overall effect on local businesses in the vicinity of the project intersections. With improved business access from proposed alternatives, there is a likely increase in vehicle traffic to those areas, which could help the overall economy.

### 2.6.3 TASK 6.3: SOCIAL

The social impact of this project is based on the fundamental idea of an RSA, which is to increase safety for all road users who utilize the intersections. One example of this can be described as improved bike and multimodal facilities while also decreasing the likelihood of a collision. Also, improved vehicle safety at the intersections leads to less severe crashes and a better overall feeling for drivers using them.

## 2.7 TASK 7.0: PROJECT DELIVERABLES

The following tasks are deliverables associated with the CENE 486 class and will be submitted by their respective deadlines:

### 2.7.1 TASK 7.1: 30% REPORT

The 30% report will include incremental progress for the overall project and will encompass:

- Task 1: Background Research
- Task 2: Site Visit

### 2.7.2 TASK 7.2: 60% REPORT

The 60% progress report will contain all information described in Task 7.1 as well as the following:

- Task 3: Traffic Studies
- Task 4: Generate Alternatives

### 2.7.3 TASK 7.3: 90% REPORT

The 90% progress report will encompass all items described in Tasks 7.1 and 7.2 as well as the remaining content in the following:

- Task 5: RSA Report
- Task 6: Project Impacts

### 2.7.4 Task 7.4: Final Report

The final report submittal will contain all technical and regulatory content described in the above tasks as well as any final additions or revisions specified by the grading instructor.

### 2.7.5 Task 7.5: Project Website

The project website content will be created and modified alongside completing the respective work in the above tasks. This website will showcase the work of the project in a less technical medium and will allow public access to the completed work.

## 2.8 Task 8.0: Project Management

This task will consist of necessary sub-tasks that will help plan, coordinate, and monitor the progress of the project. This task will ensure that the project meets quality standards and is completed on time.

### 2.8.1 Task 8.1: Resource Management

Project resources will be managed and organized in an efficient manner. This includes tracking and organizing staffing, equipment, cost, and data collection to ensure all tasks are executed effectively throughout the project.

### 2.8.2 Task 8.2: Team Meetings

Weekly team meetings will be held among the project team members to cooperate on the project. Team meetings will be intended for the coordination and completion of project work, to review progress and data, and ensure work is completed by set deadlines. Meeting minutes will be created after each meeting to keep track of progress.

### 2.8.3 Task 8.3: Client and TA Meetings

Meetings with the client and technical advisor will be held bi-weekly throughout the course of the project. These meetings will be held to review progress, share information, and receive feedback. Meeting minutes will be created after each meeting to keep track of information and topic discussions.

### 2.8.4 Task 8.4: GI Meetings

Meetings with the grading instructor will be held regularly throughout the course of the project. The meetings will be held to go over project deliverables and to receive feedback. These sessions will ensure deliverable requirements and expectations are met. Meeting minutes will be created after each meeting to keep track of each session.

### 2.8.5 Task 8.5: Schedule Management

The project schedule will be developed outlining all tasks, milestones, and deliverables throughout the course of the project. The schedule will be monitored regularly to ensure it is followed tentatively and to adjust it based on any changes or updates.

## 2.9 Exclusions

### 2.9.1 Plan Sets

A Road Safety Assessment does not incorporate full plan sets and designs for new projects, it only recommends alternatives which are at the discretion of the client or their agency for taking action.

### 2.9.2 Hydrologic Analysis

This project does not look specifically at existing drainage plans or full hydrologic analysis. Rather, as part of the site visit, any noticeable safety concerns regarding flooding or drainage issues will be noted and considered when generating alternatives.

# SECTION 3.0: SCHEDULE

This section outlines the schedule that the team will follow during the Spring 2026 semester to complete the RSA for the study sites located at the S Milton Rd/W University Ave and S Milton Rd/Route 66 intersections in Flagstaff, Arizona. The schedule points out the major tasks, anticipated milestones, and deliverable deadlines that will help guide the project's progression from initial proposal through to final documentation. A detailed Gantt chart was developed using Microsoft Project [4], which shows the full project schedule and is located in Appendix A for a visual aid of the overall timeline.

