

FINAL REPORT

# Fourth Street Corridor Study - South

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PROJECT NO.: 03-09001



Prepared by



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Engineering an environment of excellence



Prepared for





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## Executive Summary

### Project Background

The City of Flagstaff has adopted the *Flagstaff Area Regional Land Use and Transportation Plan* (November 2001) and *2002 to 2025 Regional Transportation Plan* (May 2002) for the Flagstaff area. These visionary plans are predicated on shaping growth in a way that preserves the natural environment while developing a livable community. The plans set forth guiding policies for attaining a multi-modal transportation system that includes pedestrians, bicycles, transit and vehicles. A key mobility issue identified in the plans is the lack of north-south circulation and multi-modal continuity. To help define specific needs for various north-south corridors, the City of Flagstaff began conducting studies throughout the Flagstaff area. Two corridor studies in the central region were initiated in August 2009, including the *Fourth Street Corridor Study (FSCS) – North* and the *FSCS - South*.

The *FSCS - South* establishes the facility type, number of lanes, and right-of-way of Fourth Street that will eventually be required to accommodate forecast travel demands within the corridor. In cooperation with the local community and adjacent stakeholders, the study identifies the preferred roadway improvements, intersection configurations, multi-modal features, access management guidelines, and a plan for implementing those guidelines that will achieve a high degree of safety and efficiency on the ultimate facility.



Looking north from Butler Avenue along Fourth Street

The *FSCS- South* addresses the critical need for improved roadway circulation, capacity and access in central Flagstaff. The City of Flagstaff was built-up around the east-west railroad line that traverses the middle of the city to this day. While the railroad has historically brought abundant benefits to the community, it also acts as a barrier to north-south movements throughout the region. Fourth Street provides the north-south movement between Linda Vista Drive (northern limit) to Butler Avenue (southern limit), with long range plans for a southern extension to J.W. Powell Blvd. On August 28, 2006, the City opened the Fourth Street Railroad Crossing to enhance north-south transportation operations in the central part of the city. As a result, the traffic on Fourth Street has increased significantly. The City is looking to improve traffic operations, pedestrian safety and multimodal transportation opportunities while implementing a unifying theme that defines the Fourth Street corridor for adjacent residents and commercial property owners as well as motorists, cyclists and pedestrians who utilize the facility on a daily basis.



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### Location and Study Limits

The study is located on Fourth Street in central Flagstaff, see Figure ES-1. The study site is positioned in the Southwest ¼ of Section 13 and Northwest ¼ of Section 24, Township 21 North, Range 07 East, of the Gila and Salt River Base Meridian, Coconino County. The study limits extend from Butler Avenue to Huntington/ Industrial Drive, approximately 0.75 miles in length.

The majority of land within this study area is developed with low to high density residential areas, institutional centers and light industrial facilities. Fourth Street is one of a few established north-south arterial roadways in Flagstaff that has both a grade separated crossing at Interstate 40 (I-40) and the BSNF Railway (BNSF) tracks.

### Goals and Objectives

Two levels of goals were identified for this study, regional and study goals. The regional goal addresses the broad sub-regional transportation challenge that gives rise to the need for the study. The study goals relate to achieving consensus based recommendations.

#### Regional Goal

The regional goal of the study is to provide recommendations consistent with the *2002 – 2025 Regional Transportation Plan*.

#### Study Goals

- Ensure the study addresses the critical concerns of the local community and the City of Flagstaff.
- Define a preferred roadway footprint and intersection configurations (Sparrow, Soliere and Butler Avenues) between Butler Avenue and Huntington/Industrial Drive.
- Establish the basis for design that will meet the City of Flagstaff's circulation and safety needs of all modes.
- Keep the community informed and involved.
- Identify the impacts and resources required for implementation.

Study objectives were established to achieve the goals noted above. Critical study processes and features were outlined for each study goal. See Table 1.6 for more details.

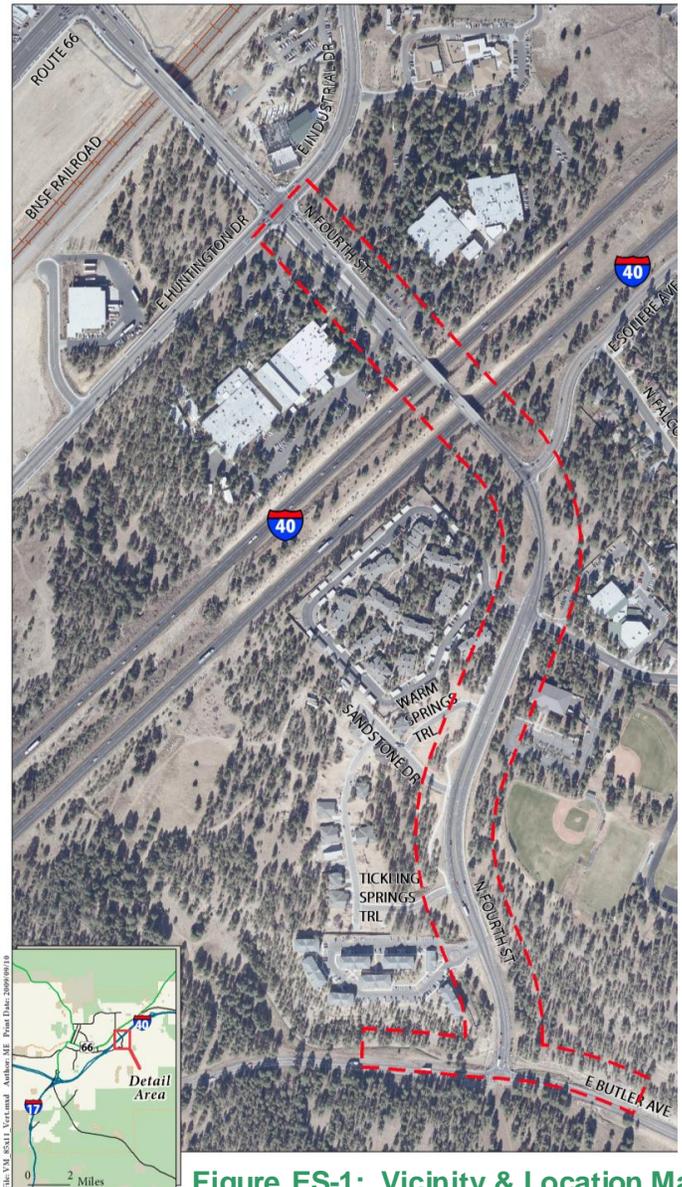


Figure ES-1: Vicinity & Location Map



## Corridor Alternatives

The alternatives developed for evaluation sought to minimize adverse impacts and maximize regional and local benefit. The recommended alternative was selected to best meet the goals and objectives of the study.

### Alternatives

Three primary alternatives were studied, as described in the preceding paragraphs. Four sub-options were developed for each primary alternative based on various combinations of intersection configurations to minimize adverse impacts and optimize best features. The alternatives are limited to the existing Fourth Street corridor. All options provide capacity for the projected traffic of the 2030 design year, upgrading Fourth Street to a minor arterial with two through lanes in each direction. Differences between alternatives are focused on the roadway typical section and geometry. A two-step evaluation process was applied to the following alternative combinations. The four combinations of intersection types possible include:

- A - Conventional intersections at all intersections
- B - Roundabouts at Soliere & Sparrow Avenues, conventional intersection at Butler Avenue
- C - Roundabout at Soliere Avenue, conventional intersections at Sparrow & Butler Avenues
- D - Roundabout at Sparrow Avenue, conventional intersections at Soliere & Butler Avenues

#### Alternative 1, Widen with Flush Median

Alternative 1 would utilize the existing roadway to the fullest extent by sawcutting and widening the pavement to provide a continuous five-lane section between Butler Avenue and I-40. The two through lanes would be separated by a two-way left turn lane (flush median). The existing horizontal and vertical alignments were maintained except at Butler Avenue where the profile grade would be raised to accommodate drainage needs. The segment of Fourth Street previously improved between Tricking Spring Trail and Sparrow Avenue would remain in the existing condition. The Flagstaff Urban Trail System (FUTS) trail would extend from Butler Avenue to Industrial Drive on the west side of Fourth Street. Alternative 1 was expanded to Sub-Alternatives 1A, 1B, 1C and 1D with four different combinations of intersection types.

#### Alternative 2, Partial Reconstruction with Flush Median

Similar to Alternative 1, Alternative 2 would provide a continuous five-lane section separating two through lanes with a two-way left turn lane (flush median). However, in Alternative 2 the roadway would be reconstructed in areas where existing geometry does not meet current design standards for 40 mph. The segment of Fourth Street previously improved would remain in the existing condition. The FUTS trail would extend from Butler Avenue to Industrial Drive on the west side of Fourth Street. Alternative 2 was expanded to Sub-Alternatives 2A, 2B, 2C and 2D with four different combinations of intersection types.

#### Alternative 3, Partial Reconstruction with Raised Median

Alternative 3 consisted of two through lanes in each direction separated by a raised median. Like Alternative 2, the existing roadway would be reconstructed in areas where the geometry



does not meet current design standards for 40 mph. The existing roadway would also require widening in areas that have been previously improved to a five-lane section to accommodate the raised median. The additional width would be attained by sawcutting the east edge between Trickling Springs Trail and Sparrow Avenue, removing the existing curb and gutter, and widening the pavement by 6 feet, curb, gutter and sidewalk. As a result, the entire corridor would have a 4.5 foot bike lane measured to the lip of gutter. Alternative 3 was expanded to Sub-Alternatives 3A, 3B, 3C and 3D with four different combinations of intersection types.

## Evaluation Criteria

The study purpose set forth the basis for the evaluation process. The alternatives analyzed aimed to maintain design standards, avoid impacts and promote multi-modal usage. This included considerations such as providing corridor consistency, minimizing throwaway of existing improvements, enhancing pedestrian and biking opportunities, and maintaining environmental character. The alternative evaluation process involved two levels of assessment. Level 1 Alternatives were evaluated using criteria from the following major categories:

- Traffic Operations – *Meets capacity and delay requirements*
- Roadway - *Meets current design standards*
- Drainage - *Meets current design standards*
- Multi-modal Accommodations – *Compatible with all modes of travel*
- Right-of-Way Requirements – *Considers the area of new right-of-way*
- Other Considerations – *Environmental, utility impacts*
- Construction Cost – *Considers cost to construct alternative for comparison purposes*

Level 2 Alternatives were assessed using the criteria noted below:

- Intersection Level of Service (LOS) – *Operational performance of intersection*
- Overall Intersection Delay – *Wait time at the intersection*
- Vehicle Speed Within Corridor – *Design speed and posted speed*
- Vehicle Crashes – *Based on published data that considers intersection safety*
- Bicycle Friendly – *Level of comfort users experience from the alternative*
- Pedestrian Friendly – *Level of comfort users experience from the alternative*
- Physical Features Conducive to Intersection Type – *Approach grades considered*
- Environmental Concerns – *Air and noise quality, as well as wasting natural resources*
- New Right-of-Way Required - *Considers the area of new right-of-way*
- Construction Costs – *Considers cost to construct alternative for comparison purposes*

## Preferred Alternative

*Alternative 3A – Partial Reconstruction with Raised Median and Conventional Intersections* was selected as the recommended alternative of the *FSCS – South*. As identified through the Level 1 and Level 2 alternative evaluation process, this alternative best achieved the goals and needs established for this corridor. Alternative 3A provides the greatest consistency with the *Flagstaff Area Regional Land Use and Transportation Plan* and the *2002 to 2025 Regional Transportation Plan*, which identifies Fourth Street as a multimodal facility linking commercial, educational, recreational, employment and residential areas with developable lands to the south. Also, the raised median typical section is the City’s preferred section for a minor arterial.



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The implementation of Alternative 3A includes two projects, *Alternative 3A – South (Butler Avenue to Trickling Springs Trail)* and *Alternative 3A – North (Trickling Springs Trail to Huntington / Industrial Drive)* due to constructability considerations at Butler Avenue. Project *Alternative 3A - South* reconstructs the Fourth Street and Butler Avenue intersection including 750 lineal feet of approach roadway on Fourth Street and 1,750 lineal feet on Butler Avenue. *Alternative 3A - North* includes all of the ultimate improvements on Fourth Street from Trickling Springs Trail to Huntington/Industrial Drive. The projects can be constructed in any order. The preliminary total project cost is \$6,570,000 for *Alternative 3A – South* and \$7,560,000 for *Alternative 3A – North*. The preliminary estimates include construction, design, construction management, new right-of-way and utility relocation costs.

### Public Outreach

Public outreach was critical component of this study. Two public information meetings were held during the course of the study process. The first meeting, held on September 9, 2009, provided the community with an opportunity to inform the study team about the study area and local transportation needs as well as comment on preliminary alternative concepts. The second meeting was held December 9, 2009. This meeting identified the preferred alternative and solicited input on intersection types at Sparrow and Soliere Avenues.

The study team presented recommendations to the City of Flagstaff City Council at their work session held January 26, 2010. The Council concurred with the recommendations. City staff will request adoption of the recommendations with the completion of the *FSCS – South*.

### Considerations for Future Development

A list of considerations has been compiled to assist with the future development of the Fourth Street corridor. In general, the development progression may start with identifying the need for, then preparing a Design Concept Report (DCR) that better defines the proposed improvements. The DCR will provide the necessary information for specific design and construction projects to the funded in the City of Flagstaff *Transportation Improvement Program (TIP)*. Projects may be advanced according to developer participation.

- *Project Funding* - Funding for final design and construction has not yet been identified. The *FSCS – South* recommendations will be evaluated for inclusion in the Flagstaff *TIP*. A portion of the funding may come from adjacent developments as part of project requirements.
- *Study Adoption* - The City of Flagstaff will be responsible for seeking Council adoption and updating the Regional Transportation Plan with the *FSCS – South* recommendations.
- *Right-of-Way Preservation* - A DCR-level document is needed to preserve the right-of-way requirements for the Fourth Street corridor. The City of Flagstaff will be responsible for obtaining new right-of-way and/or preserving the corridor during future development.



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- *Fourth Street I-40 Underpass Structures* - The existing structures will require widening to accommodate the future traffic needs on Fourth Street. The structures are owned and maintained by ADOT. As part of the *I-40 Belmont to Winona DCR and EA*, it is anticipated that capacity on I-40 will be increased with additional lanes in the eastbound and westbound directions. The Initial DCR has not yet been prepared, however ADOT Flagstaff District and Bridge Section have indicated that the bridges will be replaced. The Fourth Street Underpasses can be widened to meet the needs of the *FSCS – South*. Cost sharing opportunities should be explored between the agencies.
- *Environmental Impacts* - The environmental task for this study was limited to identifying the future level of documentation needed for this project. Due to the impacts associated with improving the Fourth Street Underpass Structures for I-40, the project will require Federal Highway Administration (FHWA) approval. Concurrent with this study, the Arizona Department of Transportation (ADOT), in conjunction with FHWA, is preparing the *I-40 Belmont to Winona DCR and Environmental Assessment (EA)*, which includes the Fourth Street Underpasses. The *FSCS – South* team inquired with ADOT about the possibility of utilizing the environmental work in this area as a result of the EA to avoid duplicate efforts and FHWA review. The City of Flagstaff will be responsible for requesting ADOT Environmental Planning Group to include bridge widening with the EA. If this is agreed upon, major improvements to the Fourth Street Underpass Structures will not be allowed until the EA is complete, which is estimated to take approximately 2 years.
- *Butler Avenue Improvements* - Butler Avenue at Fourth Street has been previously studied by the City of Flagstaff. Improvements recommended by the study impact the Fourth Street corridor, including the proposal to raise the intersection by 4.5 feet to place it above the 100-year flood elevation. While raising the intersection has little impact on selecting the preferred alternative for widening Fourth Street, it does play a large role in implementing the corridor improvements.
- *Northland Preparatory Academy Potential Improvements* - Northland Preparatory Academy has held a pre-application meeting with the City regarding future expansion plans. The Academy is considering purchasing the property immediately north of their existing facilities to increase services, provide recreational facilities and improve traffic circulation. This acquisition will increase their frontage from Sparrow Avenue to Soliere Avenue. Access to the school will be from both crossroads, which will change traffic patterns in the area.
- *Drainage* - The existing Fourth Street roadway is partly located in a flood zone at its intersection with Butler Avenue. The roadway must be designed to accommodate the water flow from major storms without flooding. The alignment conflicts with the delineated 100-year floodplains. Conditional Letters of Map Revision (CLOMR) may be required for the construction of proposed improvements. The “North East Area Master Drainage Study – Phase 1” by the WLB Group evaluated regional drainage solutions in the Switzer Canyon Wash area. Further coordination will be required to avoid unnecessary throwaway improvements.



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- *Bicycle, Pedestrian and Transit Access* - The corridor will be designed to accommodate alternative modes of travel to help encourage reduction in single occupant vehicle usage over time and provide access to trails and neighborhoods in the area.
- *Utility Relocations* - Utility relocations will be required to implement the corridor improvements. Coordination with existing utility owners is required. New utilities should be coordinated with the recommended improvements to minimize future conflicts.
- *Landscaping Plans* – Landscaping will be a part of the final project design for this corridor. Through significant public outreach, the *FSCS – North* is developing thematic options the Fourth Street corridor. Recommendations from the *FSCS – North* will be used on the south corridor, as applicable. The streetscape design may include aesthetic treatments for structures, lighting, bus stop embellishments as well as landscaping. The *FSCS – North* also is considering areas for public art, which may extend to the south corridor.



# 1 Introduction

## 1.1 Project Overview

The City of Flagstaff has conducted a Corridor Study for a section of Fourth Street extending from Butler Avenue to Huntington/Industrial Drive, see Figure 1.1. The corridor length is approximately 0.75 miles. This study, the *Fourth Street Corridor Study (FSCS) - South* was one of two concurrent studies initiated by the City to determine needed improvements on Fourth Street. By undertaking the *FSCS - South* simultaneously with the *FSCS - North*, the City elicited input from various public and private stakeholders along and adjacent to the corridor to develop a plan that best meets the transportation, access, future development and aesthetic needs of the Flagstaff community. The recommendations of the studies should be consistent with the *Flagstaff Area Regional Land Use and Transportation Plan* that strives to increase safety, balance, connectivity, efficiency and diversity.

Fourth Street is a key component of the regional transportation network. It is a multi-modal corridor that links commercial, educational, recreational, employment and residential areas with developable lands to the south. The Fourth Street corridor is one of a few established north-south arterial roadways in Flagstaff that has a grade separated crossing of Interstate 40 (I-40) and the BSNF Railway (BNSF) tracks. Construction of the railroad crossing was completed in 2006 and resulted in increased traffic volumes on Fourth Street. Due to the continued increase in projected traffic, roadway capacity and phasing of traffic improvements needed to be evaluated.



Figure 1.1: Vicinity & Location Map



This section of Fourth Street is classified as a minor arterial according to *Map 10* of the *Circulation – Regional Roadway Categorization Plan*. Presently within the corridor study area, Fourth Street exists as a variable-width paved roadway providing five lanes in some segments and only two lanes in others. During the past 14 years, some segments of the roadway have been improved by the City of Flagstaff and private development, leaving an inconsistent roadway cross section. This requires motorists to frequently merge from the outside dropped lane, creating driver frustration and potential for conflict.

Existing traffic generators in this corridor consist of low to high density residential developments, educational facilities and light industrial. Predicted destinations are the Sinagua High School, Flagstaff Unified School District (FUSD) Administrative Center, Northland Preparatory Academy and the two campuses of W.L. Gore and Associates (Gore). Future developments will generate additional low to medium residential traffic and some light industrial traffic. Additionally, significant development is anticipated in the region to the south of Butler Avenue, which will add a higher volume of pass-through traffic to the Fourth Street corridor.

The primary purpose of the *FSCS - South* is to evaluate the Fourth Street corridor needs from Butler Avenue to Huntington/Industrial Drive and provide definition of the future multimodal facility. This corridor study establishes the facility type, number of lanes, and right-of-way that will eventually be required to accommodate forecast travel demands within the area. The study also develops access management guidelines and a plan for the implementation of those guidelines that will ensure a high degree of safety and efficiency on the ultimate facility.

## **1.2 Other Transportation Studies in the Vicinity**

Two other related studies are currently being conducted in the study area; the City of Flagstaff *FSCS - North* and the Arizona Department of Transportation (ADOT) *I-40 Design Concept Report (DCR) and Environmental Assessment (EA)*.

The City of Flagstaff initiated the *FSCS - North* and *FSCS - South* in August 2009. The *FSCS - North* study limits extend from Route 66 north to Linda Vista Drive. It is a revitalization study involving significant public outreach. The anticipated completion date is April 2010. The *FSCS - South* team is coordinating closely with the North study team to ensure a unified message is presented to the public and applicable solutions from the *FSCS - North* are utilized in the South Study. These solutions will potentially include Fourth Street thematic features, landscaping and public art.

The *ADOT I-40, Bellemont to Winona DCR and EA* was initiated in the spring of 2009. The purpose of the DCR is to develop a long-range plan to provide added capacity to and improve operations on I-40 from milepost 184 to milepost 214. Public and agency scoping meetings occurred in July 2009. The Initial DCR and Draft EA are expected in spring 2010. The significance of the I-40 DCR to Fourth Street will be to recommend additional number of lanes on eastbound and westbound I-40 beneath the underpass structures. Input received during the scoping process involved potentially increasing I-40 capacity from two lanes to three or four



lanes in each direction. Since the capacity recommendation will occur after the *FSCS - South* is complete, various options for widening I-40 are considered in this study. Opportunities to partner with ADOT on environmental documentation and structural improvements have been explored as part of the *FSCS - South*.

Other studies that have been recently completed include:

- *Butler Avenue DCR (2008)*: This study was prepared to evaluate Butler Avenue between Sinagua Heights and the I-40 Traffic Interchange (TI) west of Little America. The recommendations included raising the Butler Avenue and Fourth Street intersection by 4.5 feet since a 1,300-foot section of Butler Avenue is inundated by the 100-year storm event. Consideration for the coordinated effort on Butler Avenue and Fourth Street is necessary to avoid throwaway improvements.
- *ADOT I-40 / Butler Avenue TI Study (2006 - 2009)*: The final scoping document has been completed for enhancing the Butler Avenue TI. In addition, the team is evaluating a possible roundabout concept in conjunction with City of Flagstaff. A preliminary report is expected in October 2009.
- *Fourth Street/I-40 TI Study (2007)*: The study was prepared to evaluate and document the feasibility of adding a TI to I-40 at Fourth Street. The interchange alternatives were evaluated in terms of impact on regional and local traffic volumes and traffic patterns, effect on adjacent properties, cost, future potential economic development, environmental impacts, and stakeholder and agency support. The study concluded that further examination of a TI at Fourth Street is not recommended.

### 1.3 Need for Study

The *FSCS - South* addresses the critical need for improved roadway circulation, capacity and access in central Flagstaff. The City of Flagstaff was built-up around the east-west railroad line that traverses the middle of the city to this day. While the railroad has historically brought abundant benefits to the community, it also acts as a barrier to north-south movements throughout the region. Fourth Street provides the north-south movement between Linda Vista Drive (northern limit) to Butler Avenue (southern limit), with long range plans for a southern extension to J.W. Powell Blvd. On August 28, 2006, the City opened the Fourth Street Railroad Crossing to enhance north-south transportation operations in the central part of the city. As a result, the traffic on Fourth Street has increased significantly. The City is





looking to improve traffic operations, pedestrian safety and multimodal transportation opportunities while implementing a unifying theme that defines the Fourth Street corridor for adjacent residents and commercial property owners as well as motorists who utilize the facility on a daily basis. This study identifies the preferred interim and ultimate improvements required for the corridor.

## 1.4 Study Description

The improvements associated with the Fourth Street corridor between Butler Avenue and I-40 include constructing a continuous four-lane minor arterial with two travel lanes in each direction to accommodate traffic for the design year 2030. Pedestrian and bicycle traffic are accommodated on both sides of the roadway. Bike lanes within the roadway section are provided in each direction. A five-foot detached sidewalk is provided on the east side of Fourth Street and a ten-foot detached Flagstaff Urban Trail System (FUTS) trail is provided on the west side. Additional right-of-way is required for this roadway section.

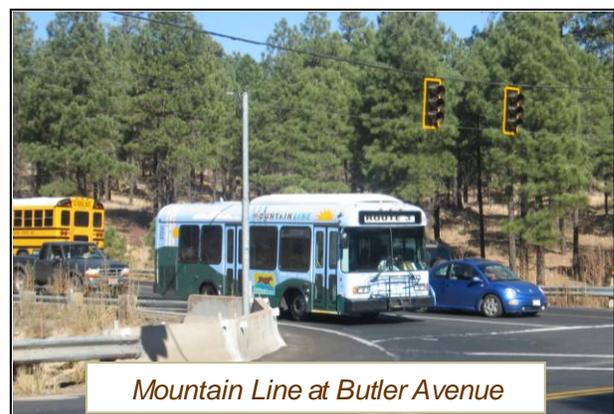
Between I-40 and Huntington/Industrial Drive, the roadway improvements providing two through lanes in each direction were previously constructed with the Fourth Street Railroad Crossing Project. As part of this study, the existing five-foot sidewalk on the west side of Fourth Street will be widened to the ten-foot FUTS trail standard width, which will complete the Fourth Street Trail and provide connectivity to the Route 66 Trail and Switzer Wash Trail.

At I-40, the existing bridges must be widened or replaced to provide for two through lanes in each direction. According to the 2008 ADOT Bridge Inspection Reports, the bridges are structurally sound and can be widened without decreasing the existing vertical clearance to I-40.

Two different intersection types were evaluated for use within the corridor; conventional intersections (signals) and roundabouts. The preferred intersection type is the conventional intersection. The selection of the intersection type was based on the forecasted traffic patterns, pedestrian/bicycle considerations, and new right-of-way requirements. Signals warrants were evaluated throughout the corridor for the existing and future needs. The required capacity for left and right turning movements at each intersection was also determined.

At-grade pedestrian and bike crossings are located at each signalized intersection. A flashing beacon is recommended to be installed at the existing pedestrian crossing connecting the Gore campuses.

Transit facilities will be relocated to improve traffic flow on Fourth Street, which is on Route 3 of the Mountain Line. Two bus stops are located on the south side of Sparrow Avenue, one in each direction of travel. Constructing bus pullouts on the downstream side is desirable.





Improvements to the transit facilities will be coordinated with the Northern Arizona Intergovernmental Public Transportation Authority (NAIPTA).

Drainage culverts will be installed to meet the City of Flagstaff *Stormwater Management Design Manual (SWMDM)* and provide all-weather access. According to the recommendations of the Butler Avenue DCR, one major drainage structure will be located within the corridor north of Butler Avenue. All other culverts are single pipes of less than 24 inches in diameter.

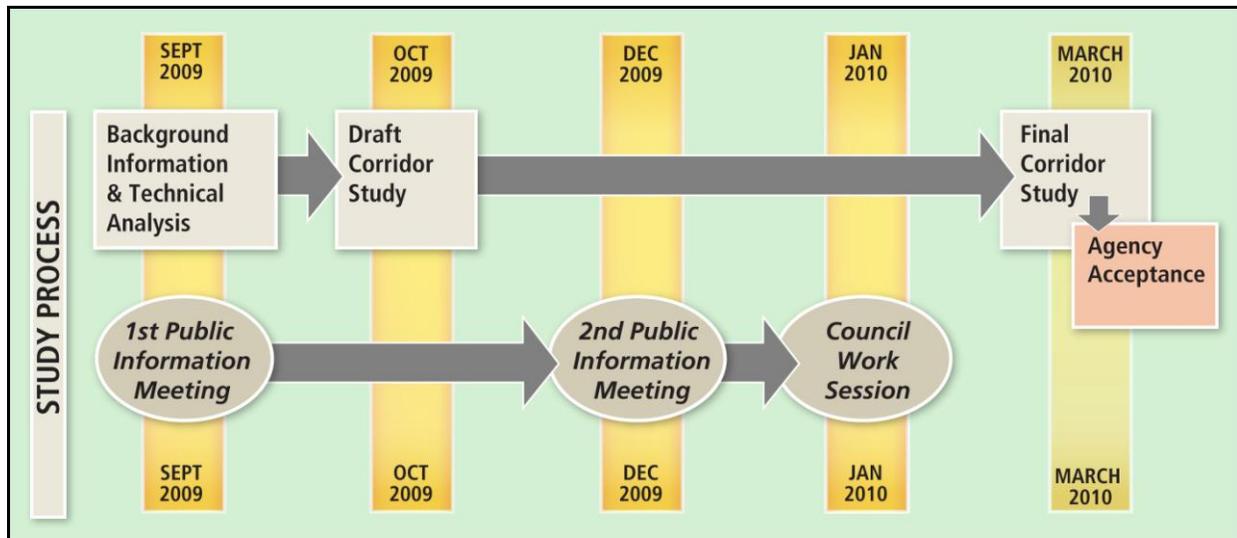
Access management features are considered to improve traffic flow along the corridor. As this facility is an arterial, direct access to and from private residences is discouraged and future commercial driveways should be minimized or encouraged to access the local connector.

The ultimate improvements of the Fourth Street corridor will be implemented in two projects due to constructability considerations at Butler Avenue. The projects can be constructed in any order or combined. Potential interim projects are also provided to address immediate concerns noted during the study process.

## 1.5 Study Process

The *FSCS - South* was conducted in two phases: a Planning Phase and an Engineering Phase.

**Figure 1.5: Project and Study Process**



**Planning Phase:** During the Planning Phase, the study team gathered general background information and performed technical analyses (traffic analysis, drainage, utilities) leading to recommendations for improvements along Fourth Street. Meetings were conducted with affected jurisdictions, agencies, stakeholders and the impacted public to form a broad consensus of the overall needs and vision of the corridor. Based on the needs identified, alternatives were developed and evaluated for technical feasibility, public acceptability and economic viability. The alternative evaluation followed a two-step process. The Level 1 Evaluation considered a



broad range of improvement options. Evaluation criterion was developed to reflect the study goals and objectives, intending to identify any fatally flawed alternatives. The Level 2 Evaluation analyzed the intersection treatments of the advanced alternative in greater detail. From this evaluation, a preferred alternative was selected and presented in the *Draft FCSC – South* report for concurrence by the study team.

*Engineering Phase:* The Engineering Phase of the study followed concurrence of the preferred alternative by the study team and is presented in the *Final FSCS - South Report*. Preliminary engineering design plans, right-of-way requirements and estimated construction costs have been prepared for near-term and long-term roadway improvements. Roadway construction phasing priorities, along with policies and guidelines to preserve the intended function of the future roadway, are also developed.

Coordination and collaboration among the study team members ensured that the *FSCS - South* meets transportation needs, considers public and agency stakeholder input, respects budget constraints, and is technically feasible. Study team members participated in the process on multiple levels including Organizational, Departmental, Study, Stakeholder, and Public Involvement responsibilities.

## 1.6 Study Goals and Objectives

The regional goal of the study is to provide recommendations consistent with the *2002 – 2025 Regional Transportation Plan*. To achieve this goal, specific study goals and objectives were established, as summarized in Table 1.6.

**Table 1.6: Study Goals**

Goals	Objectives
Ensure the study addresses the critical concerns of the local community and the City of Flagstaff.	<ul style="list-style-type: none"> <li>▪ Take full advantage of the public involvement opportunities to understand the issues and how they can best be addressed in the course of developing alternatives and solutions</li> <li>▪ Attain a high level of mobility while preserving the community character</li> </ul>
Define a preferred roadway footprint and intersection configurations (Butler, Sparrow, and Soliere Avenues) between Butler Avenue and Huntington/Industrial Drive.	<ul style="list-style-type: none"> <li>▪ Establish centerline alignment</li> <li>▪ Define needed carrying capacity (number of lanes)</li> <li>▪ Recommend realistic access management plan</li> <li>▪ Ensure support of existing and future land uses</li> </ul>
Establish the basis for design that will meet the City of Flagstaff’s circulation and safety needs of all modes.	<ul style="list-style-type: none"> <li>▪ Prepare preliminary design plans for the 0.75 mile segment between Butler Avenue and Industrial Drive and with sufficient detail to identify critical design issues and develop solutions or strategies for solutions.</li> <li>▪ Ensure roadway design meets City requirements for safety and operational efficiency</li> <li>▪ Develop conceptual plans to connect the two existing FUTS trails located at the study termini</li> <li>▪ Include bike lanes on Fourth Street</li> </ul>



Goals	Objectives
	<ul style="list-style-type: none"> <li>▪ Provide pedestrian friendly solutions throughout corridor, especially at Sparrow Avenue where children and transit users cross the roadway</li> <li>▪ Address pedestrian crossing, ingress and egress issues associated with Gore</li> <li>▪ Coordinate with ADOT on options for the existing Fourth Street Overpass over I-40</li> </ul>
Keep the community informed and involved as we move forward together in completing this study.	<ul style="list-style-type: none"> <li>▪ Conduct community information meetings</li> <li>▪ Establish and maintain open lines of communication with the community</li> <li>▪ Provide study information to local associations at their regular meetings, as requested</li> </ul>
Identify the impacts and resources required for implementation.	<ul style="list-style-type: none"> <li>▪ Identify 401/404 permit needs for future improvements.</li> <li>▪ Research type of environmental documentation required for the recommended alternative</li> <li>▪ Define prioritized interim and ultimate improvements.</li> <li>▪ Determine project cost for future funding</li> <li>▪ Note any special project requirements</li> </ul>

## 1.7 Public and Stakeholder Involvement

Gaining consensus among the agencies and the public is critical to the success of the study and implementation of its recommendations. Two public information meetings were held during the course of the study process as well as a work session presentation to City Council. Summary reports from the public meeting activities are provided in Appendix C.

The first meeting, held on September 9, 2009, provided the community with an opportunity to inform the study team about the study area and local transportation needs as well as comment on preliminary alternative concepts. The meeting was open house format. The community’s most important improvements to be made to Fourth Street included:

- Widen roadway (and I-40 bridges)
- Improve intersections (hard to turn on to Fourth Street )
- Improve pedestrian features (sidewalks, crossings)

The second meeting was held on December 9, 2009. Project Manager Bret Petersen presented the study findings and recommended improvements. Intersection types at Sparrow and Soliere Avenues were discussed at length. The Summit Park Condominium community provided a written summary of their concerns and recommendations as part of the comment process.

The study team presented the *FSCS - South* findings and recommendations to the City Council on January 26, 2010 during a work session. The recommendations included the preferred alternative and the intersection types at key crossroads. The Council supported the recommendations. The City of Flagstaff Capital Improvement staff will request adoption from the Council once the *FSCS – South* has been finalized.



## 2 Corridor Characteristics

### 2.1 Existing Conditions

Fourth Street is a collection of various roadway sections between Butler Avenue and Huntington/Industrial Drive, approximately 0.75 miles in length. The existing roadway ranges in functional classification from a minor collector to an urban minor arterial with a posted speed of 35 mph. At the northern terminus, the roadway has been improved to an urban five-lane section with the recent Fourth Street Railroad Crossing Project. Approximately 200 feet north of I-40, Fourth Street narrows to one travel lane in each direction, widening south of I-40 to provide a left turn lane at the intersection with Soliere Avenue. South of Sparrow Avenue to Trickling Springs Trail, Fourth Street has two travel lanes in each direction separated by a two-way continuous left turn lane. Improvement projects occurring within the study limits are summarized in Table 2.1-1.

**Table 2.1-1: Previous Project Summary**

<b>Project Name</b>	<b>Date</b>	<b>Limits</b>	<b>Description</b>
Butler Avenue at Fourth Street	2006	Butler Avenue and Fourth Street Intersection	Temporary Signal
Forest Springs Townhomes	2005	Trickling Springs Trail to Sparrow Avenue	Widen Fourth Street to five-lane; FUTS trail
Fourth Street Railroad Crossing (Phase 1)	2003	I-40 to Route 66	Reconstruct Fourth Street to five-lane; Connect to Route 66; FUTS trail
Soliere Avenue Extension Project	2002	Fourth Street / Soliere Avenue	Connect Soliere Avenue to Fourth Street
Summit Park Condominiums (Phase 1)	1996	Fourth Street / Sparrow Avenue	Adjacent development
Summit Park Condominiums (Phase 2)	1996	Fourth Street / Sparrow Avenue	Adjacent development
Fourth Street Extension	1983	Butler Avenue to Sparrow Avenue	26-foot roadway grade and drain
Fourth Street	1979	I-40 to Sparrow Avenue	26-foot roadway grade and drain

The roadway geometry was reviewed according to as-built information collected for the study and compared against the City of Flagstaff *Engineering and Construction Standards* (January 20, 2009) and AASHTO *A Policy on Geometric Design of Highways and Streets* (2004) for a 40 mph design speed.

The horizontal alignment consists of three horizontal curves as summarized in the following table. One horizontal curve does not meet current design standards for curvature. The existing rate of superelevation for the horizontal curves was not identified on the as-builts nor was survey



information for the existing roadway collected as part of this study. According to Exhibit 3-16 in the AASHTO *A Policy on Geometric Design of Highways and Streets* (2004), superelevation is not required for a radius greater than 726 feet (applicable for a roadway crowned at 1.5%).

**Table 2.1-2: Existing Horizontal Geometry**

Location	Radius	Meets City Requirements
Butler Avenue, North Approach	650 ft	Yes
Trickling Springs Trail to Sandstone Drive	750 ft	Yes
Soliere Avenue, South Approach	575 ft	No

The vertical geometry consists of four vertical curves as summarized in the following table. One vertical curve does not meet current design standards for stopping sight distance (SSD). All vertical grades comply with City standards.

**Table 2.1-3: Existing Vertical Geometry**

Location	Grade In Grade Out	Curve Length (Curve Type)	Available SSD (Required SSD)	K Factor (Required K)
Butler Avenue	3.44% 6.00%	400 ft (Sag)	563 ft (332 ft)	78 (64)
Trickling Springs Trail	6.00% 1.78%	400 ft (Crest)	456 ft (332 ft)	94 (44)
Sparrow Avenue	1.78% -4.77%	400 ft (Crest)	363 ft (325 ft)	94 (44)
Soliere Avenue	-4.77% 3.00%	500 ft (Sag)	260 ft (325 ft)	64 (64)
I-40	3.00% -3.00%	450 ft (Crest)	402 ft (315 ft)	75 (44)

The existing pavement between Butler Avenue and I-40 consists of 3 ½ to 5 inches of AC over 7 to 11 inches of ABC. The original pavement was constructed in 1979. Between I-40 and Huntington/Industrial Drive, the existing pavement consists of 3 inches of AC over 8 inches of ABC and 14 inches of select fill, which was constructed in 2006.

The study site consists of the Fourth Street right-of-way and is positioned in the Southwest ¼ of Section 13 and Northwest ¼ of Section 24, Township 21 North, Range 07 East, of the Gila and Salt River Base Meridian, Coconino County. The existing right-of-way limits are summarized in the following table. The original existing Fourth Street right-of-way width was 80 feet, 40 feet west and east of centerline. With the addition of each new development on the west side of the road, additional right-of-way was dedicated. Through the section of Fourth Street between I-40 and Huntington/Industrial Drive, additional right-of-way was acquired by the City of Flagstaff for the railroad crossing project.



**Table 2.1-4: Existing Right-of-Way Limits**

Location	West Side	East Side
Butler Avenue to Trickle Springs Trail	55 ft	50 ft
Trickle Springs Trail to Sparrow Avenue	50 ft	40 ft
Sparrow Avenue to Soliere Avenue	40 ft	40 ft
Soliere Avenue to I-40	35 ft	45 ft
I-40 to Huntington/Industrial Drive	59 ft	54 ft

All access points within the corridor are shown in Table 2.1-6. The City of Flagstaff has successfully controlled the number of direct access points onto Fourth Street through the development process. On the west side of Fourth Street between Butler Avenue and I-40, all access points enter the high to medium density residential developments of Pinehurst Apartments, Forest Springs Townhomes and Summit Park Condominiums. Access has been combined into five points. On the east side of Fourth Street, public points of interest Sinagua High School, FUSD Administration Center and Northland Preparatory Academy abut the roadway along with three undeveloped parcels. Access to these locations is from the crossroads with no direct access from Fourth Street. North of I-40, access points to the Gore facilities exist both west and east of the roadway.

**Table 2.1-5: Access on Fourth Street**

Fourth Street Between		No. of Driveways	
South	North	West	East
Butler Avenue	I-40	5	0
I-40	Huntington/Industrial Drive	2	2

Currently, the segment of Fourth Street from Butler Avenue to Soliere Avenue is used by Mountain Line Route 3 (Green Route). Buses travel in both directions along Soliere Avenue, Fourth Street, and Butler Avenue (west of Fourth Street). Two existing stops for Route 3 are located within the corridor study area, at the intersection of Fourth Street and Sparrow Avenue:

- Stop 23: A southbound stop is located south of the Sparrow intersection on the west side of Fourth Street. Amenities include a bench and a trash can. Stop 23 is in-line (not a pull-out). However, the bus is able to partially pull out of traffic by using the bike lane.
- Stop 9: A northbound stop is located on the south side of the Sparrow intersection on the east side of Fourth Street. Amenities include a shelter, trash can, and bike rack. Stop 9 uses the existing right-turn lane for Sparrow Avenue.

The existing utilities include underground electric, water, sewer, gas, telephone, telephone fiber optic, and cable. APS electric is the only known utility that crosses I-40. In general, the utilities are located along the west side of Fourth Street, cross the roadway at Sparrow Avenue or Soliere Avenue and continue adjacent to the crossroads.



## 2.2 Traffic

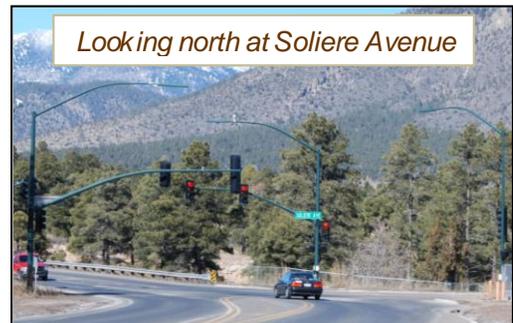
The existing 24-hour traffic counts conducted by Traffic Research & Analysis, Inc. in July and August 2008 were provided by the Flagstaff Metropolitan Planning Organization (FMPO). The counts show that Fourth Street carries 18,600 vehicles per day (vpd) between Route 66 and the I-40 overpass. South of Sparrow Avenue, Fourth Street carries 9,800 vpd. Soliere Avenue and Sparrow Avenue east of Fourth Street carry 5,200 vpd and 3,200 vpd, respectively. Butler Avenue carries 14,400 vpd west of Fourth Street and 9,700 vpd east of Fourth Street. Table 2.2-1 summarizes the existing daily traffic in the area.

**Table 2.2-1: Existing Daily Traffic Volumes**

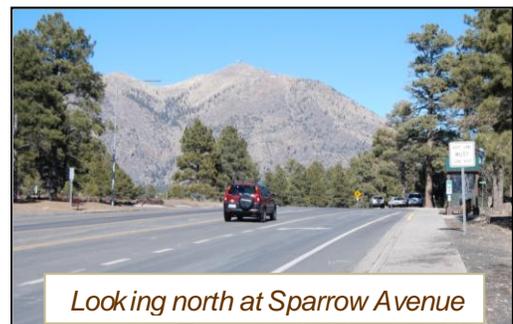
Location	ADT (VPD)
Butler Avenue (East of Fourth Street)	9,700
Butler Avenue (West of Fourth Street)	14,400
Sparrow Avenue (East of Fourth Street)	3,200
Soliere Avenue (East of Fourth Street)	5,200
Fourth Street (South of Sparrow Avenue)	9,900
Fourth Street (North of I-40)	18,600

*Source: 2008 City of Flagstaff 24-hour traffic counts*

Additionally, two hour afternoon peak (PM) turning movement counts were completed in May 2009 along Fourth Street at Soliere Avenue, Sparrow Avenue and Butler Avenue intersections. One peak hour was identified from the PM peak periods and the results are shown in Figure 2.2 on the existing roadway network.



The existing Fourth Street corridor is generally bordered along the west side by multi-unit residential development and along the east side by a combination of office and school buildings, as well as vacant forest land.

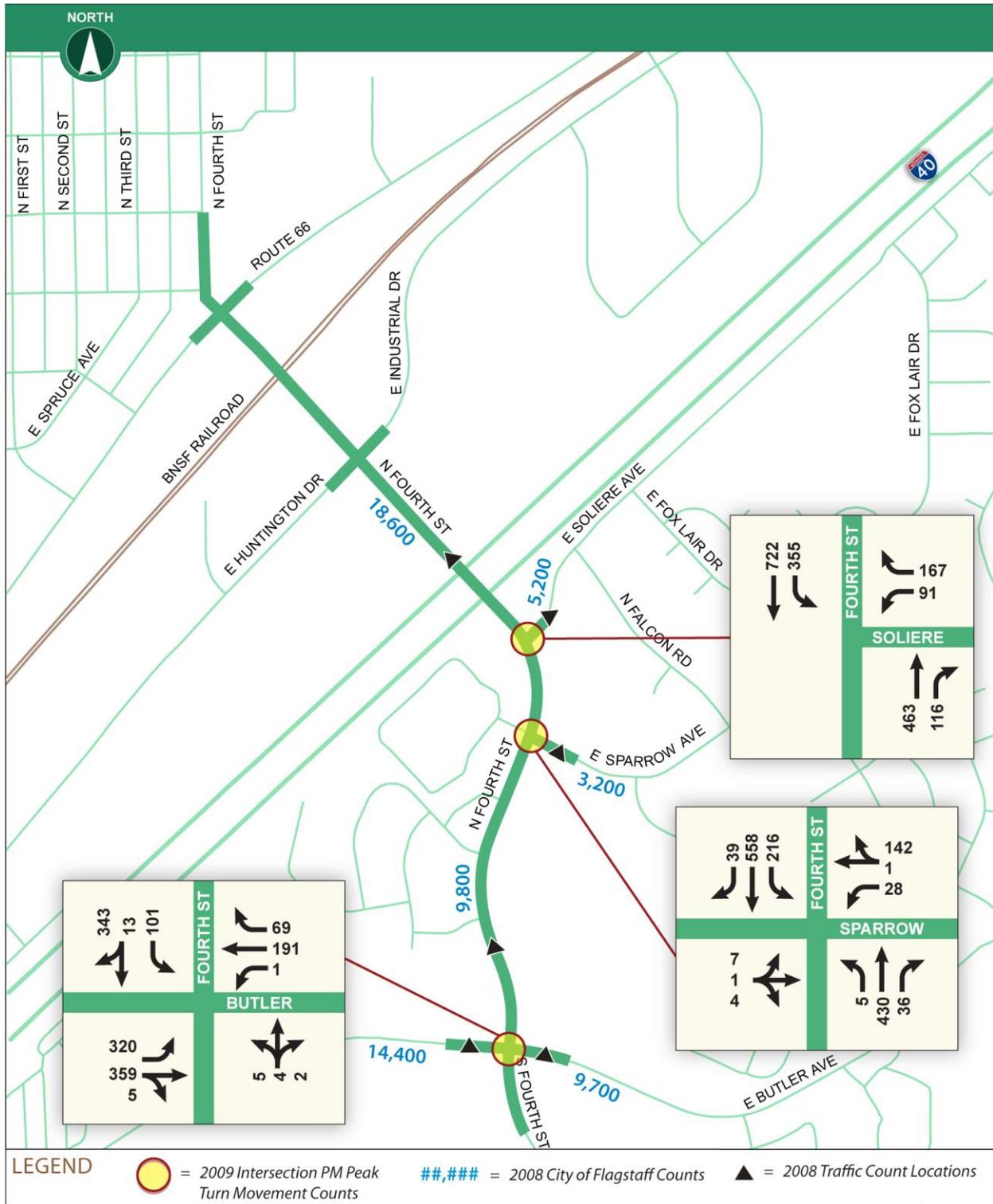


The existing roadway width varies from one lane in each direction to four lanes with left turn bays at the major crossroad intersections. South of I-40, three crossroads exist, all approaching Fourth Street with one lane in each direction. Signalized intersections are located at Butler Avenue, Soliere Avenue and Industrial Drive. The existing traffic signals are maintained and operated by City of Flagstaff and are configured as follows:



## Fourth Street – South Butler Avenue to Huntington / Industrial Drive Final Corridor Study

Figure 2.2: Existing Traffic Network





**Table 2.2-2: Existing Fourth Street Lane Configurations at Crossroads**

Intersection	Classification	Type	Traffic Control	Number of Approach Lanes			
				N	S	E	W
Butler Avenue	Major	"T"	Signal	1	Unpaved	1	1
Sparrow Avenue	Minor	"T"	One-Way Stop	1	2	1	Drive-way
Solier Avenue	Minor	"T"	Signal	1	1	1	-
Industrial Drive	Major	"+"	Signal	2	2	1	1

Crash data was obtained from ADOT for the time period January 1, 2004 through December 31, 2008, summarized in Table 2.2-3. There were a total of 155 incidents recorded during this five-year period. Of these, 31 crashes resulted in an injury. The most common type of crash was rear end collisions (46%), while collisions of single vehicle with pedestrian/cyclist or fixed objective were a close second (18%). The other significant type of crash was angle right angle, which accounted for 16% of the total number of crashes.