## 3.1 SCHEDULE OVERVIEW

The project schedule will take place during the Spring 2026 semester, beginning on January 12th and concluding on May 8th. Work will mainly occur during the regular academic session, with adjustments made to accommodate university breaks and review deadlines. The schedule is structured around multiple main tasks, beginning with a review of existing conditions and crash data for both intersections, followed by field investigation and on-site safety observations. These initial tasks will provide the base layer for data analysis and identification of safety issues related to pedestrian, bicycle, and vehicle interactions. The latter stages of the project will focus on developing both engineering and non-engineering countermeasures, concluding with the final documentation and presentation of findings.

Each task builds upon the previous one to make sure that recommendations are supported by field data, engineering judgment, and coordination with relevant city and university stakeholders. Regular team meetings will be held throughout the semester to track progress, coordinate responsibilities, and to make sure that everything is on track in accordance with the established schedule. The attached Gantt chart includes estimated start and end dates for each task in addition to "leeway time" on each for any discrepancies in duration where a certain part of the project may be taking a bit longer than expected.

## 3.2 MILESTONE AND DELIVERABLES

This RSA project includes a series of major deliverables that are used as progress checkpoints throughout the semester. These milestones are in accordance with Northern Arizona University's CENE 486 course schedule and make sure that work is completed in an organized and phased manner. The 30% submittal, due Tuesday of Week 5, will include the preliminary report summarizing site background, crash data review, and initial field findings. The 60% submittal, due Tuesday of Week 10, will present a refined analysis with identified safety issues and preliminary countermeasures. The 90% submittal, due Thursday of Week 14, will include near-final recommendations and finalized RSA documentation. The final presentation, scheduled for Friday of Week 15, will summarize the complete RSA process, findings, and recommendations to the client and faculty. The final report and submission, due Tuesday of Finals Week, will mark the completion of the project and delivery of the final documentation to the client and grading instructor.

These deliverables represent important progress checkpoints that support quality control and accountability across the semester. Each submittal task builds upon previous work, allowing for continuous refinement of the analysis and recommendations based on feedback from both the grading instructor and the project technical advisor.

## 3.3 Critical Path

The critical path for this project is centered on the progressed completion of analysis and reporting tasks. Specifically, the review of crash data (Task 1), field investigation (Task 2), and existing traffic conditions (Task 3) must be completed before the team can identify any main safety issues and come up with appropriate countermeasures (Tasks 4 & 5). Delays in these early-stage tasks would directly impact upcoming deliverables, including the 60%, 90%, and final submittals (Task 7). To help with scheduling risks, the team will coordinate early data collection, keep consistent communication between members, and give enough time for internal review and edits prior to each milestone. This structured approach will help make sure that there is a timely completion of all deliverables and will also allow the team to stay aligned with project objectives and expectations from both the client and the technical advisor. Project tasks that may incur delay have also been assigned more days than is likely necessary to ensure that the critical path will not be deviated from.

# SECTION 4.0: STAFFING PLAN

In this section, the staff positions required for this project will be identified along with their respective billing rates. Also, these staff positions' qualifications along with our team's qualifications will be described. Finally, a staffing matrix will be provided which shows the required tasks/subtasks for this project along with the estimated number of hours that each staff position will work on them for.