Less than two percent of all crashes were alcohol related, and weather or road surface conditions did not contribute to a significant number of crashes. The largest percentage of crashes in adverse roadway surface conditions were on ice or frost surface (8%). Nineteen percent of all crashes occurred at night or unknown lighting condition, and 4% at dawn.

**Table 2.2-3: Accident Summary**

Location	Total No. of Crashes	Severity			
		Incapacitating Injury	Non-Incapacitating Injury	Possible Injury	No Injury
Industrial Drive to Soliere Avenue	85	1	4	13	69
Solier Avenue to Sparrow Avenue	27	1	2	0	22
Sparrow Avenue to Butler Avenue	43	3	3	4	33

## 2.3 Drainage

The project watershed is comprised of native ponderosa pine/mixed conifer vegetation with scattered development that, for the most part, has not altered historical drainage patterns. The Switzer Canyon Wash is the most significant drainage conveyance feature in the area. The wash is located along the north side of Butler Avenue and conveys runoff to the east.



## Fourth Street – South Butler Avenue to Huntington / Industrial Drive Final Corridor Study



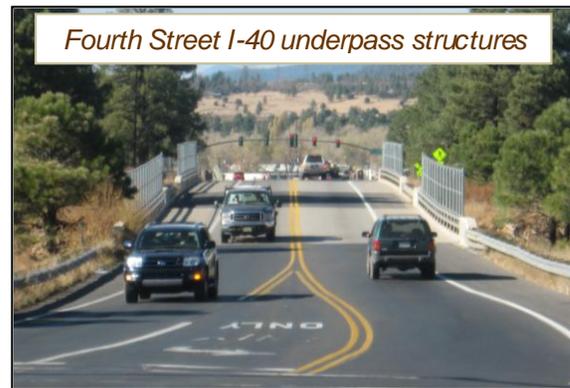
Existing CMPAs at Butler Avenue

Off-site drainage within the study area is conveyed beneath the existing roadway in four locations. All existing culverts are pipe culverts including 8-64" x 43" corrugated metal pipe arches (CMPA) at Butler Avenue, a 24" corrugated metal pipe (CMP) 200 feet north of Butler Avenue, an 18" CMP south of Tricking Springs Trail and an 18" CMP between Soliere Avenue and I-40. The 8-64" x 43" CMPAs were recommended to be upgraded to a 2-10'x5' reinforced concrete box culvert (RCBC) according to the Butler Avenue DCR. Street drainage on Fourth

Street flows south to Switzer Canyon Wash at Butler Avenue. On-site drainage is collected in a storm drain system for those segments of the roadway improved with curb and gutter.

### 2.4 Structures

Two major structures are located within the study limits, Fourth Street Underpass (UP) Eastbound (EB) (Structure No. 1182) and Fourth Street UP Westbound (WB) (Structure No. 1183). The structures were constructed as simple-span welded plate steel girder bridges in 1968. Both structures carry Fourth Street traffic over I-40 at milepost 199.30. The structures are separated longitudinally by 75 feet with one structure spanning over I-40 EB and one structure spanning over I-40 WB.



Fourth Street I-40 underpass structures

### 2.5 Physical Features



Corridor ponderosa pine

North of the Mogollon Rim, on the Colorado Plateau, the study area lies within the lower reaches of Switzer Canyon Wash, a headwater tributary of the Rio de Flag that eventually flows into the Little Colorado River. The underlying geology is Kaibab limestone rock with occasional basalt intrusions. Within the study area, the profile rises from approximately 6,790 feet elevation near Butler Avenue to 6,880 feet elevation near Industrial Drive.

Within the study area, ponderosa pine is the dominant tree, often occurring in nearly monotypic stands within the Petran montane conifer forest. Some other common perennial trees and shrubs varying in abundance, depending on slope and exposure, include buck brush (*Ceanothus fendleri*), Gambel oak (*Quercus gambelii*), New Mexico locust (*Robinia neomexicana*), and Arizona rose (*Rosa arizonica*). The open forest situation also promotes several species of grass, including purple threeawn, Porter brome (*Bromus porteri*), pine dropseed (*Blepharoneuron tricholepis*), and muttongrass (*Poa fendleriana*).



## **2.6 Socioeconomic Environment**

### **2.6.1 Land Jurisdiction and Ownership**

The Fourth Street corridor is located in the central portion of the Flagstaff urban area, in Coconino County. The area lies within the jurisdiction of the City of Flagstaff. Land ownership is a combination of private and public land.

### **2.6.2 Existing Land Use**

The existing land use is mixed along the Fourth Street corridor, as illustrated in Figure 2.6-1. The use immediately adjacent to the roadway consists of undeveloped vacant land, low to medium density residential, institutional, light industrial and open space/recreational. The approximate percentages of existing land uses adjacent to the study area are:

- Low Density Residential – 10%
- Medium Density Residential – 28%
- Light Industrial – 18%
- Commercial - 0%
- Open Space/ Recreation – 25%
- Institutional – 19%

### **2.6.3 Planned Future Land Use**

The City of Flagstaff has an approved General Plan that identifies the planned land uses within the corridor, see Figure 2.6-2. Since the corridor is predominantly established, the planned land uses do not differ significantly from the existing land uses within the study limits. Immediately south of study limits is open space that is planned for development. As identified in the General Plan, Fourth Street will be extended south to J. W. Powell Boulevard. A multimodal center is planned for the southeast quadrant of Fourth Street and Butler Avenue intersection.

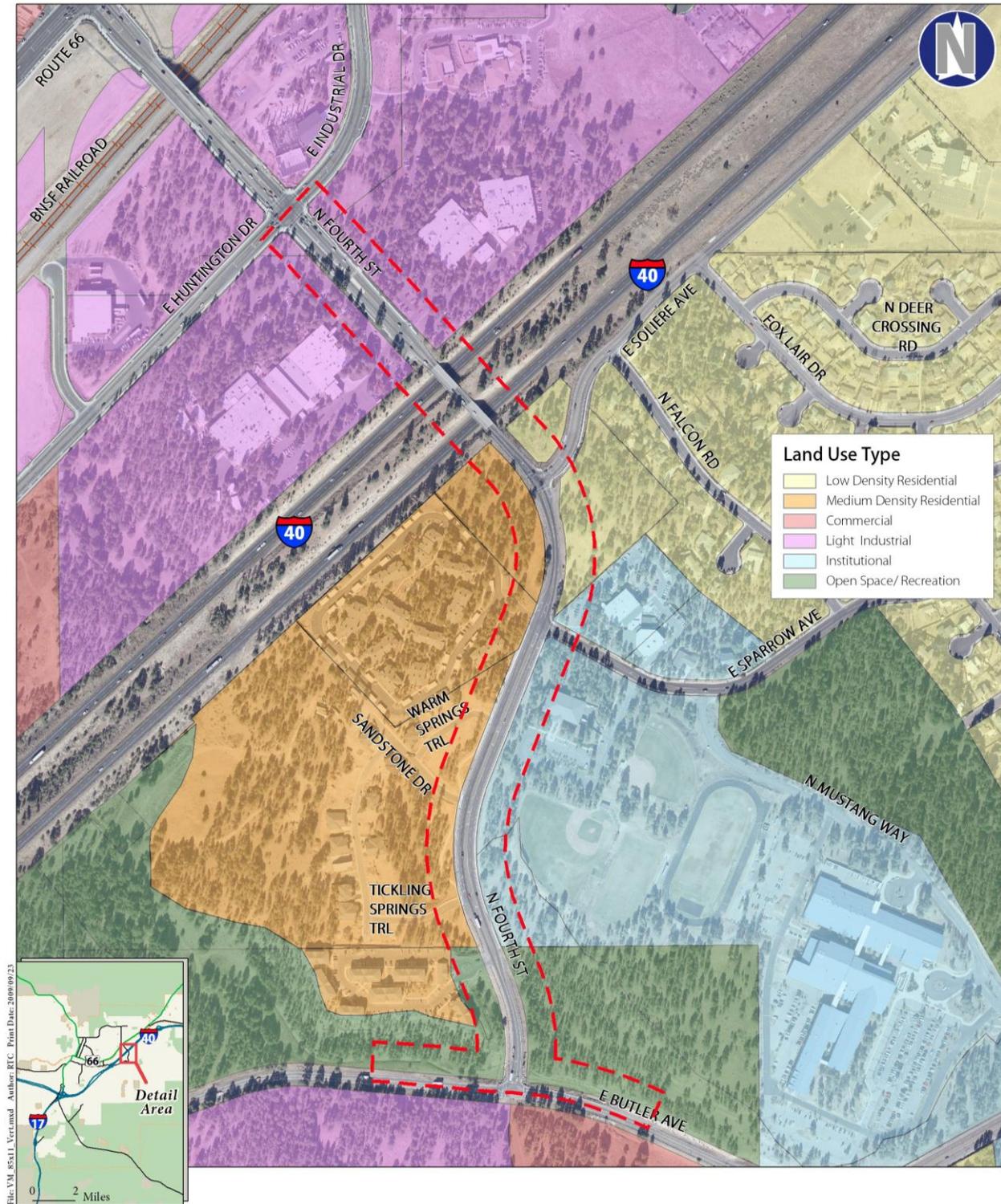
Approximate percentages of the planned land uses adjacent to the study area are:

- Low Density Residential – 11%
- Medium-High Density Residential – 16%
- Light Industrial – 18%
- Commercial - 0%
- Open Space/ Recreation – 44%
- Institutional – 11%



**Fourth Street – South  
Butler Avenue to Huntington / Industrial Drive  
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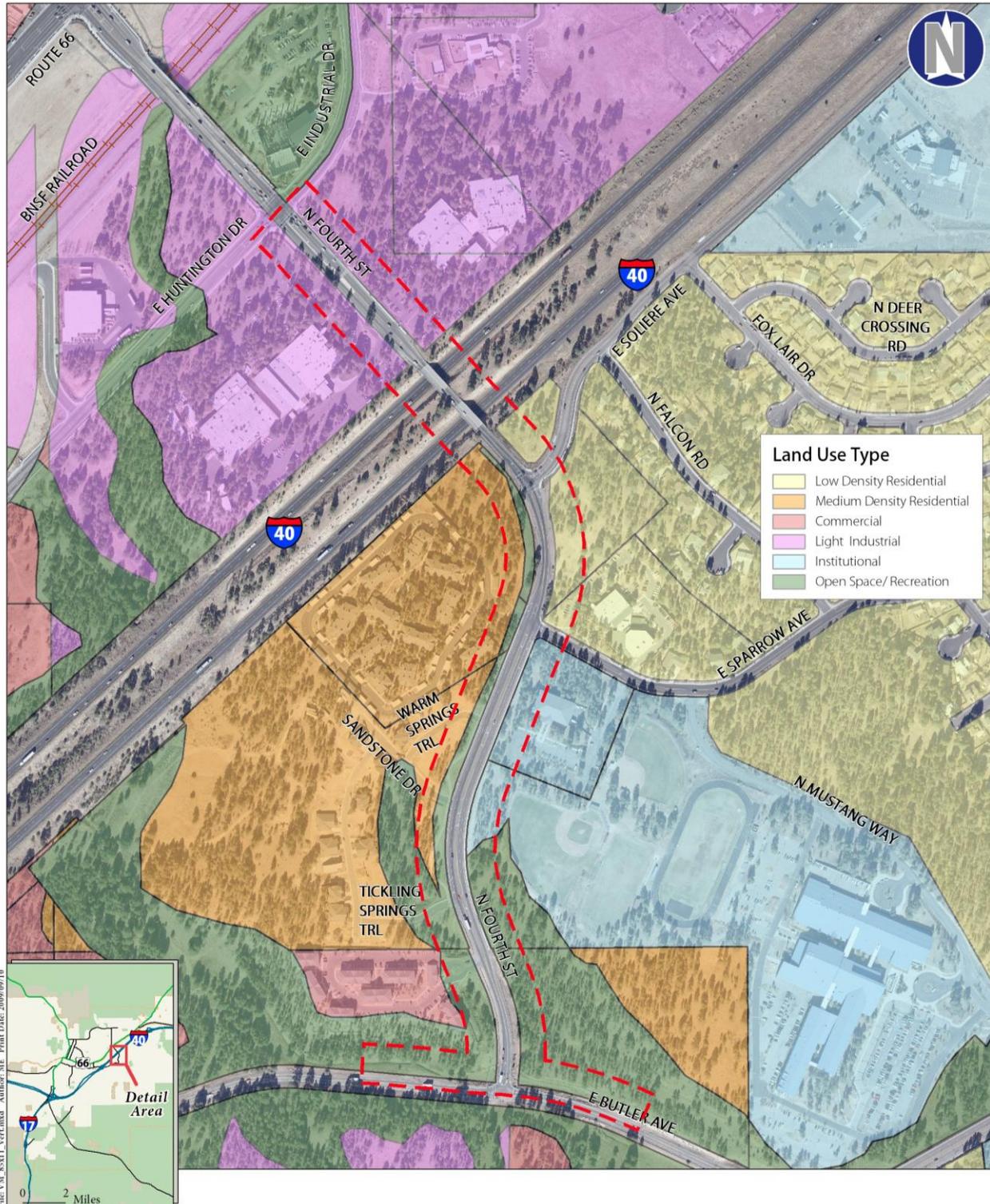
**Figure 2.6-1: Existing Land Use**





**Fourth Street – South**  
*Butler Avenue to Huntington / Industrial Drive*  
**Final Corridor Study**

**Figure 2.6-2: Future Land Use**





## **2.7 Future Roadway Improvements**

### **2.7.1 City of Flagstaff**

The City of Flagstaff 2010 to 2014 Transportation Improvement Program does not include any improvement projects within the study area.

### **2.7.2 ADOT**

The ADOT 2010 to 2014 Five-Year Transportation Facilities Construction Program does not include any improvement projects within the study area aside from the ongoing studies mentioned in Section 1.3.

### **2.7.3 Private Development**

The City of Flagstaff has been approached informally regarding two potential future developments. The Northland Preparatory Academy has held a pre-application meeting with the City regarding future expansion plans. The Academy is considering purchasing the property immediately north of their existing facilities to increase services, provide recreational facilities and improve traffic circulation. The number of students is targeted to increase from 300 to 600 with the expansion.

The second potential development is Canyon del Rio, which is located along Butler Avenue and south of Fourth Street. Prior to the economic slowdown, Canyon del Rio had plans to develop the Fourth Street/Butler Avenue area including the south leg of the intersection. Initial discussions included a multi-modal center and other amenities.



## 3 Traffic Analysis

The Traffic Analysis summarizes future conditions of the Fourth Street corridor. The analysis presented includes projected traffic volumes, roadway segment capacity, intersection capacity and Gore pedestrian crossing solutions.

### 3.1 Future Volumes

The year 2030 ADT projection for the study area was obtained from the FMPO, which includes updated socio-economic and planned development data along the Fourth Street south corridor and the vicinity areas. These traffic volumes are with all the east-west streets modeled as one lane each way. The Fourth Street was modeled as two lanes each way. Figure 3.2 shows the 2030 average daily traffic on Fourth Street ranging from 19,000 to 20,000 vpd between Butler Avenue and Sparrow Avenue, 26,000 vpd between Sparrow Avenue and Soliere Avenue, and 32,000 to 33,000 vpd between Soliere Avenue and Huntington/Industrial Drive. Butler Avenue will be expected to carry 11,000 vpd east of Fourth Street and 26,000 vpd west of Fourth Street. Sparrow Avenue will be expected to carry low traffic volumes of 6000 vpd. Soliere Avenue is expected to carry traffic volumes of 14,000 vpd east of Fourth Street.

The year 2009 PM turning movement counts and the City of Flagstaff 24-hour volume counts collected during 2008 summer provided the PM peak hour traffic patterns and information on turning movement distribution (peak direction patterns, PM peak K- and D-factors as well as the truck percentages). The truck percentage is 5% in Fourth Street south study area. In the PM peak hour, the majority of the traffic is traveling south on Fourth Street.

The PM design hour approach volumes were derived by applying a general 10% K factor (percentage of peak hour traffic to the daily traffic) on all the roads and D-factor of 60% (directional factor with the high amount of traffic in the peak direction) on most locations to get the approach design hour volumes. These factors are representative of the existing conditions in the study area.

With the derived approach design hour volumes, future turning movement volumes were developed by applying the existing turning movement distribution to replicate the existing traffic patterns. The future roadway network Average Daily Traffic and the PM peak hour turning movement volumes are all presented in Figure 3.1.

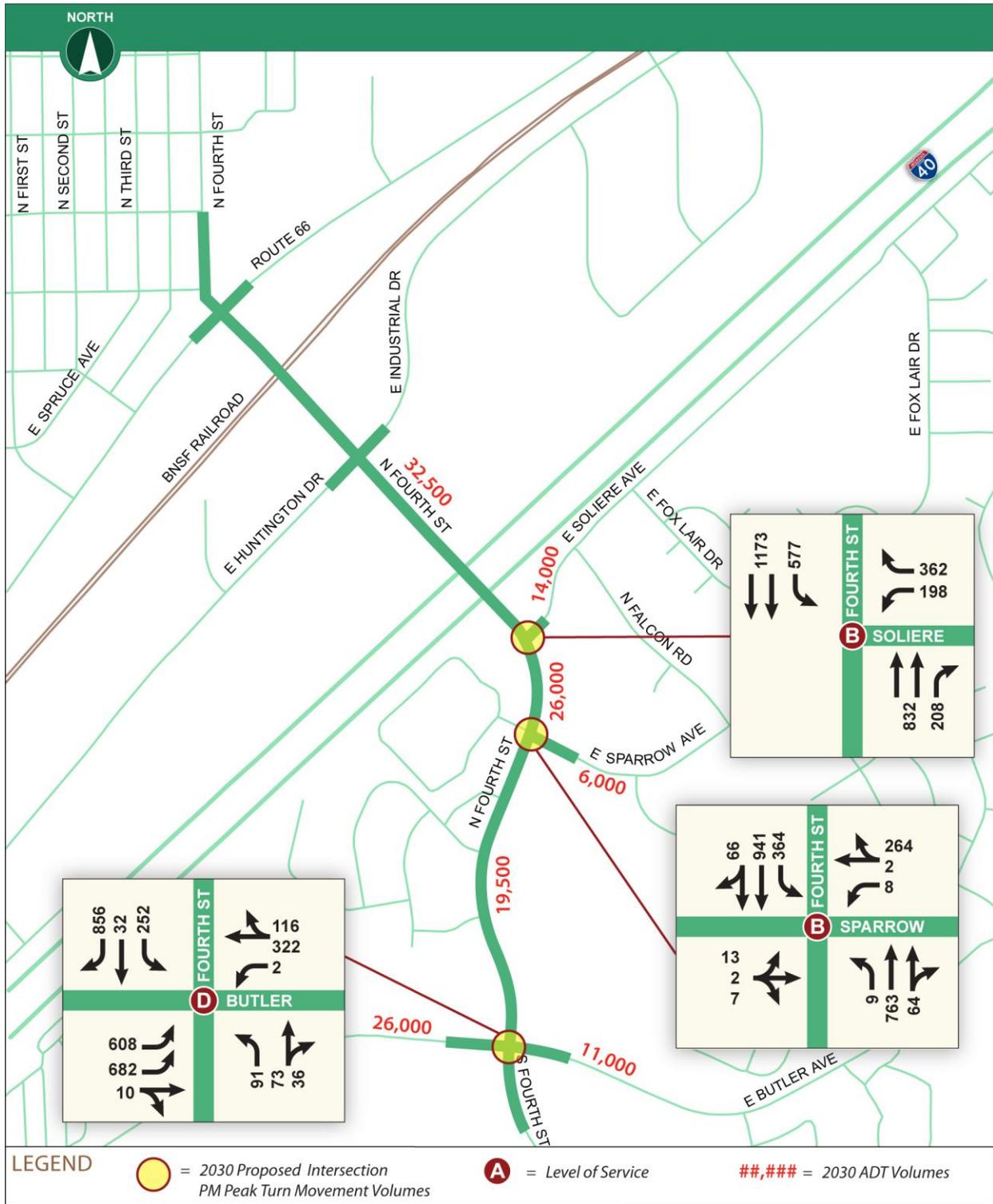
### 3.2 Segment Level of Service

The efficiency of roadway system components, such as intersections and road segments, can be described by Level of Service (LOS). LOS is used to describe the degree of congestion for a roadway. LOS, which range from A to F, is generally defined as follows:



## Fourth Street – South Butler Avenue to Huntington / Industrial Drive Final Corridor Study

**Figure 3.1: Future Traffic Volumes**





- *Level of Service A* represents free flow operation
- *Level of Service B* is in the range of free flow, but the presence of other users in the traffic stream begins to be noticeable
- *Level of Service C* is in the range of stable flow, but marks the beginning of the range in which the operation of individual users becomes significantly affected by others.
- *Level of Service D* represents high density but stable flow. Speed and freedom to maneuver are severely restricted, and the driver experiences a generally poor level of comfort and convenience
- *Level of Service E* represents operating conditions at or near the capacity level. All speed is reduced to a low but relatively uniform value
- *Level of Service F* is used to define forced or stop and go travel. This condition exists wherever the amount of traffic approaching a point exceeds the amount that can traverse that point.

The LOS for street segments is determined by comparing the projected traffic volumes to the roadway segment LOS thresholds that have been developed for this study based on the HCS+ ArtPlan 2002 Model. The ArtPlan model estimates the arterial segment LOS based on the roadway facility information such as number of lanes, the signalized intersections density, median type, design speed; traffic information in terms of K%, D% and peak hour factor (PHF); and the signal controller information which includes controller type, major through movement g/C ratio, cycle length, etc. Table 3.2-1 shows the LOS thresholds for the Fourth Street as a four lane minor arterial with center two-way left turn lane and a four lane minor arterial with raised median.

**Table 3.2-1: HCS + ArtPlan Level of Service Criteria for Fourth Street**

Facility Type	LOS A	LOS B	LOS C	LOS D	LOS E
	Maximum Average Daily Traffic (vpd)				
4-lane with Two Way Left Turn Median	13,400	22,200	32,000	42,300	51,600
4-lane with Raised Median	10,600	17,500	25,200	33,400	40,700

- 1) Source: AADT based Level of Service Criteria from Highway Capacity Software (HCS+) Version 5.21, ARTPLAN Module
- 2) Assumptions:
  - a) Default value of PHF 0.925
  - b) 5% Heavy Vehicle percentage
  - c) 0.90 Local Adjustment Factor
  - d) 10% K-factor and 60% D-factors are generalized from City of Flagstaff filed counts.
  - e) Posted Speed Limit is 35 MPH



For this study, LOS D is considered acceptable for Fourth Street. The future ADT along the Fourth Street south of the I-40 Overpass was compared to the threshold volumes listed in Table 3.2-1 to determine the roadway segment LOS. The results are summarized in Table 3.2-2.

**Table 3.2-2: Fourth Street Roadway Segment LOS**

From	To	2030 ADT	4-lane with Two Way Left Turn Median (LOS)	4-lane with Raised Median (LOS)
Butler Avenue	Sparrow Avenue	19,500	B	C
Sparrow Avenue	Solier Avenue	26,000	C	D
Solier Drive	Industrial Avenue	32,500	D	D

### 3.3 Intersections

Two design options were identified for potential intersection types at Sparrow and Solier Avenues. Analysis was performed for conventional signalized intersections and roundabouts. Mixed combinations of intersection types were also considered.

#### 3.3.1 Conventional Intersections

The LOS analysis for signalized intersections was performed utilizing the methodology presented in the 2000 Highway Capacity Manual. This method uses the critical volumes passing through the intersection in one hour and compares those volumes to the capacity of the intersection and an associated delay. The analysis incorporates the effects of traffic volumes, geometry, traffic signal operation, truck and local bus volumes, pedestrian activity, and peaking characteristics. The result is a LOS determination for each approach and for the intersection as a whole. The capacity criteria are presented in terms of average vehicle delay in Table 3.3-1.