## 4.1 STAFF POSITIONS/BILLING RATES

The following table shows the required staff positions to complete the project:

**TABLE 4-1: LIST OF STAFF POSITIONS**

| Position | Abbreviation |
|---|---|
| Senior Engineer | SE |
| Project Manager | PM |
| Traffic Engineer | TE |
| Roadway Engineer | RE |
| Engineer In Training | EIT |

The table shown below details the specified billing rates for each of the respective positions described above:

**TABLE 4-2: LIST OF BILLING RATES BY POSITION**

| Position | Abbreviation | Billing Rate ($/HR) |
|---|---|---|
| Senior Engineer | SE | 250 |
| Project Manager | PM | 200 |
| Traffic Engineer | TE | 150 |
| Roadway Engineer | RE | 135 |
| Engineer In Training | EIT | 75 |

## 4.2 STAFF POSITIONS QUALIFICATIONS

Below are the qualifications and responsibilities needed for each staff position in this project:

- **Senior Engineer**

  The Senior Engineer is a licensed Professional Engineer (PE) in the State of Arizona or qualified in another state, with around 10 to 15 years of experience in transportation design, roadway operations, and highway safety. This position requires great experience in applying safety principles, geometric design standards, and traffic engineering practices, as well as previous experience in RSAs for state/local agencies.

  The SE gives technical oversight and makes sure that all engineering standards and safety principles are properly applied throughout the RSA process. This role includes reviewing existing roadway design and traffic control items for compliance with ADOT/COF design criteria and best practices. Overall, the SE gives technical justification for proposed improvements.

  In the context of an RSA, the SE will look over geometric design features, roadside items, and infrastructure conditions that may be a cause to crash potential. They recommend practical and cost-effective countermeasures to these issues, taking into consideration the constructability and performance of these items. Additionally, the SE will review the work of junior staff and verify the technical accuracy and completeness of the RSA team's findings and recommendations.

- **Project Manager**

  The Project Manager generally has a PE license or Project Management Professional (PMP) certification and has at least 10 years of experience managing transportation and safety projects for public agencies. Strong communication, organizational, and leadership skills are very important, as this role is the main person to coordinate between ADOT, local stakeholders, and the consultant team.

  The PM overlooks the overall RSA work, and more specifically into the project scheduling, budget management, and quality assurance. This role makes sure that RSA tasks align with ADOT and Federal Highway Administration (FHWA) procedures, and that each project deliverable meets agency standards. The PM also manages internal resources and keeps consistent communication among team members to make sure the RSA progresses efficiently.

  During the RSA, the PM is in charge of meetings, field reviews, and makes sure that all documentation accurately reflects the team's observations and findings. The PM also leads the preparation of the RSA report, making sure that the recommendations are clear, objective, and actionable. This role is very important for keeping integrity, punctuality, and transparency of the entire RSA process.

- **Traffic Engineer**

  The Traffic Engineer is a licensed PE with a specific background in traffic or transportation engineering, typically having 7 to 12 years of experience in traffic operations, safety analysis, and signal design. This person is proficient in using/applying the Manual on Uniform Traffic Control Devices (MUTCD), the Highway Capacity Manual, and ADOT's traffic design policies to real-world roadway conditions.

  In general, the TE analyzes traffic volumes, speeds, and crash data to identify operational or safety issues. They test the overall use of existing traffic control devices, signing, and pavement markings, and evaluate intersection/corridor performance. The TE gives input on traffic flow efficiency and driver behavior, pointing out systemic and site-specific safety concerns.

  Within the RSA, the TE conducts on-site evaluations of operational conditions, driver interactions, and visibility issues. They recommend both short-term and long-term improvements to help maximize safety and mobility, like adjustments to signal timing, signage, or lane setups/geometry. Their contribution to the project forms an important part of the RSA's recommendations and documentation based on their data found.

- **Roadway Engineer**

  The Roadway Engineer is a licensed PE with about 5 to 10 years of experience in roadway design and construction. This position requires a great understanding of AASHTO geometric design standards, ADOT design manuals, and practical construction methods. The RE gives technical insight into how design features have an impact on roadway safety and driver performance.

  The RE looks over alignments, cross sections, and roadside items to find areas where design geometry may affect visibility, stability, or driver expectancy. They evaluate the consistency of roadway features and highlight constraints/deficiencies that could impact operational safety in a specific area. The RE contributes their own expertise in design specifically to making sure that the overall development is feasible and that the countermeasures set in place work in terms of the overall performance of an area.