**Table 3.3-1: Capacity Criteria for Signalized Intersections**

Level of Service (LOS)	Control Delay per Vehicle (sec)
A	less than 10
B	10.1-20
C	20.1-35
D	35.1-55
E	55.1-80
F	over 80

*\*Source: Highway Capacity Manual*



**Fourth Street – South**  
*Butler Avenue to Huntington / Industrial Drive*  
**Final Corridor Study**

The conventional intersections with traffic signals were evaluated using Synchro 7 software for the 2030 PM peak hour volumes. The LOS analysis showed that Sparrow Avenue and Soliere Avenue intersections will operate at LOS B and C, respectively, for the 2030 PM peak hour volumes. The westbound left turn volumes at Soliere Avenue will experience higher through volumes on Fourth Street.

**Table 3.3-2: Signalized Intersection at Sparrow Avenue**

Approach	SB			NB			EB			WB			ALL
	Left	Thru	Right										
Volume	364	941	66	9	763	64	13	2	7	8	2	264	2503
Delay	17.4	9.1	8.7	14.7	13.2	11.1	37.7	20.4	36.9	49.4	53.4	7.9	11.7
LOS	B	A	A	B	B	B	E	E	E	D	D	A	B
Avg Queue	42	42	42	26	26	26	12	12	12	5	5	14	20
Max Queue	445	445	445	286	286	286	39	39	39	172	172	222	445

**Table 3.3-3: Signalized Intersection at Soliere Avenue**

Approach	SB			NB			EB			WB			ALL
	Left	Thru	Right										
Volume	577	1166	7	9	823	208	13	2	7	198	2	362	3374
Delay	12.7	3.5	4.7	29.9	31.6	37.8	281	172	141	70.7	33.6	19.7	20
LOS	B	A	A	C	C	D	F	F	F	E	C	B	C
Avg Queue	33	33	8	118	118	118	31	31	27	134	134	134	77
Max Queue	674	674	254	550	550	550	113	113	111	600	600	600	674

### 3.3.2 Roundabouts

RODEL analysis was used to model the performance of roundabouts at Sparrow and Soliere Avenues. The RODEL analysis parameters were:

E = 14 feet entry width for each entry lane.

R = 75 feet entry radius except as noted.

L' = 26 feet except as noted

V = 12' or 24' as appropriate

Φ = 30 degrees (default value)

D = 160 feet

PHF = 0.90

Truck Percentages = 2 percent

#### Fourth Street and Sparrow Avenue Roundabout

The RODEL analysis showed acceptable operations at both the 50% Confidence Level (CL) and the 85% CL for the currently proposed design. Very little change in the delay resulted between the 50% and 85% CL, indicating adequate reserve capacity. Table 3.3-4 summarizes the results.



**Fourth Street – South**  
*Butler Avenue to Huntington / Industrial Drive*  
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**Table 3.3-4: RODEL Summary – Fourth Street and Sparrow Avenue Roundabout**

		50% CL				85% CL			
Street Leg	Direction	Average Delay	LOS *Signalized	Average Queue	Max Queue	Average Delay	LOS *Signalized	Average Queue (veh)	Max Queue (veh)
Fourth Street	SB	3.7	A	1	2	4.7	A	2	2
Sparrow	EB	7.0	A	<1	<1	11.9	B	<1	<1
Fourth Street	NB	2.8	A	1	1	3.3	A	1	1
Sparrow	WB	6.9	A	1	1	11.8	B	1	1

In order to achieve good lane/volume balance, the lane assignments on Fourth Street for both the northbound and southbound entry lanes should be;

RIGHT LANE: shared through/right

LEFT LANE: shared through left

**Fourth Street and Soliere Avenue Roundabout**

This roundabout was analyzed with a fourth leg on the west side (eastbound approach) serving future development. The RODEL analysis showed acceptable operations at the 50% Confidence Limits (CL), but not at the 85% CL. A sensitivity analysis showed that the eastbound approach is very close to capacity for the currently proposed design. This is mainly due to the low opposing volumes experienced at the southbound entry lanes. Consequently, there are not enough available gaps in traffic for the Soliere eastbound left turn approach traffic. A somewhat similar situation exists at the westbound approach, though the right turn traffic is much higher and is being impeded by the lower volume left turning traffic. Table 3.3-5 summarizes the results for the currently proposed design.

**Table 3.3-5: RODEL Summary – Fourth Street and Soliere Avenue Roundabout**

		50% CL				85% CL			
Street Leg	Direction	Average Delay	LOS *Signalized	Average Queue	Max Queue	Average Delay	LOS *Signalized	Average Queue (veh)	Max Queue (veh)
Fourth Street	SB	7.3	A	4	5	12.6	B	6	10
Soliere	EB	27.4	C	<1	<1	681.7	F	4	11
Fourth Street	NB	3.9	A	1	2	5.1	A	2	2
Soliere	WB	18.0	B	3	4	122.5	F	21	41

In order to acceptably reduce the delay at the eastbound and westbound approaches, an additional lane was added for each approach. The summary RODEL results are shown in the following table.



**Table 3.3-6: RODEL Summary – Fourth Street and Soliere Avenue Roundabout  
 with an Additional Lane**

Modified		50% CL				85% CL			
Street Leg	Direction	Average Delay	LOS *Signalized	Average Queue	Max Queue	Average Delay	LOS *Signalized	Average Queue (veh)	Max Queue (veh)
Fourth Street	SB	7.3	A	4	5	13.5	B	7	11
Soliere	EB	9.7	A	<1	<1	26.4	C	<1	<1
Fourth Street	NB	3.9	A	1	2	5.1	A	2	2
Soliere	WB	7.1	A	1	2	12.5	B	2	3

In order to achieve good lane/volume balance at the approaches, lane assignments on Fourth Street for both the northbound and southbound entry lanes should be;

RIGHT LANE: shared through/right

LEFT LANE: shared through left

For the modified eastbound and westbound approaches, the lane assignments at the entry lanes should be:

RIGHT LANE: right turn only

LEFT LANE: shared left/through/right

### 3.3.3 Conclusions

Modeling of both intersection types indicated that either intersection type would perform at an acceptable LOS for the design year. The SYNCHRO analysis of conventional intersection with traffic signals showed that both intersection operate at LOS B for 2030 PM peak hour volumes.

The roundabout design concept at Fourth Street and Sparrow Avenue should perform adequately up through the 2030 design year. Although the RODEL results at the 85% CL suggest additional entry lanes on Soliere Avenue, one lane entries for an interim period with the ability to easily expand to two lane entries at some future time would perform satisfactorily, potentially beyond the future 2030 design year. This would improve the safety of the roundabout until such time as the additional lanes are required.

## 3.4 Gore Pedestrian Crossing

South of Industrial/Huntington Drive on Fourth Street, the Gore campuses have two sets of driveways and an existing crosswalk across Fourth Street. The crosswalk is in between the two sets of driveways. The south driveways allow full access including left turns from the Gore campuses to Fourth Street. Left turns are not allowed at the north driveways because of their close proximity to Industrial/Huntington Drive. A raised median was designed into Fourth Street



expressly to prohibit left turns from these driveways. Right in/ right out access is the only operation allowed at these north driveways.

The City of Flagstaff and W.L. Gore have discussed the concerns of the current pedestrian crossing connecting the Fourth Street campuses and have agreed to evaluate improvement alternatives. Three improvement alternatives were analyzed as part of this project. These alternatives included:

- Installation of a traffic signal at the Gore south driveways
- Installation of a traffic signal at the existing crosswalk
- Relocation of the cross walk location south to line up with the Gore south driveways
- Installation of a Pedestrian Actuated Yellow Flashing Beacon at the existing cross walk

City staff was consulted to obtain background information from the City interaction with W. L. Gore on vehicular and pedestrian requirements. It is understood that Gore runs three eight hour shifts with one shift ending at 3 pm.

**Driveway Counts**

City counted the vehicles entering and exiting the two sets of Gore driveways with Fourth Street during the first two weeks of September 2009. These counts were obtained at each driveway over a week period including Saturday and Sundays. The highest counts during a day, morning peak hour and afternoon peak hour are listed below:

**Table 3.4: Gore Driveway Vehicle Counts**

Driveway Location	Peak Daily Count (vehicles per day)	AM Peak Count (vehicles per hour)	PM Peak Count (vehicles per hour)
North Driveway West Side	399	66	66
North Driveway East Side	231	40	29
South Driveway West Side	1047	134	130
South Driveway East Side	831	132	119

**Pedestrian Counts**

Pedestrian counts in 15-minute intervals were also completed by the City for a two-day period in the second week of September 2009. Five hundred seventy-nine (579) pedestrians used the crosswalk over one day with counts ranging from 3 to 9 pedestrians per 15-minute interval to 23 to 30 pedestrians per hour.

**3.4.1 Traffic Signal at the Existing Crosswalk Location**

The *Manual of Uniform Traffic Control Devices* (MUTCD) Warrant 4-Minimum Pedestrian Volume states that a traffic signal may be installed where the average pedestrian volume crossing the major street at an intersection or mid-block location is 100 or more for each hour during any



consecutive four hour period or 190 or more during any one hour period. Based on the hourly pedestrian counts of 23 to 30 pedestrians at the existing crosswalk, this warrant is not met.

### 3.4.2 Traffic Signal at South Driveway Location

Based on the number of vehicles using the driveways, a traffic signal at this driveway will not meet MUTCD signal warrants. In addition, there will be a cost for traffic signals, signing and pavement marking.

### 3.4.3 Relocate the Existing Crosswalk South

Under this alternative, the crosswalk would be moved closer to the existing south driveways to provide additional distance from the Industrial/Huntington Drive intersection. Research indicated that this alternative would not be used by pedestrians because of 1) long-term utilization and familiarity with the existing crosswalk; 2) the additional walking distance for pedestrians; and 3) the high probability that pedestrians would continue to cross at the existing location even after the crosswalk was relocated.

### 3.4.4 Pedestrian Actuated Yellow Flashing Beacon

Pedestrian-actuated beacons consist of a traffic pole with a yellow light mounted on a mast arm on each side of the crosswalk. The lights are dark until activated by a pedestrian pressing a push button attached to the pole. Signs in advance of the beacons warn drivers to stop for pedestrians when the lights are flashing. Several cities in Arizona including Phoenix, Scottsdale, Tucson and Peoria have installed pedestrian-actuated flashing yellow beacons. Beacons have already been installed in Flagstaff at two locations.



Given that the first two alternatives do not meet warrants for signals and that relocating the crosswalk to the south driveways would not achieve the desired results, the most viable alternative is to install pedestrian-actuated flashing yellow beacons at the existing crosswalk.

The installations in Phoenix and Tucson use pedestrian signal heads with countdown timers to alert pedestrians to the time remaining to cross the street. City of Flagstaff staff members believe the countdown timers give a false sense of security to pedestrians and for that reason will not be used on the beacon installation at the Gore crosswalk.



## 4 Structural Analysis

### 4.1 Existing Bridges

The existing structures are simple-span welded plate steel girder bridges with stub abutments supported on spread footings. The abutment spread footings are founded on Kaibab limestone rock. Each structure consists of five girders spaced at 9'-0" with a superstructure depth of 6'-6" feet and a span length of 115'-0". The typical section for each bridge consists of two 12-foot lanes with 8-foot inside and outside shoulders with a clear roadway width of 40'-0". Both structures have H-2-1 rail on a 1'-3½" curb along the inside and outside edge of deck, resulting in an out-to-out bridge width of 42'-7". Pedestrian safety fence has been added at the back of the curb. The existing typical section has a 1.5% center crown and the horizontal alignment is on a tangent. The vertical profile for the westbound bridge is on a crest curve, while the eastbound bridge is on a sag curve.



*North Fourth Street I-40 underpass*

### 4.2 Proposed Bridge Typical Sections

The proposed roadway section of Fourth Street at the bridge crossing is symmetrical about the Fourth Street construction centerline and profile grade line. The roadway consists of two 12'-0" through lanes and one 6'-6" bike lane in each direction. In order to eliminate pavement tapers at the bridge approaches, the 5 foot asphalt bike lanes and the 1'-6" concrete gutter pan are combined on the concrete bridge deck as a 6'-6" bike lane. The northbound and southbound roadways are separated by a 12'-0" median. A 12'-0" FUTS trail is located outside of the northbound thru lanes while a 5'-6" raised sidewalk is located outside of the southbound thru lanes. Behind the FUTS trail and the sidewalk are 1'-2" wide combination pedestrian-traffic bridge railings with fences. The FUTS trail will be separated from vehicular traffic by a 42" F-shaped concrete barrier with safety rail on top. The resulting clear roadway width is 73'-0" with an out-to-out bridge width of 94'-4".

### 4.3 Bridge Alternatives

A concurrent study is being performed by ADOT to investigate potential options to widen I-40 by one or two lanes in each direction. This poses several issues for the Fourth Street underpasses before considering improvements to Fourth Street. According to the most recent inspection report dated October 2008, the existing minimal vertical



*Eastbound I-40 from Fourth Street*



clearance at the westbound underpass is 16.6 feet. If I-40 is widened by one lane toward the median, the existing minimum vertical clearance at the WB structure will be reduced to approximately 16.2 feet. If I-40 is widened by two lanes toward the median, the existing minimum vertical clearance will be reduced to approximately 15.8 feet. The opening under the bridge appears to be sufficient for widening I-40 by one lane, but extensive work may be required to widen I-40 by two lanes. Table 4.3 summarizes the various I-40 widening options and the corresponding recommended bridge improvements.

**Table 4.3: Various I-40 Widening Options (Additional Lanes)**

Fourth Street Bridge Features	Options for adding lanes to I-40 at Fourth Street				No I-40 Widening
	One-Lane (Outside)	One-Lane (Median)	Two-Lane (Outside)	Two-Lane (Median)	
Adequate vertical clearance provided to I-40	✓	✓	✓	No	✓
Adequate horizontal clearance is available for widening	✓	✓	No	No	✓
Existing bridge modifications are necessary	None Required	None Required	substantial slope shoring	substantial slope shoring	None Required
Recommended bridge improvement alternative	Widen	Widen	Replace	Replace	Widen

Since the results of the I-40 study are not available for the *Final FSCS - South Report*, the following alternatives will be considered to provide sufficient background information:

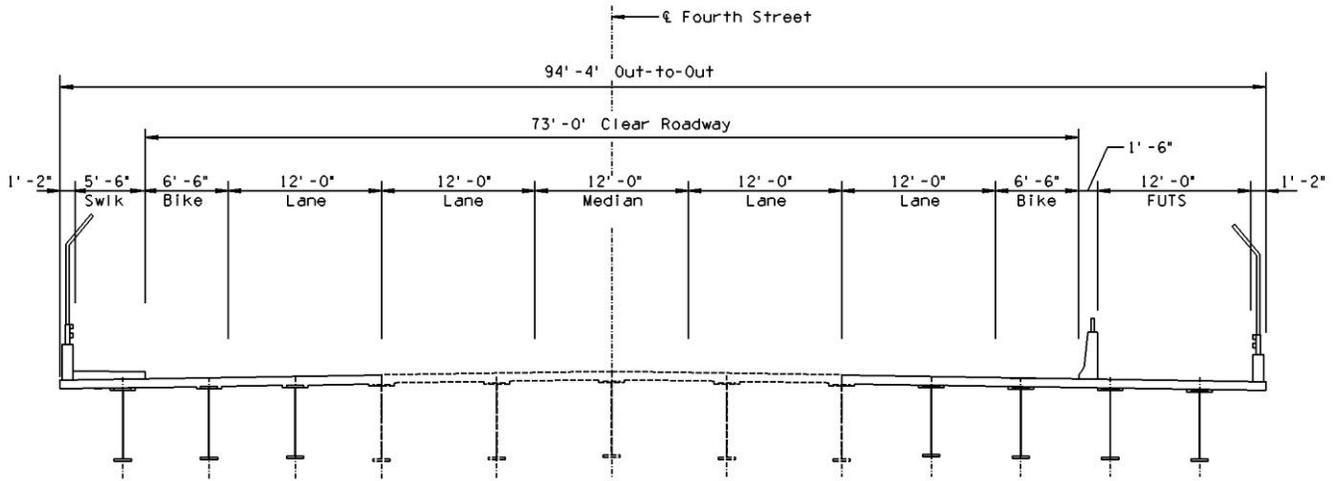
- Widen Fourth Street Bridges without any improvements to I-40
- Replace Fourth Street Bridges with the addition of two-lanes to I-40 in each direction

**Alternative 1 – Widen Fourth Street Bridges**

To accommodate the proposed typical section of Fourth Street, the bridges will be widened by 29’-10½” to the west side and 21’-10½” to the east side. Three new girders spaced at 7’-6” for the east widening and four new girders spaced at 7’-3” for the west widening will be required. To maintain a minimum vertical clearance over the interstate of 16’-6”, the superstructure depth of the widened section will need to be shallower than the existing superstructure by approximately 8 inches. This can be accomplished through utilizing a shallower girder depth or reducing the cross slope on the widened section of the bridge or a combination of both. Two lanes of traffic including pedestrian access can be maintained on each bridge while the bridge is being widened to the east. Once the east side widening is completed, four 11-foot lanes can be opened to traffic while construction of the west widening occurs.



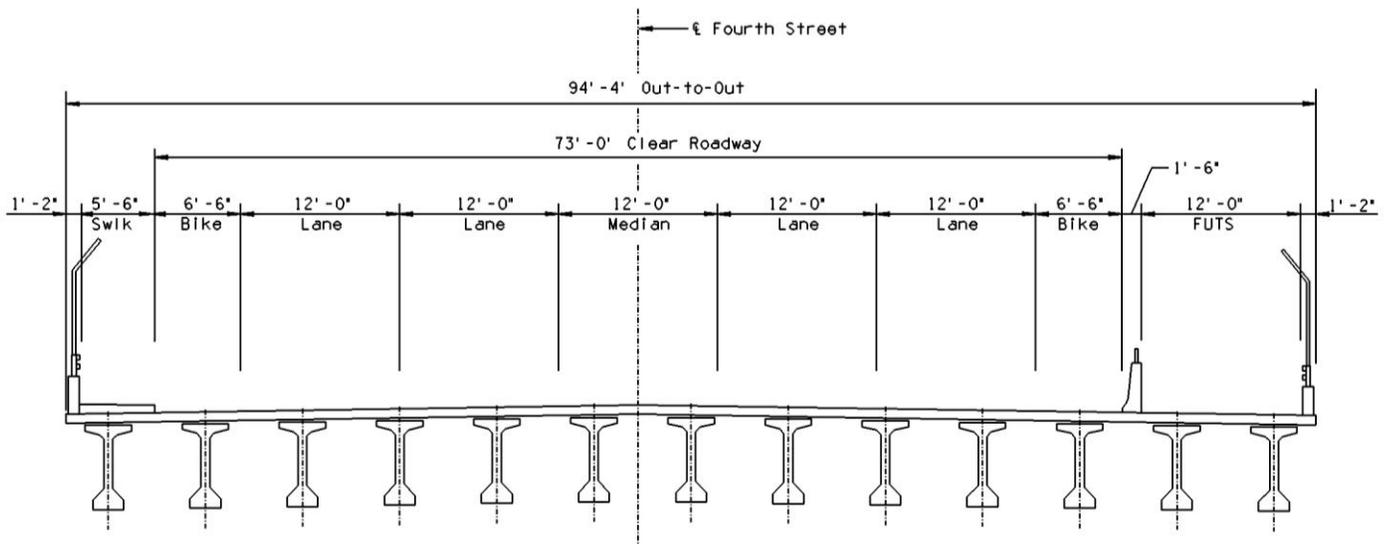
**Figure 4.3-1: Bridge Widening Typical Section**



**Alternative 2 – Replace Fourth Street Bridges**

The recommended replacement option is two new simple-span precast prestressed AASHTO Type Super VI Modified girder bridges to span the overall improvements to I-40. To avoid conflict with the existing substructures, the new abutments will be located behind the existing abutments. The new span length will be approximately 147'-6" and require a structure depth of 7'-4". A profile raise on Fourth Street would be needed to accommodate the increased structure depth due to the longer span, additional depth due to the cross-slope of Fourth Street as well as the additional depth due to the cross-slope of the I-40 widening. The longitudinal separation between Abutment 2 of the EB bridge and Abutment 1 of the WB bridge will be reduced, however the final separation amount depends on whether the I-40 improvements occur towards the median or to the outside.

**Figure 4.3-2: Bridge Replacement Typical Section**





In order to maintain traffic on Fourth Street, phased construction will be required for the construction of the new bridges. The first phase of construction will require the removal of the easternmost exterior girder which still allows for two 11-foot lanes plus 1-foot shy distance to the barriers plus a 4-foot sidewalk on the existing structures. Phase one construction will build 35'-6" of the eastern most bridge replacement. Phase two construction will shift traffic onto the newly built structure and complete demolition of the remaining existing structure along with construction of the remaining portion of the new bridge.

### **Other Alternatives**

In lieu of new utilizing precast concrete girders, steel girders were initially considered for the superstructure. Steel girders will result in a lower superstructure depth, thus reducing the overall profile raise required. However, due to the additional maintenance costs, increased inspection requirements and the additional initial costs, this option was not evaluated further.

Since the longitudinal separation between the proposed structures could be reduced, consideration should be given to utilizing a two-span continuous structure instead of two separate simple-span structures. This option can be evaluated further after the results of the I-40 Study are available.

### **Conclusions**

Several possibilities are available for improving the Fourth Street bridges. The primary unknown factor at this time is the number of I-40 lanes the bridges must span and whether the I-40 widening will occur to the median or outside shoulder. These factors must be considered in determining the appropriate improvements. Based on the current bridge inspection reports, it is possible to widen the existing bridges to accommodate the required Fourth Street roadway section and still maintain the existing vertical clearance provided there are no improvements to I-40. However, early conversations with ADOT Flagstaff District and Bridge Design Section indicate that ADOT's preference will be bridge replacement with concrete structures. The critical outcome of this study is to identify that ADOT will require the bridges to be lengthened and the City of Flagstaff will require the bridges to be widened, thus providing the potential for cost sharing opportunities. After the results of the *I-40 Bellemont to Winona DCR and EA* are fully reviewed, a recommendation can be made to accommodate the roadway crossing.



## 5 Drainage Analysis

This narrative provides a summary of the preliminary drainage analysis for the *FSCS – South*. The preliminary drainage analysis includes performing preliminary assessments of the off-site and on-site drainage impacts associated with the proposed road improvements. This analysis also includes identifying possible drainage problems and proposes hydraulic improvements. The preliminary design of the stormwater management system is intended to conform to the City of Flagstaff *Stormwater Management Design Manual* (SWMDM).

### 5.1 Existing Conditions

The Existing Conditions Drainage Map displays the approximate 45.2-acre study watershed divided into seven sub-basins for analysis, see Figure 5.1. Basins 1 thru 5 convey runoff to the south, into the Switzer Canyon Wash. Basins 6 and 7 convey runoff into the existing open channel located near the southern portion of the ADOT I-40 right-of-way. The watershed west of Fourth Street is comprised mainly of residential subdivisions, while the east side of Fourth Street is characterized by the FUSD Administration building and Sinagua High School baseball fields.