  During the RSA process, the RE focuses on the relationship between geometric design and observed crash patterns/driver behavior. They work on developing conceptual design changes to improve safety and prepare rough cost estimates for recommended improvements. The RE makes sure that proposed changes are practical and align with ADOT's design and maintenance capabilities.

- **Engineer In Training**
  The Engineer in Training has a bachelor's degree in civil or transportation engineering and has completed the Fundamentals of Engineering (FE) exam. This role is expected to have anywhere from 2 to 4 years of experience and supports the RSA team through data collection, analysis, and documentation under the supervision of licensed engineers.
  In general, the EIT assists the senior team members with research, field inspections, and technical documentation. They compile traffic and crash data, prepare figures and tables, and help with drafting technical reports. This position provides valuable learning opportunities and gives important analytical/administrative support to the RSA process.
  Within the RSA, the EIT takes part in field reviews, collects documentation, and organizes team notes and sketches for the final report. They help in making draft/final RSA deliverables, making sure that there is clarity and completeness among all the work. Through this work, the EIT contributes to the technical aspect and quality of the RSA while gaining practical experience in roadway safety evaluation.

## 4.3 TEAM QUALIFICATIONS

Below are the qualifications for each team member working on this project:

- **Edgar Guia** is a civil engineering student with experience in the following:
  - Project Management
  - Bluebeam/Microsoft Software
  - Traffic Studies
  - Traffic Safety Analysis
  - Traffic Volume Counts
- **Jacob Reiff** is a civil engineering student with experience in the following:
  - Traffic Studies
  - Highway Engineering
  - Traffic Safety Analysis
  - Crash Data Analysis
- **Ryan Roberts** is a civil engineering student with experience in the following:
  - Traffic Engineering
  - Intelligent Traffic Systems
  - FAA Part 107 Drone Surveying
  - Report Drafting and Revising
- **Skyler Padilla** is a civil engineering student with experience in the following:
  - Autodesk/Microsoft Software
  - Signal Warrant Analysis
  - Traffic Studies
  - MUTCD & AASHTO Safety Evaluations
  - Quality Assurance/Control

## 4.4 STAFFING MATRIX

Below is a staffing matrix describing the estimated number of staff hours required to complete each designated task and subtask. Also, the bottom of the table shows the total hours for each staff position.

In total, the project has an estimated total of 606 hours to complete all tasks. The task with the most hours is project management, which is explained by the number of meetings our team is scheduled to have, as well as schedule and resource management tasks. The next largest tasks in terms of hours estimated are project deliverables and traffic studies. Project deliverables include compiling project progress and creating reports, while traffic studies include field work and crash data analysis which are all highly involved tasks. Overall, the tasks described above encompass the bulk of the work to be completed for this project, which is reflected in the staffing matrix below.