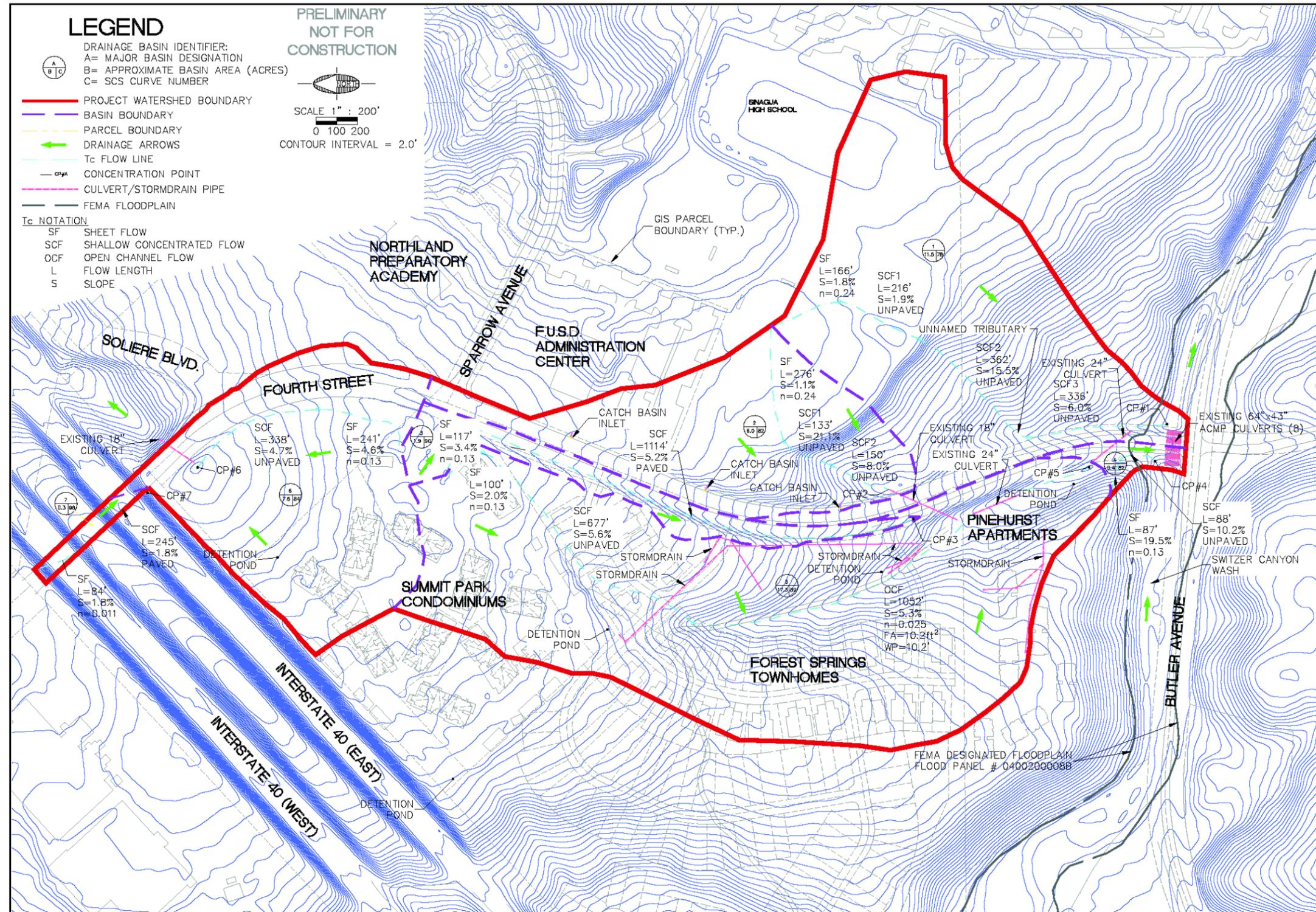
Fourth Street roadway runoff within Basin 2 is conveyed into three separate catch basin inlets; the inlets convey the runoff into the excavated open channel located east of the sidewalk. Runoff from the Fourth Street roadway is conveyed into open channels that parallel the street. Though the majority of the open channels are not maintained and do not contain erosion protection, no obvious drainage related problems were identified during a study team site visit.

City aerial topographic information was utilized to establish watershed delineation as well as the time of concentration pathways and slopes. The SWMDM provided intensity, duration, and frequency rainfall information. As-built/construction plan and drainage report information was requested from the City of Flagstaff for all developments within the project watershed. The City was able to provide construction plans for the majority of the developments, though some as-built information and the majority of the drainage report information were not readily available.

Recent developments within the project watershed have been constructed with individual detention pond structures. For this preliminary analysis, hydrologic calculations were simplified and detention structures were not analyzed. This results in artificially high calculated peak flow values; the study team believes this methodology produces reasonable and conservative results for this preliminary analysis. The drainage sub-basins areas were analyzed with Bentley's PondPack software program, utilizing SCS methodology (TR-55). Results from the analysis of a 2, 10, and 100-year storms event for the existing conditions are provided in the following table; Appendix D contains detailed results from the PondPack analysis of the 2, 10, and 100-year storm events.



Figure 5.1: Existing Conditions Drainage Map





**Table 5.1: Hydrologic Summary Table – Pre-Development Peak Flow Values**

Concentration Point #	Pre-Development Peak Flows (cfs)		
	2-year	10-year	100-year
1	3.4	9.2	21.3
2	1.9	4.3	9.3
3	2.4	4.3	7.7
4	0.4	0.8	1.6
5	19.5	36.1	66.1
6	5.6	11.8	23.9
7	0.7	1.1	1.7

## 5.2 Proposed Conditions

The on-site drainage concept is based on the current layout, which is approximately 76-foot wide (from back of curb to back of curb), a 6-foot wide sidewalk paralleling the east side of the roadway and a 10-foot wide sidewalk paralleling to the west, see Table 5.2. The proposed roadway is assumed to have a crown cross-section for the purposes of this analysis. For instance, a superelevated roadway will move some inlets to the lower side of the roadway; a raised median will require inlets on the medians.

For any of the preferred alternatives, this analysis assumes the following:

- Drainage inlets are located on both sides of the road at 600-ft intervals (maximum spacing per the SWMDM).
- Storm drain is sized throughout the street section for the maximum flow rate. The storm drain will be downsized at upper reaches once drainage inlet locations are finalized.

**Table 5.2: Hydrologic Summary Table – Post Development Peak Flow Values**

Concentration Point #	Post Development Peak Flows (cfs)		
	2-year	10-year	100-year
1	2.7	7.7	18.7
2	1.3	3.1	7.0
3A	1.6	2.5	4.0
3B	2.0	3.4	6.0
3C	1.5	2.3	3.7



Concentration Point #	Post Development Peak Flows (cfs)		
	2-year	10-year	100-year
3D	1.7	3.0	5.2
3E	1.6	2.4	3.8
3F	1.7	2.6	4.2
4A	0	0.1	0.2
4B	0.2	0.4	0.6
4C	0.2	0.3	0.5
5	18.7	34.6	63.4
6A	3.6	8.1	17.3
6B	3.0	4.9	8.1
6C	3.0	4.6	7.3

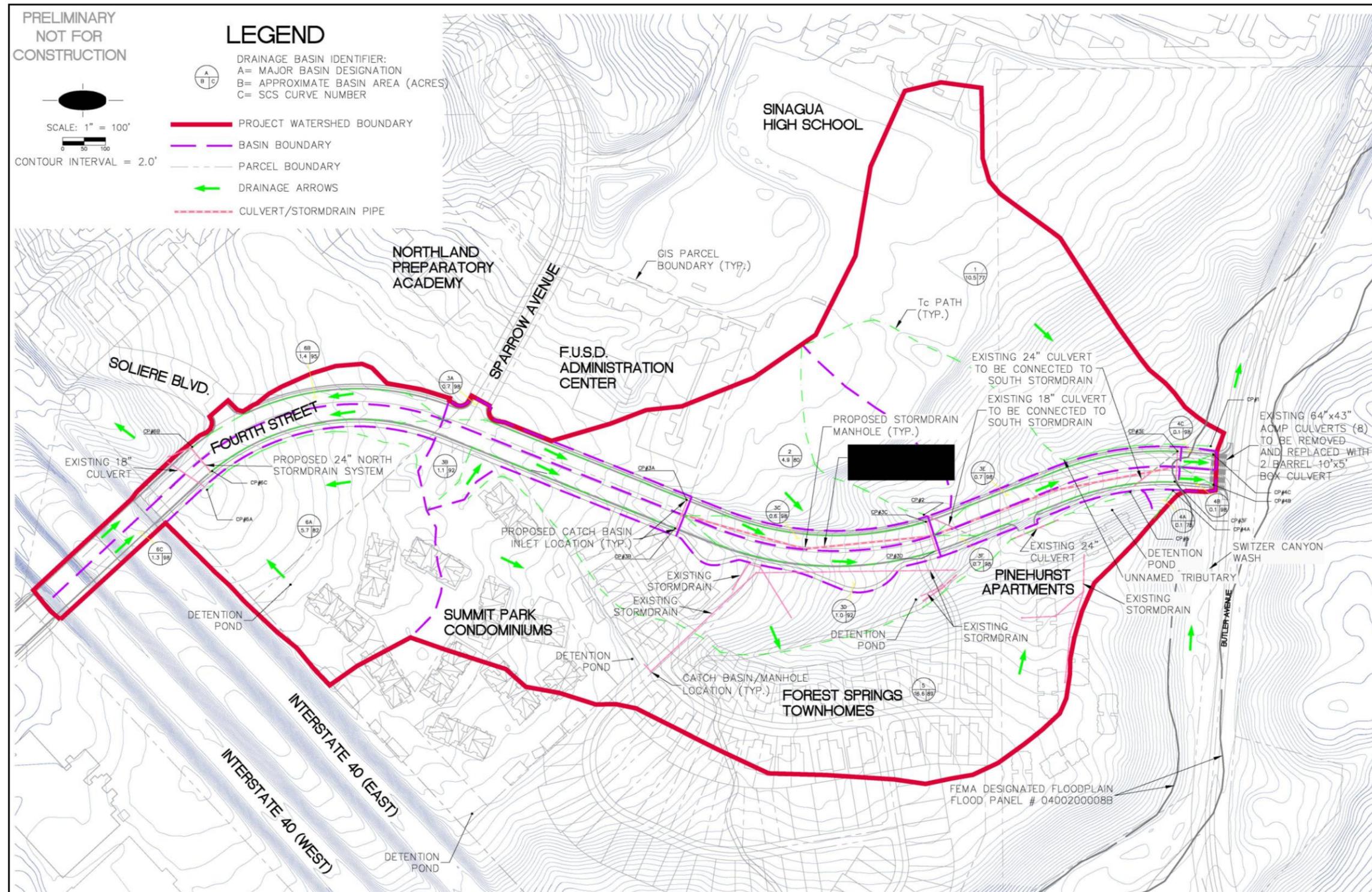
The Post Development Drainage Map displays the extents of the proposed roadway and identifies additional sub-basin areas within the project watershed, see Figure 5.2. Figure 5.2 also displays tentative locations for two separate storm drain systems; the north storm drain will collect roadway runoff within basins 6 and 7 and outlet into the existing channel located downstream of the existing 18-inch culvert crossing near the I-40 ROW. The south storm drain system will collect all runoff (within the project watershed) that is currently being conveyed to Switzer Canyon Wash.

Existing culverts, which currently convey runoff under the Fourth Street roadway, will be connected to the proposed storm drain. Bentley’s StormCAD software program was utilized to estimate a maximum pipe diameter size of 42 inches for the south storm drain system. Appendix D contains detailed results from the StormCAD analysis.

Drainage significantly affecting the project area includes Switzer Canyon Wash, which crosses Fourth Street at the intersection with Butler Avenue. Switzer Canyon Wash is a FEMA-mapped wash that crosses Fourth Street via 8 – 64”x43” CMPA’s. During the 100-year storm event, approximately 1,300 feet of Butler Avenue is inundated including the Fourth Street intersection. Raising the intersection of Fourth Street and Butler Avenue approximately 4.5 feet, in combination with improvements to the channel and drainage structures, will remove the road from the 100-year floodplain. A 2-10’ x 5’ RCBC is proposed under Fourth Street to convey the 800-cfs associated with the 100-year flow and to accommodate the proposed street widening.



Figure 5.2: Post Development Drainage Map





### 5.3 Detention and Low Impact Development (LID)

Detention pond analysis (and implicitly LID) was specifically excluded from the scope of this project. The stormwater management discussed in this report employs a conventional design utilizing drainage inlets and catch basins; however a brief discussion of LID opportunities is warranted. Opportunities for employing LID features include the following:

- Conserve Natural Areas – The preferred alternative includes a raised median, which could be landscaped. This approach reduces the impervious areas.
- Minimize Disturbances to Natural Drainages – An LID approach might entail removing the storm drain and restoring the roadside ditches with vegetation.
- Bio-retention cell for mitigating stormwater near ADOT right-of-way

The study team met with City of Flagstaff Stormwater Management staff on September 15, 2009 to discuss drainage related issues for this study. The discussion included implementation of the LID design. City staff noted that at this time LID implementation is voluntary, though they would like to see LID concepts utilized. City staff also noted that currently there is an internal discussion on whether to allow LID retention structures within the ROW. A decision has not yet been made.

### 5.4 Conclusions

Peak discharges for the 2, 10, and 100-year storm events were determined for the project watershed the existing conditions. Two storm drain systems (north and south) were tentatively located and sized; the storm drains will collect runoff from the roadway and convey it into existing channels in a historical fashion.

### 5.5 References

- City of Flagstaff *Stormwater Management Design Manual*, March 2009
- TR-55, *Urban Hydrology for Small Watersheds*, Natural Resources Conservation Service, 1986
- Software: Bentley's PondPack, v10.01 and Bentley's StormCAD, v5.6



## 6 Utilities Overview

The Utility Overview describes the existing utilities, planned utilities and potential utility conflicts located within the study area. A request for Utility Maps and a Memo to Franchise Utilities requesting prior rights status was sent to the utility contacts (see Table 6.1). All utility maps have been received and are reflected in the Existing Utility Map. Responses regarding prior rights status have only been received from UniSource at this time. Their response indicated no easements exist within the project corridor and their facilities were installed per their Franchise Agreement. See Appendix F for the franchise agreement between the City of Flagstaff and UniSource.

### 6.1 Existing Utilities

The majority of the private and public utilities run along the western edge of the existing road under the sidewalk or in the undeveloped portion of the right-of-way as shown in the Existing Utilities Map, Figure 6.1. The existing utilities include underground electric, water, sewer, gas, telephone, telephone fiber, and cable. The only known utility that crosses I-40 is APS electric. In general, the remaining utilities cross Fourth Street and proceed along Sparrow Avenue or Soliere Avenue.

**Table 6.1: Utility Contacts**

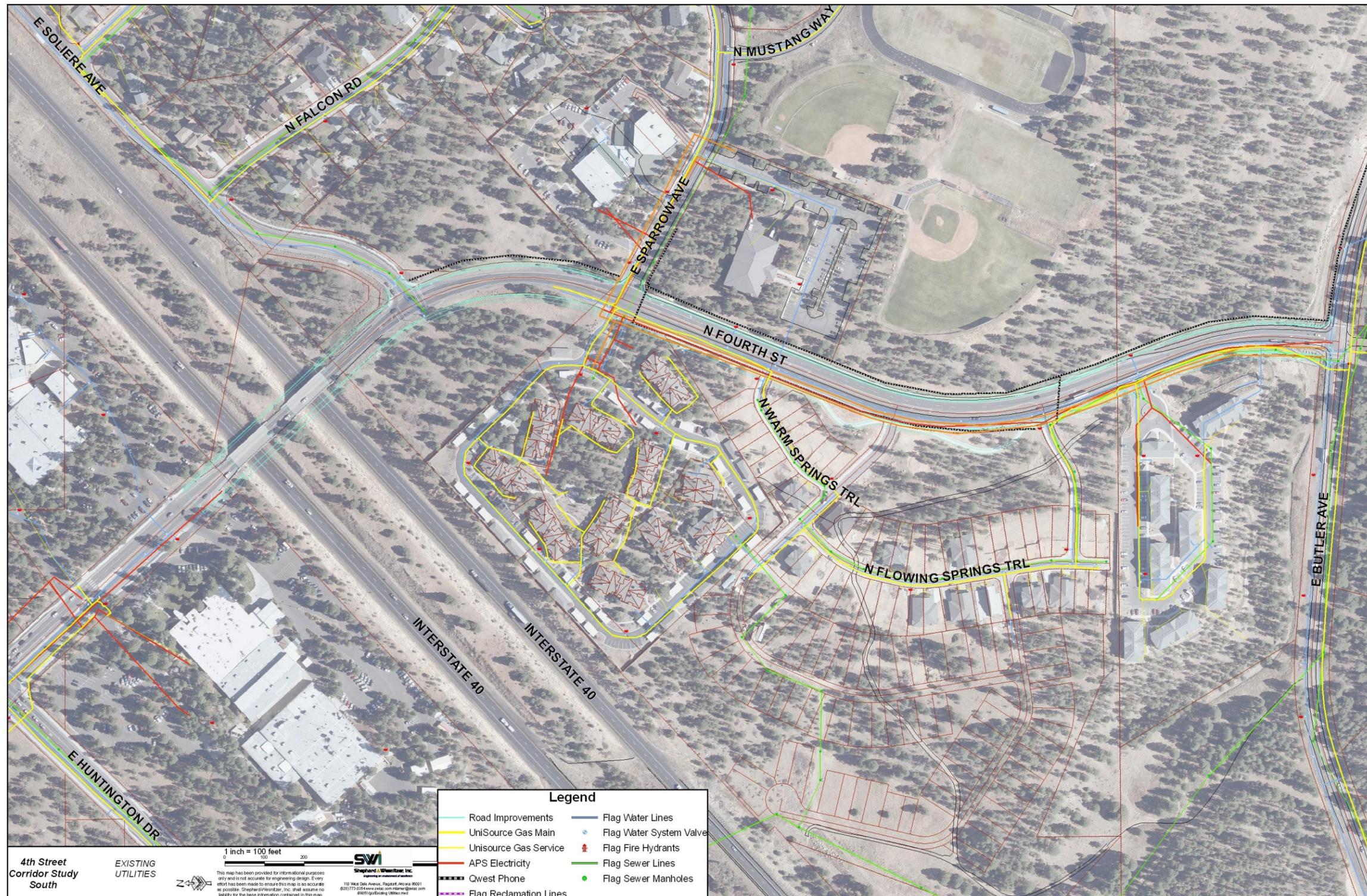
Utility	Facility	Contact	Information
City of Flagstaff (COF)	Water & Sewer	Jim Davis	211 West Aspen Avenue Flagstaff, AZ 86001 (928) 779-7685 (ext. 7257)
Arizona Public Service	Electric	Brian Wallace	2200 E. Huntington Dr, M.S. 4424 Flagstaff, AZ 86004 (928) 773-6306
Qwest	Fiber Optics, Telephone	Skip Bardsley	112 North Beaver Street Flagstaff, AZ 86001 (928) 779-4935
NPG Cable	Cable	Lewis Lambros	1601 South Plaza Way Flagstaff, AZ 86001 (623) 584-3467
UniSource Energy Services	Natural Gas	Martin Conboy	2901 W Shamrell Blvd #110 Flagstaff, AZ 86001 (928) 226-2269

#### 6.1.1 Electric

APS owns all of the electric power lines within the study area. These lines service the local residences and consist of direct buried lines and underground secondary lines. The lines are located on the western extents of the existing Fourth Street alignment and are generally located under the current sidewalk or in the undeveloped right of way at the back of the walk.



Figure 6.1: Existing Utilities Map





### 6.1.2 Water and Sewer

The City of Flagstaff provides the water and sewer service in this area. According to the provided as-built maps and the City GIS information, the existing water and sewer lines on Fourth Street are as follows:

#### Water

- A 12-inch ductile iron water line runs on the west side of Fourth Street parallel to the centerline from the Fourth Street/Butler Avenue intersection to a cross (12"x8"x8"x8") at the Fourth Street/Sparrow Avenue intersection. An 8-inch Asbestos Concrete (AC) water line continues north for about 150 feet (*Note: removing AC pipe may be cost prohibitive due to hazardous material handling requirements*).
- Several 12"x8" tees provide 8-inch main extensions to adjacent properties (see Figure 6.1).
- Six fire hydrants are adjacent to the project corridor, which may require relocation depending on the preferred roadway alternative.



#### Sewer

- An 8-inch PVC sewer line runs on the west side of Fourth Street parallel with the centerline from the Fourth Street/Butler Avenue intersection for about 800 feet north before running west to service the Forest Springs Townhomes.
- Additional sewer mains in the project corridor include an 8-inch vitrified clay pipe (VCP) crossing along Sparrow Avenue and an 8-inch PVC crossing at Soliere Avenue.

### 6.1.3 Gas

UniSource Energy Services supplies gas to the project area. Gas service consists of 4-inch coated steel pipe, and 2-inch and 4-inch plastic pipe. The 4-inch lines run along the western side of Fourth Street and cross Fourth Street at Sparrow Avenue. The 2-inch line comes off of a 4-inch line and provides service to the Summit Park Condominiums. Four-inch lines also serve Forest Springs Townhomes and Pinehurst Apartment Complex.

### 6.1.4 Telephone Lines

Qwest has underground facilities within the project area. Existing lines run on both the east and west sides of Fourth Street predominately under the sidewalks and within the undeveloped right-of-way. Qwest appurtenances consist of telephone lines and fiber optic cables that provide service to local residents and schools. Qwest has a conduit crossing of Fourth Street at Sparrow Avenue containing both fiber optic cables and telephone lines. In addition to active lines Qwest also has an unused conduit along the east side of Fourth Street from Soliere to Sparrow Avenues.

### 6.1.5 CATV

NPG Cable CATV lines along Fourth Street run along the western edge of the existing road, and cross Fourth Street at Sparrow Avenue, providing service for residential customers.



## **6.2 Planned Utilities**

### **6.2.1 Potable Water**

The scope of this study initially requested a conceptual design of closing the waterline gap between the 8-inch water line on Soliere Avenue and the 12-inch water line along Fourth Street, which was later identified as an 8-inch AC line instead of a 12-inch line. As directed by the City Utility Department at a subsequent project meeting, closing the waterline gap between the existing water lines is not warranted under current conditions because the two lines are on different pressure zones.

### **6.2.2 Reclaimed Waterline**

To facilitate the future connection of reclaimed water lines in this area, a 24-inch casing was proposed for the I-40 Bridge widening (see Proposed Reclaim Line Extension). This would connect a 6-inch reclaimed water line located near the Sparrow Avenue/Mustang Way intersection with a 12-inch reclaimed water line located north of Route 66 near the First Avenue/First Street Intersection.

ADOT has stated that as long as the Fourth Street Bridges are owned and maintained by ADOT, no utilities will be allowed on the bridge. If the City of Flagstaff took over ownership and maintenance, placing utilities on the bridge would be an option. However, the City has stated that this option should not be pursued.

An alternative design would entail connecting to an existing 12-inch reclaimed water segment under Huntington Drive located near Spruce Avenue Wash (note: although City of Flagstaff as-built indicates this line is in place, City Utility staff are uncertain if the line was actually installed). The future line could then be extended along the Spruce Avenue Wash, jacked and bored under I-40, and then brought up to Fourth Street along a subdivision street or along Butler Avenue. The construction cost associated with jacking and boring a 24-inch casing pipe under I-40 would be approximately \$160,000 (*Note: this estimate does not include the 12-inch reclaimed water line*).

### **6.2.3 Franchise Utilities**

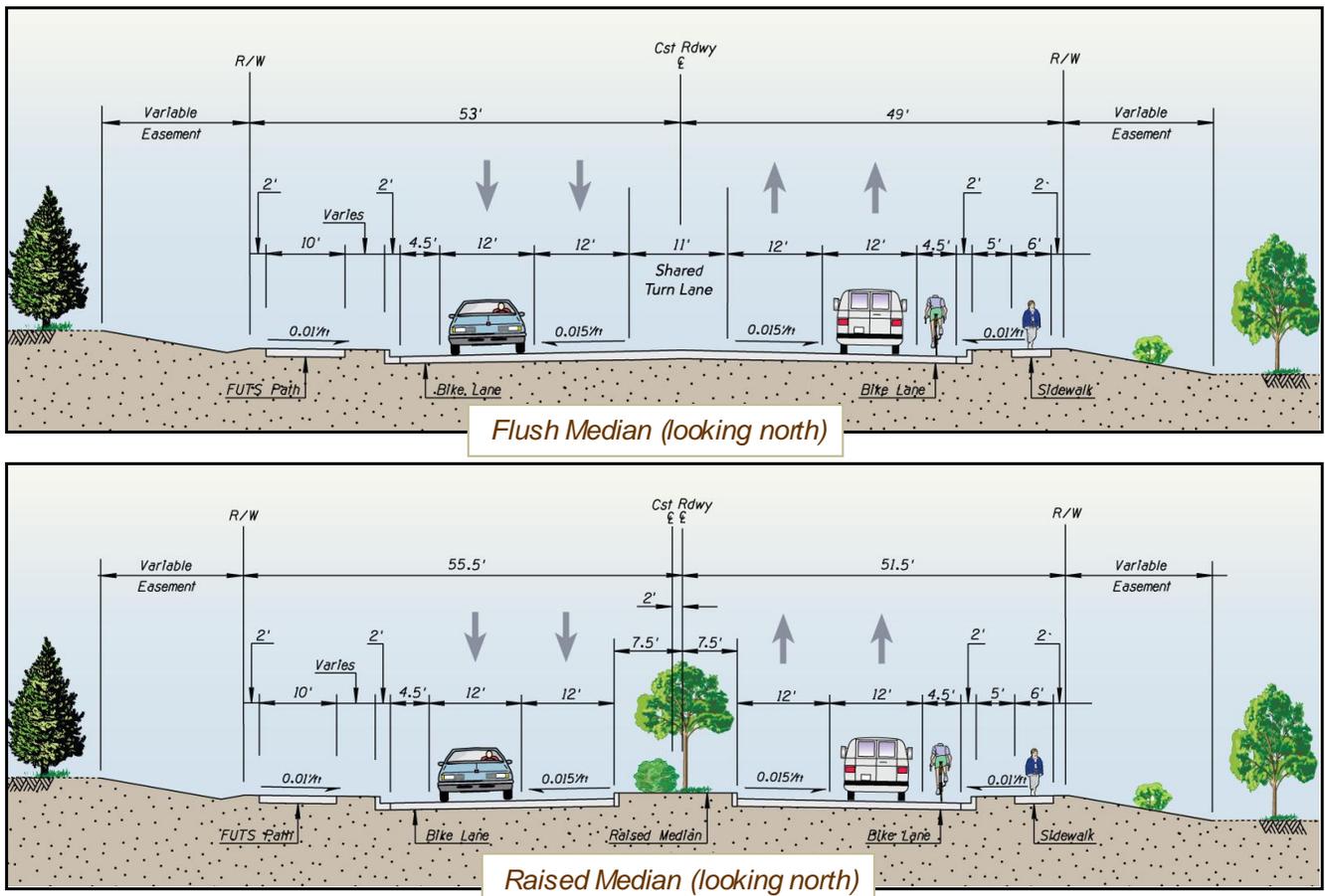
There are no known plans for franchise utility expansion in the study area.



## 7 Alternatives Development and Evaluation

Several alternatives have been identified during the study process by the City, community and study team. All options increased the capacity of Fourth Street to two through lanes in each direction as illustrated in Figure 7.0. The alternatives sought to maintain current design standards and to avoid adverse impacts. The alternative evaluation process involved a two step approach to systematically identify whether an alternative would be carried through with more development or whether the alternative was not viable for future consideration. Each step utilized an evaluation matrix of increasing level of detail, comparing the performance of each alternative against a common set of technical evaluation measures and public input to arrive at a preferred alternative.

Figure 7.0: Minor Arterial Alternative Typical Sections



### 7.1 Corridor Development Considerations & Major Constraints

The study alternatives were developed with key corridor considerations and major constraints in mind. This section describes the key considerations and major constraints.



### 7.1.1 Existing Improvements by Adjacent Development

The existence of residential development in the study area was a major consideration in developing alternatives. Approximately 1,000 feet of Fourth Street between Trickling Spring Trail and Sparrow Avenue has been improved to provide a five-lane urban section with curb, gutter, sidewalk and FUTS trail. Utilizing existing improvements was desirable.

### 7.1.2 Butler Avenue

Butler Avenue at Fourth Street has been previously studied by the City of Flagstaff. Improvements recommended from the study impact the Fourth Street corridor, including raising the intersection by 4.5 feet to clear the 100-year flood zone. While raising the intersection has little impact on selecting the preferred alternative for widening Fourth Street, it does play a large role in implementing the corridor improvements.

### 7.1.3 I-40 Crossing

Fourth Street crosses above I-40 via two steel structures. The bridge widths must be increased in order to provide two through lanes in each direction on Fourth Street. The structures are owned and maintained by ADOT. Any modification to these bridges will require ADOT approval. Complicating the decision of how to best widen the structures is the potential lane addition on I-40 (either one or two additional lanes in both the eastbound and westbound directions).

### 7.1.4 Pedestrian/Bicycle Safety

The existing development along Fourth Street has resulted in the need for a pedestrian/bicycle friendly environment. South of I-40, development on the west side of the roadway consists of medium density housing and the development on the east side of the roadway consists of public facilities (two schools, bus stop, FUSD Administrative Center). The close proximity of a medium density residential area to these public facilities, along with the nearby Aquaplex and businesses along Fourth Street north of Route 66, promote walking and biking. There are presently no continuous sidewalks/bike lanes or marked crosswalks between Butler Avenue and I-40 (north side).



To the north of I-40, Gore operates industrial facilities on both sides of Fourth Street. Since there is a high demand for Gore employees to be at both campus locations, the City of Flagstaff delineated a pedestrian crossing zone in front of their facilities (un-signalized). The traffic volume on Fourth Street has significantly increased with the railroad crossing project, making it difficult to cross the roadway. Further, with the future expansion of the I-40 bridges and the development to the south, it is anticipated that the traffic volumes will continue to increase.

### 7.1.5 Gore Access

In addition to the pedestrian concerns previously described, ingress and egress from the Gore campuses is difficult. With traffic volumes that are expected to continue increasing as new



development occurs on Fourth Street south of Butler Avenue, these turning movements will become more difficult to execute.

## **7.2 Level 1 Alternatives and Alternative Analysis**

Twelve alternatives were identified early during the study process. The alternatives offered three different options for improving Fourth Street to a minor arterial as well as utilizing various combinations of intersection types and configurations.

### **7.2.1 Alternatives**

#### **Alternative 1, Widen with Flush Median**

Alternative 1, shown in Figure 7.2-1, would utilize the existing roadway to the fullest extent by sawcutting and widening the pavement to provide a continuous five-lane section between Butler Avenue and I-40 (north side). The existing pavement retained would be overlaid. The two through lanes would be separated by a two-way left turn lane (flush median). The existing horizontal and vertical alignments would be maintained, except immediately north of Butler Avenue where the existing profile would be raised by 4.5 feet. The segment of Fourth Street previously improved would remain in the existing condition, which only provides a 3.5 foot bike lane measured to the lip of gutter. The FUTS trail would extend from Butler Avenue north to Huntington/Industrial Drive on the west side of Fourth Street. Within Alternative 1, there are four different combinations of intersection types possible, expanding Alternative 1 to Sub-Alternatives 1A, 1B, 1C and 1D as follows:

- 1A - Conventional intersections at all intersections
- 1B - Roundabouts at Soliere & Sparrow, conventional intersection at Butler
- 1C - Roundabout Soliere, conventional intersections at Sparrow & Butler
- 1D - Roundabout Sparrow, conventional intersections at Soliere & Butler

The widened roadway section would cross four pipe culverts including 8-64" x 43" CMPAs at Butler Avenue, a 24" CMP 200 feet north of Butler Avenue, an 18" CMP south of Trickling Springs Trail and an 18" CMP between Soliere Avenue and I-40. The 8-64" x 43" CMPAs were recommended to be upgraded to a 2-10'x5' RCBC according to the Butler Avenue DCR. All other pipe culverts would be extended in kind except for the pipe at Trickling Springs Trail that was previously extended. On-site drainage would be collected in a storm drain system.

The minimum required right-of-way width is 104 feet, which would result in approximately 0.7 acres of new right-of-way. No residential homes or businesses would be impacted by this alternative.

No linear utility conflicts are anticipated except near the southern termini. Most utilities are located along the west side of Fourth Street. Utility relocations between I-40 and Trickling Springs Trail would be limited to vertical grade adjustment of valves and manholes due to changes in pavement elevation. At the northern termini, the Gore power supply cabinet would need to be relocated due to widening the FUTS trail from 5 to 10 feet adjacent to their facilities. At the southern termini, several underground utilities would be impacted with additional

Figure 7.2-1: Alternative 1 – Widen with Flush Median (Alternative 1A illustrated)





embankment due to the grade increase at Butler Avenue and require significant vertical adjustment of surface facilities. Utilities including APS, UniSource, water, and gas would require horizontal re-alignment due to conflict with the proposed 2-10'x5' RCBC. The sewer line would also require an additional sanitary sewer manhole and additional sewer main lengths due to conflict with the proposed box culvert. The existing sanitary sewer manhole north of the proposed 2-10'x5' RCBC location is a drop manhole. This vertical drop would be utilized to provide sufficient slope for the proposed additional sewer main.

### **Alternative 2, Partial Reconstruction with Flush Median**

Similar to Alternative 1, Alternative 2 would provide a continuous five-lane section separating two through lanes with a two-way left turn lane (flush median), see Figure 7.2-2. However, the roadway would be reconstructed in areas where the existing geometry does not meet current design standards for 40 mph as noted in Section 2.1.

The horizontal curve at Soliere Avenue would be flattened to a radius of 600 feet, which would shift the centerline west by approximately 4 feet. The vertical curve in this area would also be improved to meet SSD. On the north leg of the Butler Avenue intersection, the profile of Fourth Street would be raised by 4.5 feet to accommodate the drainage recommendations from the Butler Avenue DCR. This would result in approximately 750 feet of reconstruction on Fourth Street to tie into the raised intersection. The segment of Fourth Street previously improved would remain in the existing condition, which only provides a 3.5 foot bike lane measured to the lip of gutter. The existing pavement retained would be overlaid. Like Alternative 1, there are four different combinations of intersection types possible, expanding Alternative 2 to Sub-Alternatives 2A, 2B, 2C and 2D.

The widened roadway section would cross four pipe culverts including 8-64" x 43" CMPAs at Butler Avenue, a 24" CMP 200 feet north of Butler Avenue, an 18" CMP south of Trickling Springs Trail and an 18" CMP between Soliere Avenue and I-40. The 8-64" x 43" CMPAs have been recommended to be upgraded to a 2-10'x5' RCBC according to the Butler Avenue DCR. All other pipe culverts would be extended in kind except for the pipe at Trickling Springs Trail that was previously extended. On-site drainage would be collected in a storm drain system.

The minimum required right-of-way width is 104 feet, resulting in approximately 0.8 acres of new right-of-way. No residential homes or businesses would be impacted by this alternative.

No linear utility conflicts are anticipated except at the southern termini. Most utilities are located along the west side of Fourth Street. Utility relocations between I-40 and Trickling Springs Trail would be limited to vertical grade adjustment of valves and manholes due to changes in pavement elevation. At the northern termini, the Gore power supply cabinet would need to be relocated due to widening the FUTS trail from 5 to 10 feet adjacent to their facilities. At the southern termini, several underground utilities would be impacted with additional embankment due to the grade increase at Butler Avenue and require significant vertical adjustment of surface facilities. Utilities including APS, UniSource, water, and gas would require horizontal re-alignment due to conflict with the proposed 2-10'x5' RCBC. The sewer line would also



Figure 7.2-2: Alternative 2 – Partial Reconstruction with Flush Median (Alternative 2A illustrated)





require an additional sanitary sewer manhole and additional sewer main lengths due to conflict with the proposed box culvert. The existing sanitary sewer manhole north of the proposed 2-10'x5' RCBC location is a drop manhole. This vertical drop would be utilized to provide sufficient slope for the proposed additional sewer main.

### **Alternative 3, Partial Reconstruction with Raised Median**

Alternative 3 consists of two through lanes in each direction separated by a raised median, see Figure 7.2-3. Like Alternative 2, the existing roadway would be reconstructed in areas where the geometry at Soliere Avenue does not meet current design standards for 40 mph. Approximately 750 feet of Fourth Street would be reconstructed approaching Butler Avenue due to raising the profile by 4.5 feet to accommodate drainage needs. The existing roadway would also require widening in areas that have been previously improved to a five-lane section to accommodate the raised median. The additional width would be attained by sawcutting the east roadway edge between Trickling Springs Trail and Sparrow Avenue, removing the existing curb and gutter, and widening the pavement by approximately 6 feet with new curb, gutter and sidewalk. As a result, the entire corridor would have a 4.5 foot bike lane measured to the lip of gutter. The existing pavement retained would be overlaid. Alternative 3 expands to Sub-Alternatives 3A, 3B, 3C and 3D.

The off-site drainage concept is the same for Alternative 3 as Alternatives 1 and 2 where the existing 8-64" x 43" CMPAs would be upgraded to a 2-10'x5' RCBC as recommended by the Butler Avenue DCR. All other pipe culverts would be extended in kind. On-site drainage would be collected in a storm drain system. The horizontal curvature has been designed to avoid superelevation, however, it is not known if the existing roadway between Trickling Springs Trail and Sparrow Avenue to be retained is superelevated. If superelevation does exist, median inlets would be required in addition to the outside inlets.

The minimum required right-of-way width is 107 feet for the raised median section, which would result in approximately 1.2 acres of new right-of-way. Additional right-of-way would need to be acquired from the Sinagua High School, FUSD and Northland Preparatory Academy. No residential homes or businesses would be impacted by this alternative.

No linear utility conflicts are anticipated except near the southern termini. Most utilities are located along the west side of Fourth Street. Utility relocations between I-40 and Trickling Springs Trail would be limited to vertical grade adjustment of valves and manholes due to changes in pavement elevation. At the northern termini, the Gore power supply cabinet would need to be relocated due to widening the FUTS trail from 5 to 10 feet adjacent to their facilities. At the southern termini, several underground utilities would be impacted with additional embankment due to the grade increase at Butler Avenue and require significant vertical adjustment of surface facilities. Utilities including APS, UniSource, water, and gas would require horizontal re-alignment to avoid conflict with the proposed 2-10'x5' RCBC. The sewer line would also require an additional sanitary sewer manhole and additional sewer main lengths to avoid conflicting with the proposed box culvert. The existing sanitary sewer manhole north of

Figure 7.2-3: Alternative 3 – Partial Reconstruction with Raised Median (Alternative 3A illustrated)





the proposed 2-10'x5' RCBC location is a drop manhole. This vertical drop would be utilized to provide sufficient slope for the proposed additional sewer main.

### **7.2.2 Alternative Analysis**

The Level 1 alternatives were compared using criteria established from the project goals and objectives listed in Section 1.6. The various combinations of intersection types were not considered during Level 1 analysis since they were similarly compatible with each alternative. The broad technical assessments of the alternative features were complemented by the community input, which assisted in selecting the alternative to be studied in more detail during the Level 2 evaluation. A summary of the alternative comparison is provided in Table 7.2.

Alternatives 1, 2 and 3 shared some commonalities. All of the alternatives would meet the forecasted future traffic needs by providing two through lanes in each direction. They would also improve pedestrian and bicycle travel through the corridor with continuous bike lanes, sidewalk and FUTS trail. Impacts to existing utilities are similar among all options. Differences between the alternatives related to meeting current design standards, median treatment, pedestrian/bicycle considerations and consistent roadway section within the Fourth Street corridor. Alternative 1 would not improve the horizontal and vertical curves on Fourth Street at Soliere Avenue to meet the required minimum design speed for a minor arterial. Since Fourth Street has future plans for significant extension and will serve as a primary north/south corridor in Flagstaff, it is desirable to meet this criterion.

Another primary difference between the alternatives is the median type, either flush or raised. Alternatives 1 and 2 would provide comparable roadway capacity and intersection operational characteristics as Alternative 3. The flush median would offer a lower cost option for these benefits since less additional right-of-way would be required, throwaway of existing improvements would be minimal and maintenance activities like snow removal would be easier. Alternative 3, the raised median option, would require that the existing eastern curb line between Trickle Springs Trail and Sparrow Avenue be removed so that the roadway can be widened to accommodate the typical section. This work is expensive, however, it would allow for 6 feet bike lanes instead of the existing 5 feet lanes and a parkway type sidewalk on the east side of Fourth Street. Pedestrian safety was noted as a key public concern at the community information meetings, particularly at Sparrow Avenue where children cross Fourth Street from the residential area or bus stop to attend school. The raised median could either act as a refuge for any future mid-block crossings or a means to channelize pedestrians to the nearest crossing, like the Butler Avenue raised median adjacent to Northern Arizona University.

Alternative 3 would be consistent with the corridor north and south of the study limits. The *FSCS – North* is evaluating options to revitalize Fourth Street north of Route 66. One potential option would be installing raised medians to improve pedestrian crossings, enhance aesthetics and introduce traffic calming. To the south of this study, Fourth Street is planned to connect to J. W. Powell Boulevard in the future. Though no plans have been submitted yet for approval, early discussions in 2005 between the City of Flagstaff and the Canyon Del Rio developer involved a raised median extending south along Fourth Street from the intersection with Butler Avenue.



**Table 7.2: Level 1 Alternative Evaluation Matrix**

CRITERIA	NO BUILD	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
Description	No Build	Five-lane (flush median) using existing roadway	Five-lane (flush median) reconstructing roadway to attain 40 mph design speed	Four-lane (raised median) reconstructing roadway to attain 40 mph design speed
Traffic				
Corridor LOS (2030)	LOS F	LOS B - D	LOS B - D	LOS C -D
Access Management	No Change	No Change	No Change	Median crossovers at Sandstone Dr and Pinehurst Apt, right-in/right-out others
Roadway				
Design Speed (mph)	Existing 35 mph	35 mph	40 mph	40 mph
Median Width	No Impact/ No Existing Median	11 feet	11 feet	15 feet
Drainage				
Offsite Drainage	Existing 18" & 24" CMPs convey offsite flows under Fourth Street (refer to drainage maps)	Connect Existing 18" & 24" CMP to proposed storm drain convey runoff into storm drain system. Other offsite flows will sheet flow over proposed curb and gutter, into catch basins.	Connect Existing 18" & 24" CMP to proposed storm drain convey runoff into storm drain system. Other offsite flows will sheet flow over proposed curb and gutter, into catch basins;	Connect Existing 18" & 24" CMP to proposed storm drain convey runoff into storm drain system. Other offsite flows will sheet flow over proposed curb and gutter, into catch basins.
Onsite Drainage	No Impact	2 storm drain systems, inlets at curb & gutter. Detention facilities will be required for increase discharge from north storm drain system.	2 storm drain systems, inlets at curb & gutter. Detention facilities will be required for increase discharge from north storm drain system.	2 storm drain systems, inlets at curb & gutter, potential for drainage inlets at median near Soliere. Detention facilities will be required for increase discharge from north storm drain system.
LID Opportunities	No Change	Linear roadside ditches	Linear roadside ditches	Linear roadside ditches, less impervious area due to landscaped median
Multi-modal				
Pedestrians and Bicycles	No Change	Continuous bike lanes, but width is less than desired in previously improved areas	Continuous bike lanes, but width is less than desired in previously improved areas	Continuous 6 foot bike lanes; median provides pedestrian refuge area (enhancing opportunities for future pedestrian crossings near schools)
Transit	No Change	Move bus stop north of Sparrow Ave for NB travel	Move bus stop north of Sparrow Ave for NB travel	Move bus stop north of Sparrow Ave for NB travel
Right-of-Way				
Estimated Right-of-Way	No Impact	104 foot width, 0.7 acres	104 foot width, 0.8 acres	107 foot width, 1.2 acres
Other				
Floodplain	Butler/Fourth Intersection within 100 year flood zone	Butler/Fourth intersection improvements include removing 8-64" x 43" CMPA and upgrading to a 2-10'x5' RCBC results in raising road ±4.5 feet and out of the 100-year floodplain	Butler/Fourth intersection improvements include removing 8-64" x 43" CMPA and upgrading to a 2-10'x5' RCBC results in raising road ±4.5 feet and out of the 100-year floodplain	Butler/Fourth intersection improvements include removing 8-64" x 43" CMPA and upgrading to a 2-10'x5' RCBC results in raising road ±4.5 feet and out of the 100-year floodplain
Potential 4(f)	No impact	R/W from schools due to raising Butler Avenue profile	R/W from schools due to raising Butler Avenue profile	R/W from schools due to raising Butler Avenue profile
Utilities Impacts	No impact	Surface facility adjustments, Gore electric cabinet relocation and electric, sewer, water & gas realign at 2-10'x5' RCBC	Surface facility adjustments, Gore electric cabinet relocation and electric, sewer, water & gas realign at 2-10'x5' RCBC	Surface facility adjustments, Gore electric cabinet relocation and electric, sewer, water & gas realign at 2-10'x5' RCBC
Cost				
Preliminary Project Cost	None	\$8,540,000	\$8,860,000	\$9,560,000



Based on this analysis, the study team recommended advancing Alternative 3 to Level 2 analysis and evaluation. This alternative is consistent with the City of Flagstaff's desired roadway section for a minor arterial. Other benefits of the raised median section include aesthetics (landscaping in the median), less impervious surface (LID considerations) and access control (right-in / right-out).

### **7.3 Level 2 Alternative Analysis**

Alternative 3 was expanded to Sub-Alternatives 3A, 3B, 3C and 3D to further evaluate the four possible combinations of intersection types. Figures 7.3-1 through 7.3-4 show the potential intersection improvements at Sparrow and Soliere Avenues.

The Level 2 analysis compared various aspects of each option to identify the respective benefits and impacts associated with the intersection types. The alternatives were assessed using the criteria noted below, which were not prioritized or weighted. The results of the evaluation process are summarized in Table 7.3.

- Intersection Level of Service (LOS) – *Operational performance of intersection*
- Overall Intersection Delay – *Wait time at the intersection*
- Vehicle Speed Within Corridor – *Design speed and posted speed*
- Vehicle Crashes – *Based on published data that considers intersection safety*
- Bicycle Friendly – *Level of comfort users experience from the alternative*
- Pedestrian Friendly – *Level of comfort users experience from the alternative*
- Physical Features Conducive to Intersection Type – *Approach grades considered*
- Environmental Concerns – *Air and noise quality, as well as wasting natural resources*
- New Right-of-Way Required - *Considers the area of new right-of-way*
- Construction Costs – *Considers cost to construct alternative for comparison purposes*

All of the Sub-Alternatives would meet current design standards and operational expectations for the design year. Traffic analysis and modeling was performed for each scenario to understand the dynamics of the same or mixed intersection types at Sparrow and Soliere Avenues. Data summarized in Table 7.3 came from VISSIM analysis utilizing RODEL parameters. The detailed results of the traffic analysis are provided in Appendix C. The City of Flagstaff indicated that mixed intersection types at Soliere and Sparrow Avenues would not be preferred due to the close spacing of these intersections.

Other evaluation criteria were compared using case study evidence on roundabouts and signalized intersections. A variety of national and international sources were referenced including FHWA, ADOT, US Access Board Research, Pedestrian and Bicycle Information Center, and Insurance Institute for Highway Safety. Information regarding vehicle crashes, multi-modal usage and environmental considerations are documented in Table 7.3.