**TABLE 4-3: SUMMARY OF HOURS BY STAFF POSITION**

| Task | SE | PM | TE | RE | EIT | Total |
|---|---|---|---|---|---|---|
| **Task 1.0: Conduct Background Research** | 3 | 2 | 5 | 5 | 7 | 22 |
| Task 1.1: Review Previous RSAs | 2 | 0 | 3 | 3 | 4 | 12 |
| Task 1.2: Obtain Previous Crash Data | 1 | 2 | 2 | 2 | 3 | 10 |
| **Task 2.0: Site Visit** | 10 | 6 | 14 | 14 | 16 | 60 |
| Task 2.1: Drone Survey | 2 | 2 | 2 | 3 | 3 | 12 |
| Task 2.2: Existing Geometry | 2 | 2 | 2 | 3 | 3 | 12 |
| Task 2.3: Identify Pedestrian and Bike Facilities | 2 | 2 | 3 | 2 | 3 | 12 |
| Task 2.4: Overall Safety Analysis | 2 | 0 | 3 | 3 | 3 | 11 |
| Task 2.5: Signal Timing Analysis | 2 | 0 | 4 | 3 | 4 | 13 |
| **Task 3.0: Traffic Studies** | 2 | 18 | 23 | 20 | 20 | 83 |
| Task 3.1: Traffic Volume Study (Fall) | 0 | 3 | 3 | 3 | 3 | 12 |
| Task 3.2: Pedestrian Count Study (Fall) | 0 | 3 | 3 | 3 | 3 | 12 |
| Task 3.3: Bicycle and Multimodal Use Study (Fall) | 0 | 3 | 3 | 3 | 3 | 12 |
| Task 3.4: Traffic Volume Study (Winter) | 0 | 3 | 3 | 3 | 3 | 12 |
| Task 3.5: Pedestrian Count Study (Winter) | 0 | 3 | 3 | 3 | 3 | 12 |
| Task 3.6: Bicycle and Multimodal Use Study (Winter) | 0 | 3 | 3 | 3 | 3 | 12 |
| Task 3.7: Crash Data Analysis | 2 | 0 | 5 | 2 | 2 | 11 |
| **Task 4.0: Generate Alternatives** | 13 | 10 | 16 | 13 | 9 | 61 |
| Task 4.1: Analyze Traffic Study Results | 3 | 2 | 5 | 2 | 2 | 14 |
| Task 4.2: Brainstorm Potential Alternatives | 3 | 2 | 3 | 3 | 2 | 13 |
| Task 4.3: Crash Modification Factors | 1 | 2 | 2 | 2 | 3 | 10 |
| Task 4.4: Decision Matrix | 3 | 2 | 3 | 3 | 1 | 12 |
| Task 4.5: Short/Medium/Long Term Recommendations | 3 | 2 | 3 | 3 | 1 | 12 |
| **Task 5.0: RSA Report** | 8 | 7 | 5 | 5 | 7 | 32 |
| Task 5.1: Finalize Recommendations | 5 | 4 | 3 | 3 | 1 | 16 |
| Task 5.2: Compile all Studies, Data, and Alternatives | 3 | 3 | 2 | 2 | 6 | 16 |
| **Task 6.0: Project Impacts** | 9 | 3 | 12 | 12 | 6 | 42 |
| Task 6.1: Environmental | 3 | 1 | 4 | 4 | 2 | 14 |
| Task 6.2: Economic | 3 | 1 | 4 | 4 | 2 | 14 |
| Task 6.3: Social | 3 | 1 | 4 | 4 | 2 | 14 |
| **Task 7.0: Project Deliverables** | 14 | 14 | 39 | 39 | 42 | 148 |
| Task 7.1: 30% Report | 2 | 2 | 10 | 10 | 10 | 34 |
| Task 7.2: 60% Report | 2 | 2 | 10 | 10 | 10 | 34 |
| Task 7.3: 90% Report | 2 | 2 | 10 | 10 | 10 | 34 |
| Task 7.4: Final Report | 5 | 5 | 4 | 4 | 5 | 23 |
| Task 7.5: Project Website | 3 | 3 | 5 | 5 | 7 | 23 |
| **Task 8.0: Project Management** | 34 | 44 | 28 | 28 | 24 | 158 |
| Task 8.1: Resource Management | 5 | 10 | 2 | 2 | 0 | 19 |
| Task 8.2: Team Meetings | 8 | 8 | 8 | 8 | 8 | 40 |
| Task 8.3: Client and TA Meetings | 8 | 8 | 8 | 8 | 8 | 40 |
| Task 8.4: GI Meetings | 8 | 8 | 8 | 8 | 8 | 40 |
| Task 8.5: Schedule Management | 5 | 10 | 2 | 2 | 0 | 19 |
| **Total of All Tasks** | 93 | 104 | 142 | 136 | 131 | 606 |

## SECTION 5.0: COST OF ENGINEERING SERVICES

In this section, a summary of the cost of engineering services for this project is provided. Each task was evaluated to determine the number of necessary hours needed to complete the tasks as well as the appropriate staffing required to complete those tasks. Corresponding billing rates were determined for each member of staff as well as the necessary expenses needed to carry out the project. The final cost of engineering services reflects an estimate of all personnel time, equipment needs, and travel expenses necessary to support the completion of the project. The table below demonstrates the cost of SERJ's engineering services that will be provided throughout the course of the project.