## Fourth Street – South Butler Avenue to Huntington / Industrial Drive Final Corridor Study

Figure 7.3-1: Alternative 3A – Conventional Intersections

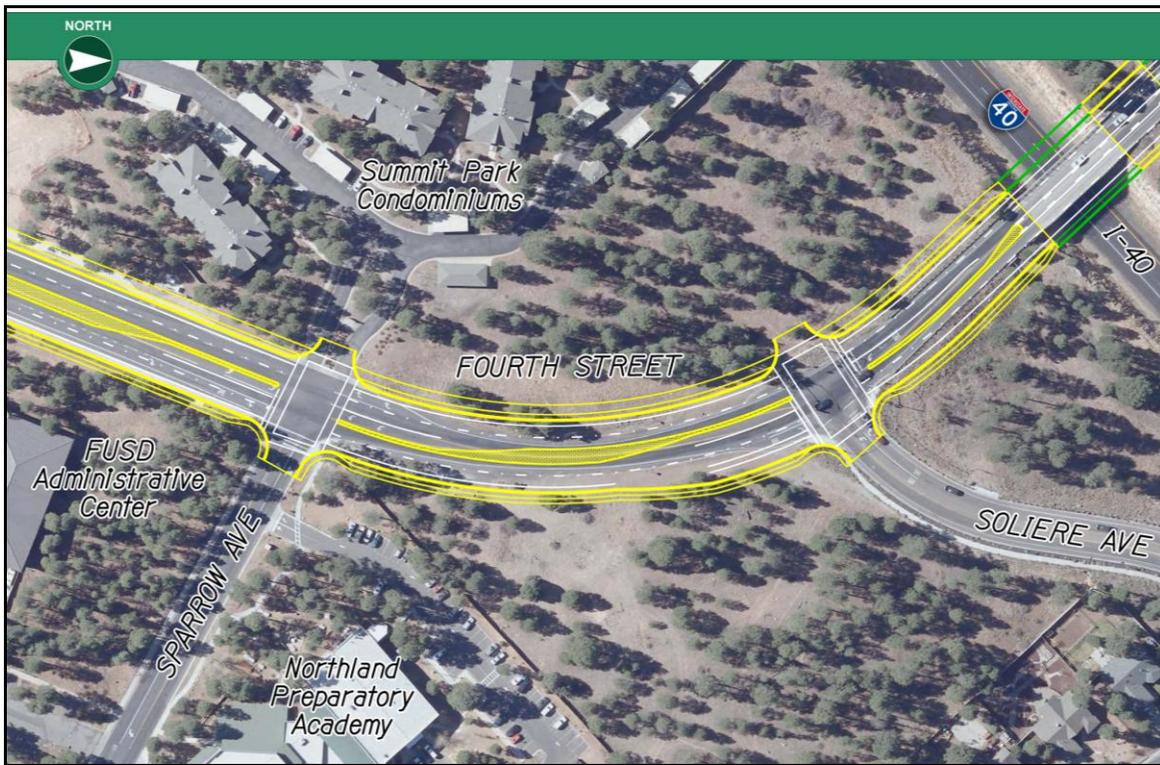
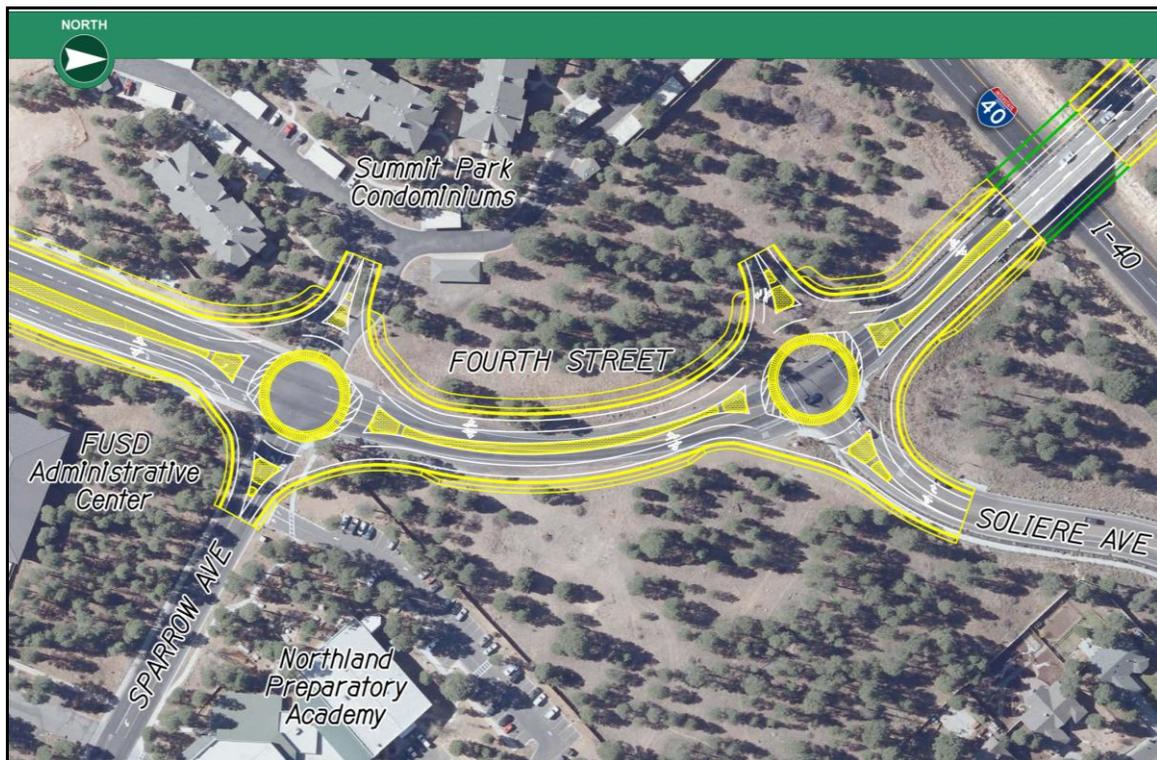


Figure 7.3-2: Alternative 3B – Roundabouts





## Fourth Street – South Butler Avenue to Huntington / Industrial Drive Final Corridor Study

Figure 7.3-3: Alternative 3C – Conventional Intersection and Roundabout

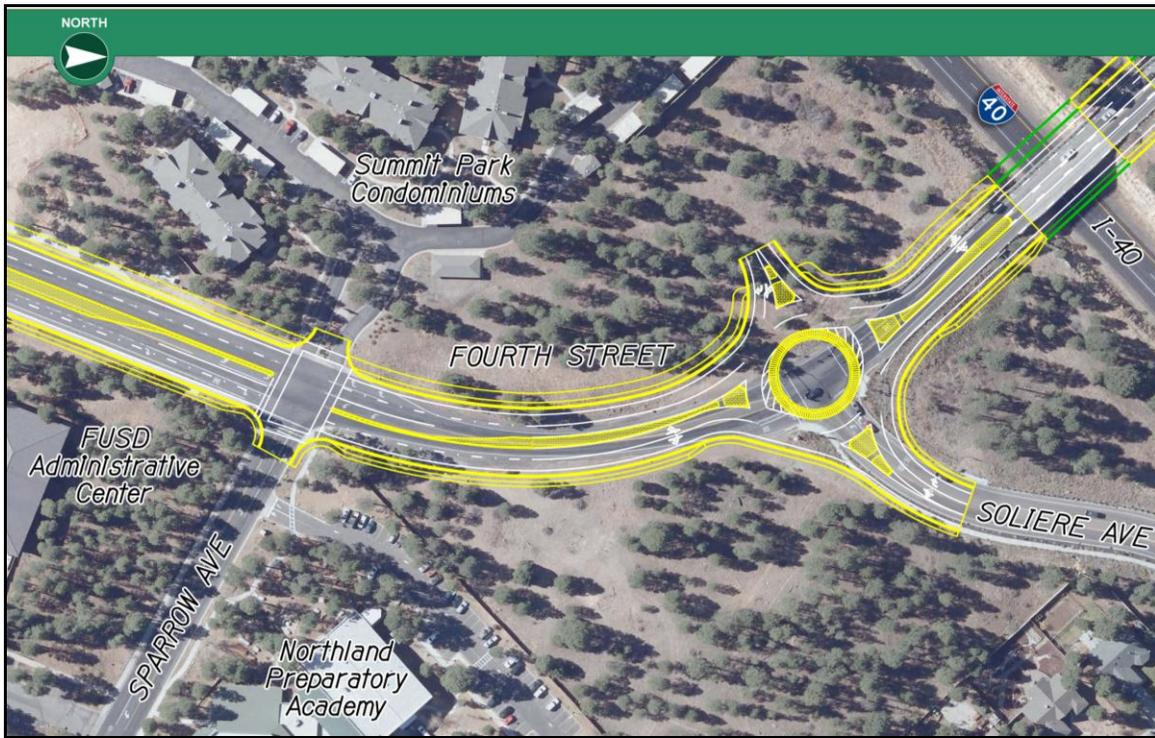
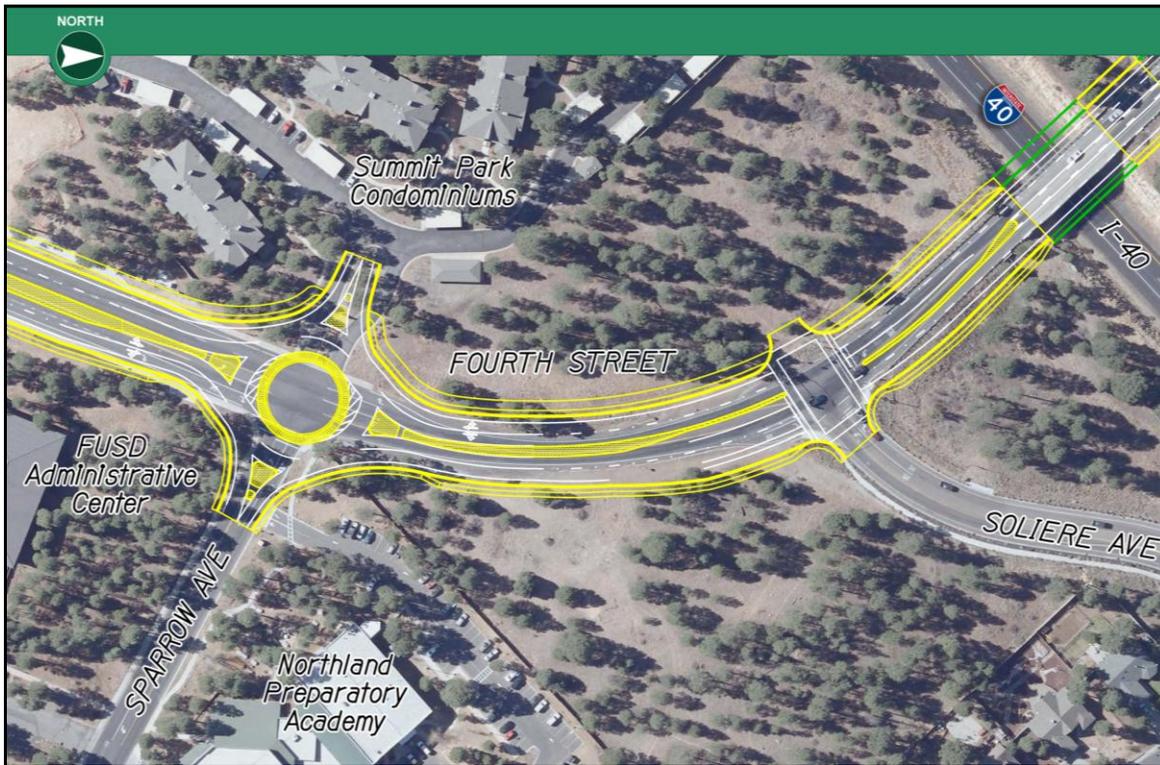


Figure 7.3-4: Alternative 3D – Roundabout and Conventional Intersection





**Table 7.3: Level 2 Alternative Evaluation Matrix**

<b>Evaluation Criteria</b>	<b>Alternative 3A Signalized Intersection Sparrow and Soliere Ave</b>	<b>Alternative 3B Roundabouts Sparrow and Soliere Ave</b>	<b>Alternative 3C Signal at Sparrow Ave Roundabout at Soliere Ave</b>	<b>Alternative 3D Roundabout at Sparrow Ave Signal at Soliere Ave</b>
Intersection Level of Service (LOS)	Sparrow - LOS B Soliere - LOS C	Sparrow - LOS A Soliere - LOS B	Sparrow - LOS A Soliere - LOS B	Sparrow - LOS A Soliere - LOS C
Overall Intersection Delay	Sparrow - 12 seconds Soliere – 20 seconds	Sparrow - 5 seconds Soliere – 14 seconds	Sparrow - 9 seconds Soliere – 11 seconds	Sparrow - 9 seconds Soliere – 27 seconds
Vehicle Speed within Corridor	35 mph posted speed	Speeds will slow to 15-25 mph in the vicinity of the roundabouts	Speeds will slow to 15-25 mph in the vicinity of the Soliere roundabout	Speeds will slow to 15-25 mph in the vicinity of the Sparrow roundabout
Vehicle Crashes	More severe crashes due to higher intersection speeds	Injury crashes can be reduced by 75% due to lower speeds through roundabouts	Injury crashes can be reduced by 75% due to lower speeds through roundabouts	Injury crashes can be reduced by 75% due to lower speeds through roundabouts
Bicycle Friendly	Travel same as vehicles	Increased crashes involving bicycles at roundabouts	Increased crashes involving bicycles at roundabouts	Increased crashes involving bicycles at roundabouts
Pedestrian Friendly	<ul style="list-style-type: none"> <li>▪ Pedestrians will cross in a protected signal phase at a cross walk</li> <li>▪ Pedestrians face a greater number of vehicular conflicts at a signal versus a roundabout</li> </ul>	<ul style="list-style-type: none"> <li>▪ Minimal data is available on pedestrian safety at multi-lane roundabouts, however, statistics show few crashes involving pedestrians</li> <li>▪ Special design features are required for visually impaired pedestrians</li> <li>▪ Consideration for school children crossing</li> </ul>		
Physical Features Conducive to Intersection Type	Roadway geometry meets design standards	Grades on east legs of Sparrow and Soliere exceed suggested 3%		
Environmental Concerns	Increased lighting from signals	Reduction in air and noise pollution resulting from shorter delays and fewer stop/starts		
New Right-of-Way Required	1.23 acres	1.90 acres	1.57 acres	1.56 acres
Preliminary Costs (Construction & R/W)	\$7.8 million	\$7.8 million	\$7.8 million	\$7.8 million

**LEGEND:**

<b>Least Impact</b> (Best Opportunity)			<b>Most Impact</b> (Least Opportunity)



Benefits of conventional intersections (signals) on Fourth Street:

- Consistent with current driver expectations on corridor
- Trends show fewer bicycle-related accidents with signals
- Requires the less new right-of-way at the intersection areas
- Results in the lowest project cost

Benefits of roundabouts on Fourth Street:

- Provides a better level of services at both intersections
- Provides a shorter delay at the intersections
- Slows speed on Fourth Street between Sparrow and Soliere to 15 – 25 mph
- Reduces the potential for injury accidents at the intersections due to lower speeds
- Reduces environmental impacts (air, noise, natural resources)
- Minimizes future maintenance costs (signal repairs and electricity)
- Provides u-turn location for Gore traffic

Alternatives 3A and 3B were considered the most viable options of the Sub-Alternatives by the study team. The key tradeoffs between these options consisted of better traffic operations and less potential for severe injury resulting from intersection crashes with the roundabouts to less additional right-of-way required and more consistent with current corridor multi-modal expectations with the conventional intersections. Other criteria like “Vehicle Speed within Corridor” and “Bicycle Friendly” could be addressed with minor adjustments to each alternative if desirable. For example, creating a speed reduction zone or removing bike lanes from within the roundabout. Public input received favored conventional intersections, particularly at Sparrow Avenue. The reasons noted:

- Multiple-user scenario (vehicles, pedestrians, bicyclists and bus riders) at Sparrow Avenue, including children as pedestrians. Concern expressed that pedestrians and bicyclists would not be able to cross safely at a roundabout.
- Roundabout would be in close proximity of Summit Park Condominium Building 3 and potential adversely affect property values. Impact to complex entryway would detract from natural landscaping.
- Unbalanced approach volumes would impact roundabout efficiency.

The difference between construction subtotal costs for each Sub-Alternative would be negligible, see Appendix A.

## **7.4 Recommended Alternative**

*Alternative 3A – Partial Reconstruction with Raised Median and Conventional Intersections* was selected as the recommended alternative of the *FSCS – South*. Alternative 3A would best meet the transportation, access, future development and aesthetics needs of Flagstaff. This alternative would offer the greatest consistency with the *Flagstaff Area Regional Land Use and*



## Fourth Street – South Butler Avenue to Huntington / Industrial Drive Final Corridor Study

*Transportation Plan* and the *2002 to 2025 Regional Transportation Plan* which identify Fourth Street as a multimodal facility linking commercial, educational, recreational, employment and residential areas with developable lands to the south. The raised median typical section is the City's preferred section for minor arterials. The conventional intersection type would provide an acceptable LOS and delay for the design year traffic while requiring the least amount of additional right-of-way from the immediate surrounding residents.



## 8 Major Design Features

The key components of *Alternative 3A – Partial Reconstruction with Raised Median and Conventional Intersections* are described in this section.

### 8.1 Roadway Features

#### 8.1.1 Design Criteria

The design criteria for this project were established using the City of Flagstaff *Engineering and Construction Standards* (January 20, 2009) including updates through May 19, 2009, City of Flagstaff *SWMDM* and *LID*, and the AASHTO *Policy on Geometric Design of Highways and Streets* (2004). Selective design criteria used for the *FSCS -South* development are summarized in Table 8.1.

#### 8.1.2 Design Speed and Posted Speed

According to the City of Flagstaff *Engineering Design and Construction Standards*, the design speed of a minor arterial is 40 mph. The posted speed will be 35 mph.

**Table 8.1: Design Criteria**

Design Feature	Criteria
Functional Classification	Minor Arterial
LOS	D
Design Year	2030
Design ADT	10,600 to 33,400
Design Speed	40 mph
Pavement Design Life	20 Years
Pavement Section	4 inches AC on 8 inches AB (New Pavement) 1 ½ inches AC (Overlay)
Horizontal Alignment	Curve Radius 600 feet Min, e = 4% Max
Vertical Alignment	Vertical curve is required for algebraic grade difference equal to or greater than 1.0%.
Longitudinal Profile Grades	0.50% Min 6.00% Max
Roadway Cross Slope	1% to 2%
Lane Width	12 feet
Median Width	15 feet
Sidewalk Width	6 feet (Parkway Section)
FUTS Trail Width	10 feet
Curb & Gutter Type	MAG Std 220, Type A
Curb Return Radii	30 feet
Cut & Fill Slopes	2:1 Maximum
Tapers	Design Speed:1 Minimum
Flares	15:1 Minimum
Right-of-Way	108 feet width Minimum

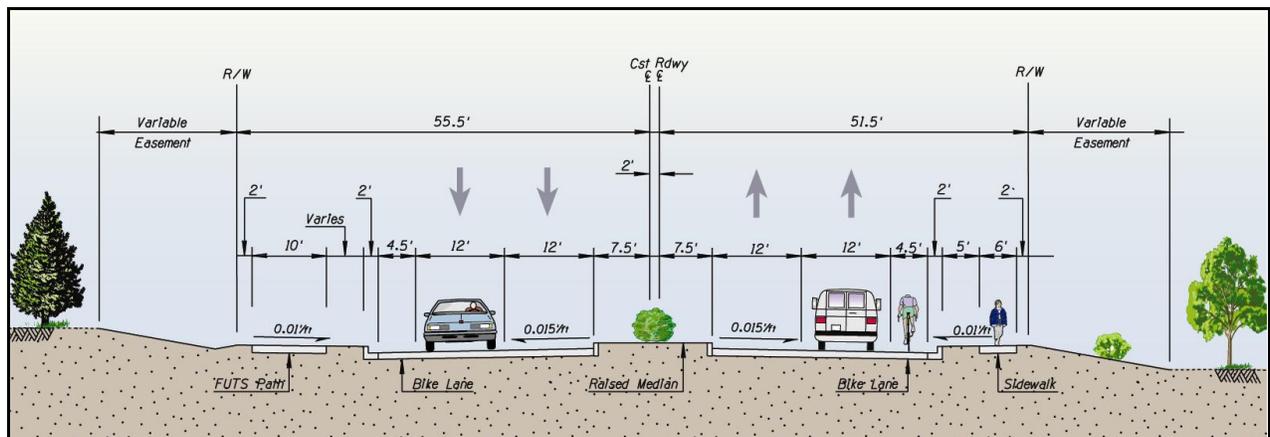


Design Feature	Criteria
On-Site Drainage	<ul style="list-style-type: none"> <li>▪ Design culverts and bridges for the 50-year event.</li> <li>▪ Design roadway for 6” maximum depth for the 50-year event.</li> <li>▪ Size storm drains for the 10-year event and provide 12’ of “dry” pavement for both directions of traffic.</li> <li>▪ On-site hydrology to be computed for the proposed right-of-way limits using the Rational Method procedures outlined in the <i>SWMPM</i></li> <li>▪ LID considerations</li> </ul>

### 8.1.3 Typical Section

The typical section for the preferred alignment alternative consists of two travel lanes in each direction separated by a 15-foot raised median. Pedestrian and bicycle traffic will be accommodated on both sides of the roadway. The typical section is shown in Figure 8.1-1.

**Figure 8.1-1: Fourth Street Typical Section**



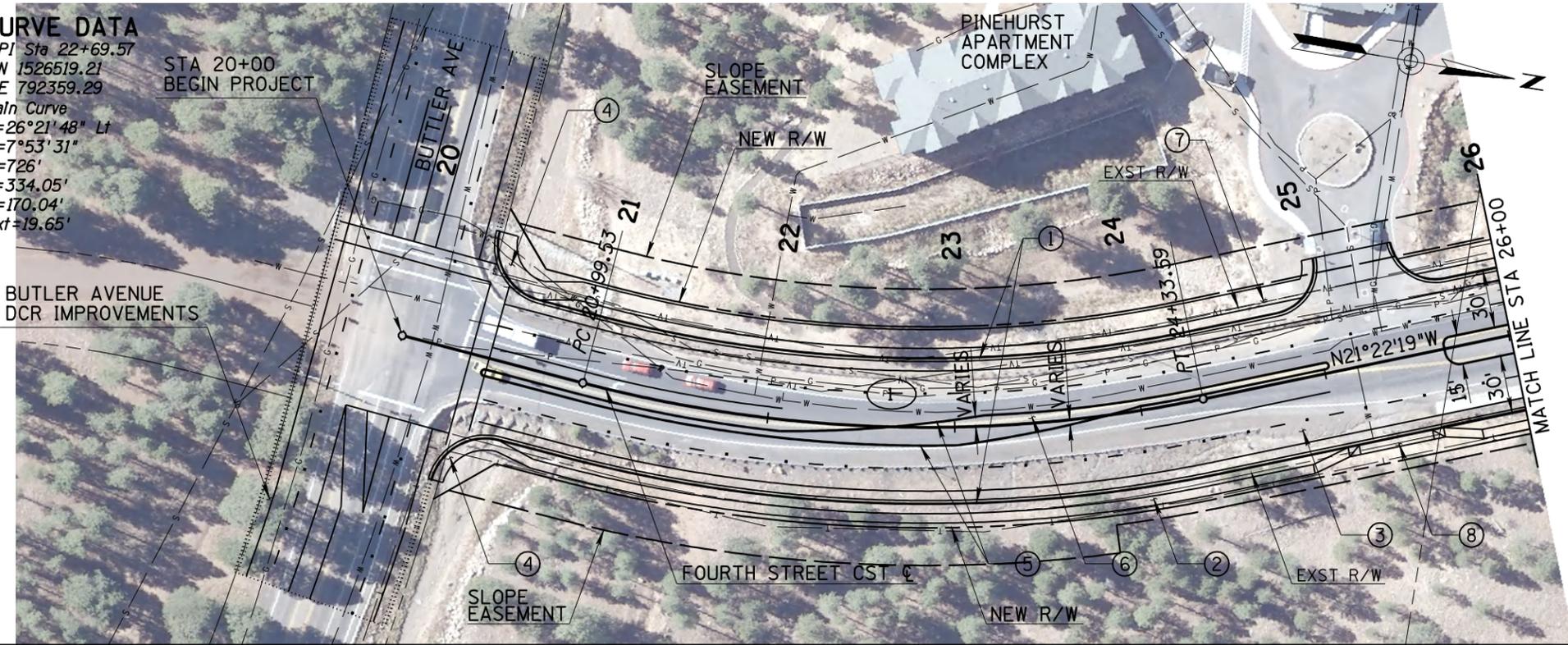
### 8.1.4 Alignment Description

Conceptual plans for the preferred corridor alignment are provided in Figure 8.1-2. The alignment follows the existing Fourth Street corridor between Butler Avenue and I-40. The roadway centerline is 2 feet offset to the east of the existing centerline since the existing west curb line was held between Trickling Springs Trail and Sparrow Avenue. The horizontal geometry consists of three curves with a 726-foot radius at Butler Avenue, 750-foot radius at Sparrow Avenue and 600-foot radius at Soliere Avenue. Superelevation will not be required for curves with a radius greater than 726-feet according to the AASHTO *A Policy on Geometric Design of Highways and Streets* (2004). The increased radius at Soliere Avenue from 575-feet to 600-feet will shift the roadway centerline to the west by approximately 4 feet.