**TABLE 4-4: COST OF ENGINEERING SERVICES**

<table>
<tr><th rowspan="7">Personnel</th><th>Classification</th><th>Hours</th><th>Rate per Hour</th><th>Cost</th></tr>
<tr><td>Senior Engineer (SE)</td><td>93</td><td>$ 250.00</td><td>$ 23,250.00</td></tr>
<tr><td>Project Manager (PM)</td><td>104</td><td>$ 200.00</td><td>$ 20,800.00</td></tr>
<tr><td>Traffic Engineer (TE)</td><td>142</td><td>$ 150.00</td><td>$ 21,300.00</td></tr>
<tr><td>Roadway Engineer (RE)</td><td>136</td><td>$ 135.00</td><td>$ 18,360.00</td></tr>
<tr><td>Engineering In Training (EIT)</td><td>131</td><td>$ 75.00</td><td>$ 9,825.00</td></tr>
<tr><td colspan="3">Total Personnel</td><td>$ 93,535.00</td></tr>
<tr><th rowspan="4">Travel</th><th>Classification</th><th>Trips</th><th>Rate per Trip</th><th>Cost</th></tr>
<tr><td>Meeting Travel (Roundtrip)</td><td>8</td><td>$ 5.00</td><td>$ 40.00</td></tr>
<tr><td>Site Visit Travel (Roundtrip)</td><td>6</td><td>$ 10.00</td><td>$ 60.00</td></tr>
<tr><td colspan="3">Total Travel</td><td>$ 100.00</td></tr>
<tr><th rowspan="7">Supplies</th><th>Classification</th><th>Days</th><th>Rate per Day</th><th>Cost</th></tr>
<tr><td>JAMAR Boards</td><td>2</td><td>$ 280.00</td><td>$ 560.00</td></tr>
<tr><td>Drone</td><td>1</td><td>$ 1,000.00</td><td>$ 1,000.00</td></tr>
<tr><td>Traffic Lab Access</td><td>6</td><td>$ 100.00</td><td>$ 600.00</td></tr>
<tr><td>SYNCHRO Software (Lump Sum)</td><td>NA</td><td>NA</td><td>$ 1,000.00</td></tr>
<tr><td>Microsoft Software (Lump Sum)</td><td>NA</td><td>NA</td><td>$ 300.00</td></tr>
<tr><td colspan="3">Total Supplies</td><td>$ 3,160.00</td></tr>
<tr><td colspan="4">Total Cost of Engineering Services</td><td>$ 96,795.00</td></tr>
</table>

Based on the cost of personnel, travel, and supplies shown above, the total estimated cost of engineering services was determined to be $96,795.00. The cost of personnel was found to be the highest with a total personnel cost of $93,535.00. This cost was obtained using the staff matrix from the previous section. The staff matrix was used to determine the staff hours required to complete each task and subtask previously mentioned. The total number of hours for each staff position along with the hourly rates were used to calculate the total personnel cost.

The total travel cost was determined to be $100.00. The travel expenses were determined based on anticipated meeting travel and future site visits. These include round-trip travel for the coordination of meetings with our client and our site visits for field observations. Eight meetings are anticipated to take place at the ADOT Regional Traffic Office located in Flagstaff, Arizona. The site visits will be conducted at both intersections for a total of six trips.

Supplies and equipment costs also make up a large section of the total cost of engineering services. The total cost of supplies was determined to be $3,160.00. These costs account for necessary tools, equipment, and software that will be necessary for the execution of the project. The daily rate costs and lump sum costs were applied based on the nature of the item. These supplies and software are necessary to support data collection and analysis throughout the course of the project.

# SECTION 6.0: REFERENCES


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# APPENDICES

## Appendix A: Project Schedule

### A.1 Schedule Gantt Chart