The vertical geometry generally matches the existing profile except at the I-40 crossings and Butler Avenue. The profile grade will need to be raised by approximately 2 feet to provide sufficient I-40 vertical clearance for the new simple-span precast prestressed AASHTO Type VI girder bridges. The vertical curve immediately south of the I-40 crossings will be flattened as part of this reconstruction to provide minimum SSD for 40 mph. The north approach to Butler

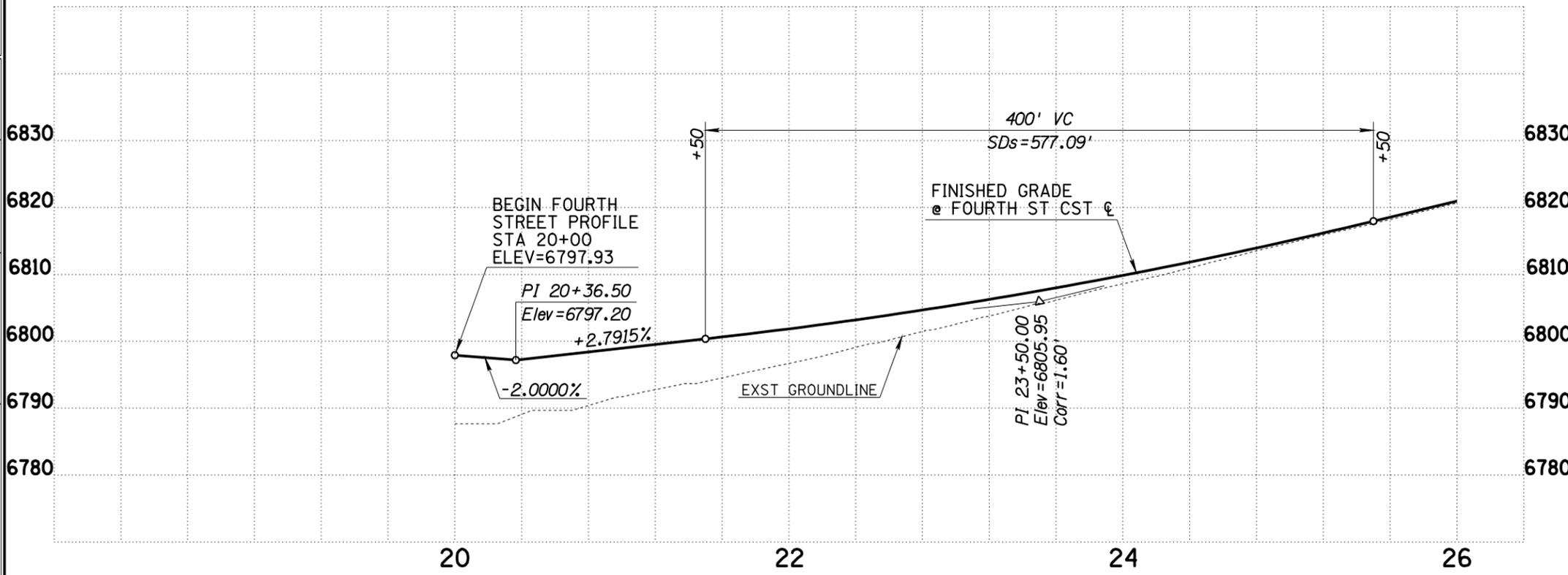
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 E 792359.29  
 STA 20+00  
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 Main Curve  
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 $D = 7^\circ 53' 31''$   
 $R = 726'$   
 $L = 334.05'$   
 $T = 170.04'$   
 $Ext = 19.65'$



**CONSTRUCTION NOTES**

- ① CONSTRUCT NEW CONCRETE CURB AND GUTTER PER MAG STD DET 220, TYPE A, H=6"
- ② CONSTRUCT NEW CONCRETE SIDEWALK PER MAG STD DET 230
- ③ CONSTRUCT NEW PAVEMENT SECTION
- ④ CONSTRUCT NEW SIDEWALK RAMP
- ⑤ CONSTRUCT NEW SINGLE CURB
- ⑥ NEW RAISED MEDIAN
- ⑦ NEW FUTS TRAIL
- ⑧ FUTURE ACCESS POINT



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 CITY OF FLAGSTAFF  
 CAPITAL IMPROVEMENTS DIVISION

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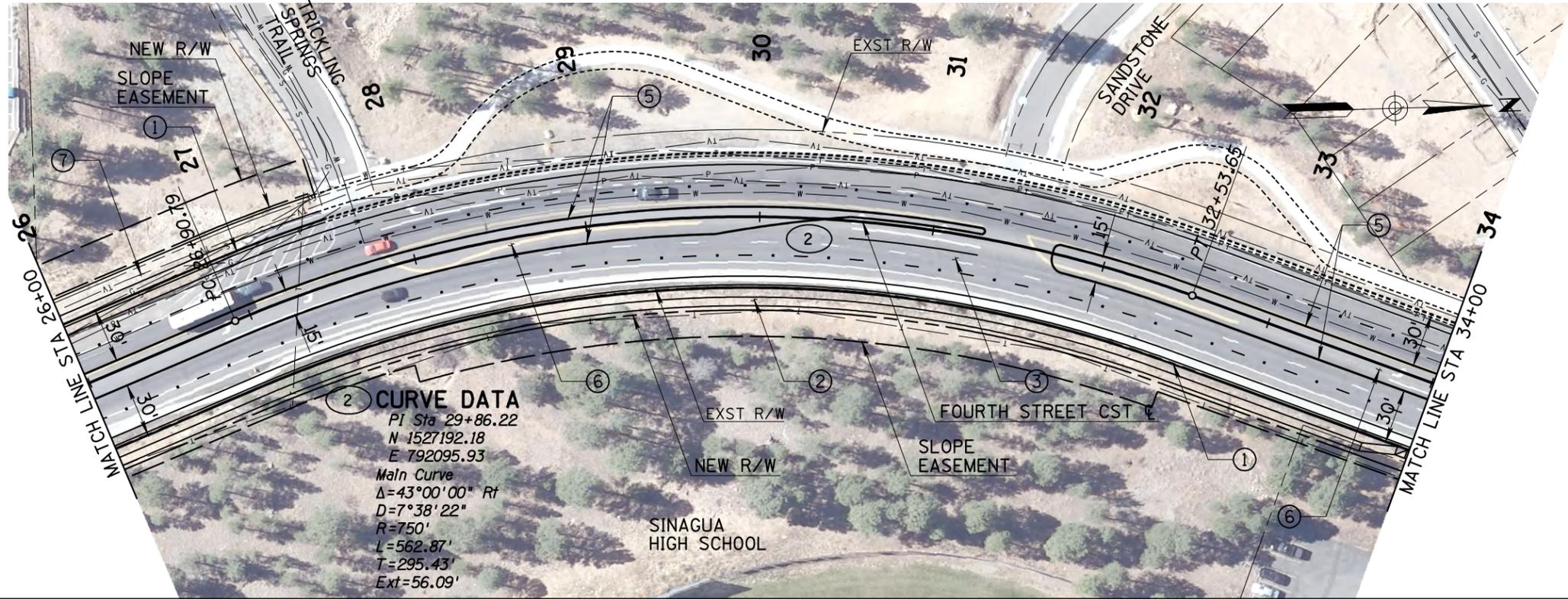
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 CHKD BY: JM 03/10



SCALE H: \_\_\_\_\_  
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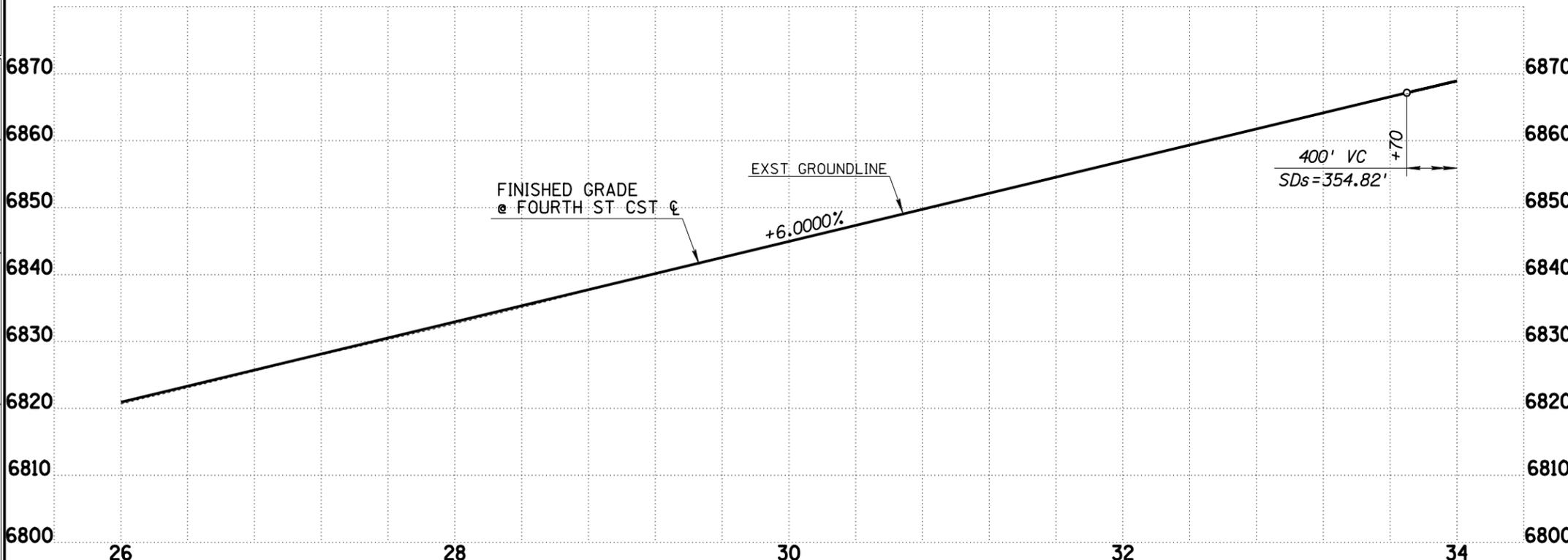
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**CONSTRUCTION NOTES**

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- ② CONSTRUCT NEW CONCRETE SIDEWALK PER MAG STD DET 230
- ③ CONSTRUCT NEW PAVEMENT SECTION
- ④ CONSTRUCT NEW SIDEWALK RAMP
- ⑤ CONSTRUCT NEW SINGLE CURB
- ⑥ NEW RAISED MEDIAN
- ⑦ NEW FUTS TRAIL



**FOURTH STREET CORRIDOR STUDY**

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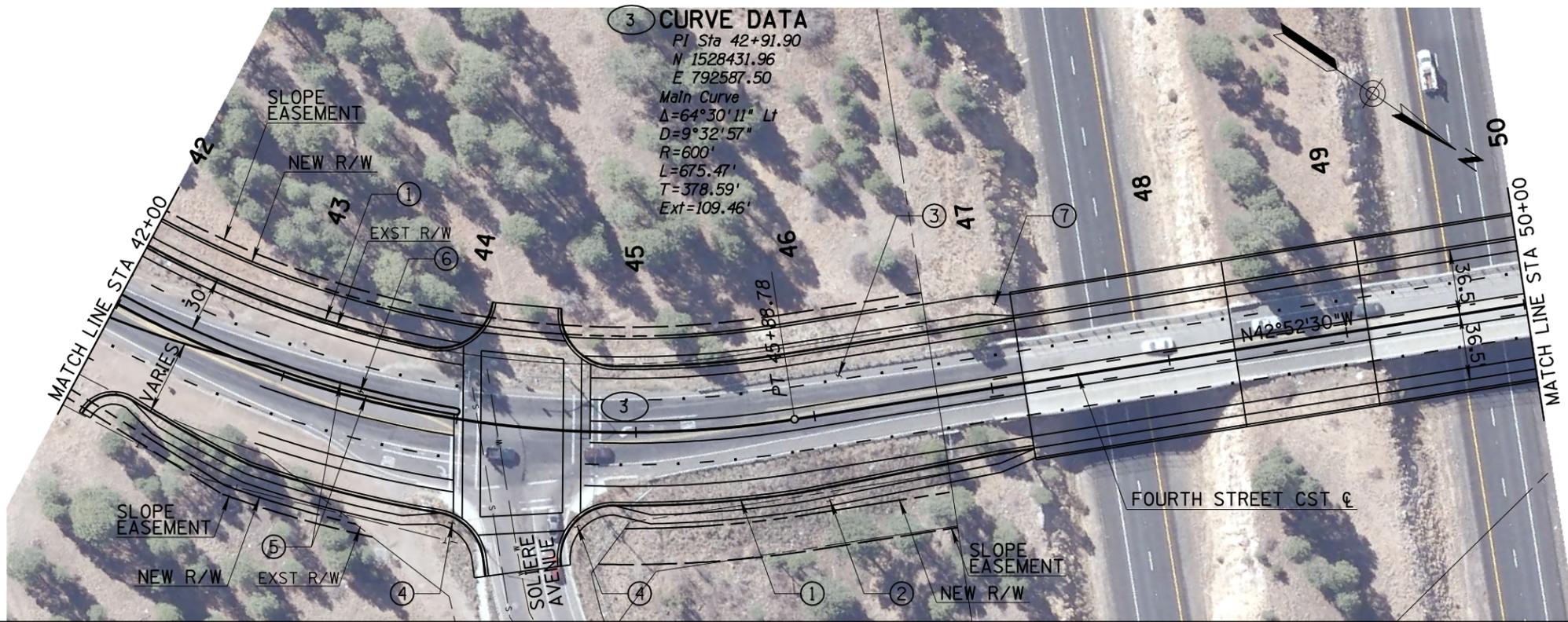
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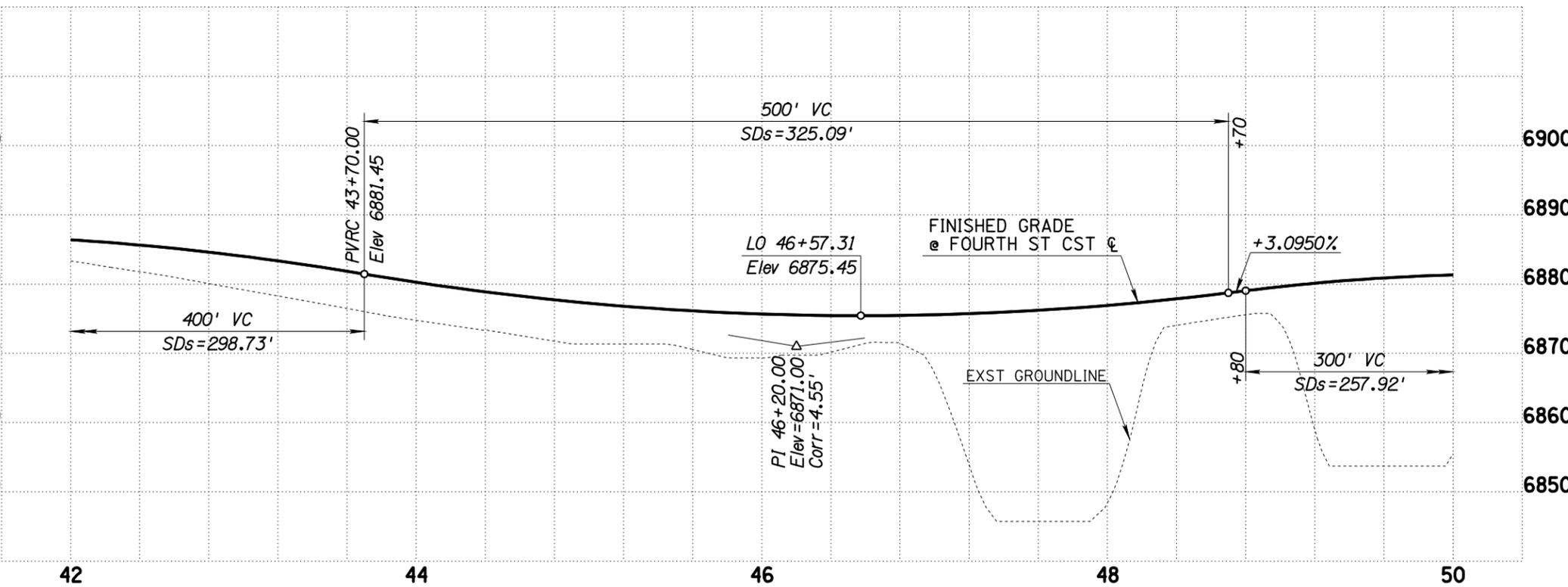
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- CONSTRUCTION NOTES**
- ① CONSTRUCT NEW CONCRETE CURB AND GUTTER PER MAG STD DET 220, TYPE A, H=6"
  - ② CONSTRUCT NEW CONCRETE SIDEWALK PER MAG STD DET 230
  - ③ CONSTRUCT NEW PAVEMENT SECTION
  - ④ CONSTRUCT NEW SIDEWALK RAMP
  - ⑤ CONSTRUCT NEW SINGLE CURB
  - ⑥ NEW RAISED MEDIAN
  - ⑦ NEW FUTS TRAIL



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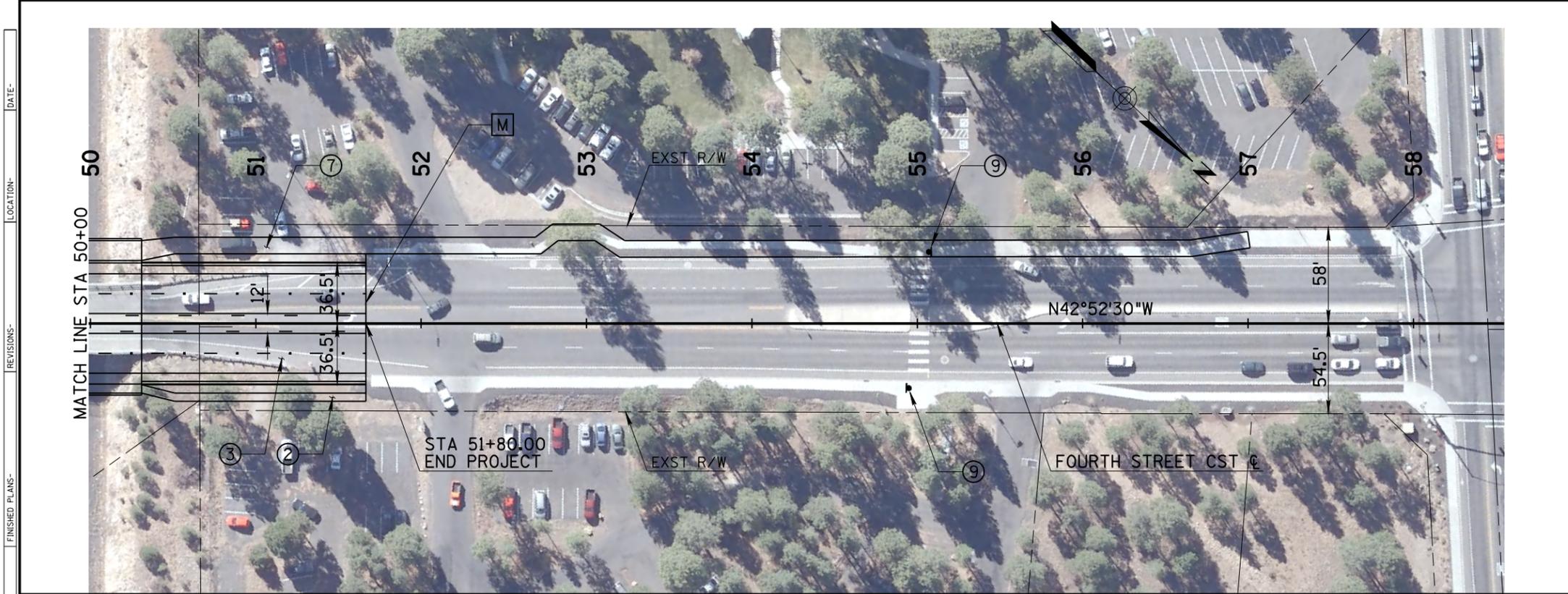


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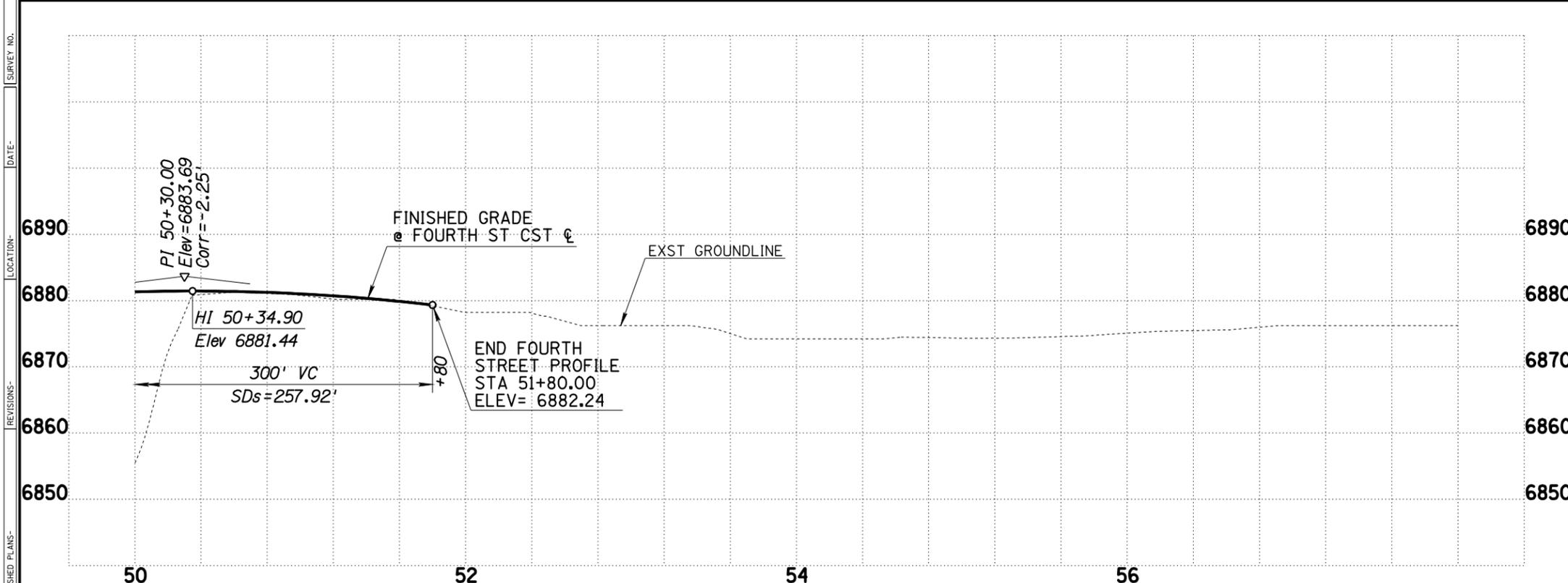
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SCALE H: \_\_\_\_\_  
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 OF \_\_\_\_\_ FIG NO. 8.1-2



- CONSTRUCTION NOTES**
- ② CONSTRUCT NEW CONCRETE SIDEWALK PER MAG STD DET 230
  - ③ CONSTRUCT NEW PAVEMENT SECTION
  - ⑦ NEW FUTS TRAIL
  - ⑨ NEW PEDESTRIAN SIGNAL SYSTEM



**NOTES**

[M] MATCH EXISTING

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Avenue will need to be raised by 4.5 feet to accommodate the drainage needs previously identified. This will require approximately 750 feet of Fourth Street to be reconstructed. The Fourth Street approach grade to the intersection is 3%, which matches the profile design of the Butler Avenue DCR. The steeper than standard grade was approved by the City of Flagstaff during the Butler Avenue study process (City standard maximum 2% grade for signalized intersections).

## **8.2 Drainage Features**

### **8.2.1 Off-Site and On-Site Drainage**

The drainage features associated with Alternative 3A are discussed in Section 5-2. The only variation from Section 5.2 is that road will have a crown except for the curve at Soliere Avenue. As a result, drainage inlets will be spaced every 600-feet along the back of curb.

### **8.2.3 Section 404 of the Clean Water Act**

#### **Preliminary 404 Jurisdiction Interpretation**

An aerial photographic review of the project area was performed to establish areas which may be potential Waters of the U.S. These areas may be subject to a preliminary jurisdictional delineation by the U.S. Army Corps of Engineers (COE) and be under the requirements set forth in the 404 Permit process.

According to the review, Switzer Canyon Wash will be eligible for jurisdictional delineation. In addition to using aerial photography, the review was based on interpretations made by the COE on a prior jurisdictional delineation of Switzer Canyon Wash at Fourth Street Crossing and immediately downstream of the Butler Avenue and Fourth Street intersection.

An adjacent unnamed tributary which parallels Fourth Street may also be a potential candidate tributary. The unnamed tributary has been altered by the development of residential projects and it is recommended that the original platting documents be reviewed to determine if the tributary was determined to be jurisdictional. A portion of this tributary on the east side of Fourth Street near Switzer Canyon Wash was already delineated, however the delineation terminated at the culvert crossing of Fourth Street. The tributary on the west side was previously shown as a potential delineation area, however, due to the drainage and detention basin improvements, further review would need to be performed to clarify the status for delineation.

No wetlands were observed in the aerial photographs and unless there is a localized seep or spring identified during a field review, it is anticipated that wetlands will be absent from the project area.

The FEMA floodplain limits and approximate 404 delineation are illustrated on Figure 8.2. Floodplain limits illustrate that the crossings are currently not designed to convey the 100 year flows.



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Figure 8.2: Approximate FEMA Floodplain and 404 Delineation





### **404 Permit Needs**

The current requirements for 404 Permit coordination enables linear projects such as roadways, utilities and similar longitudinal projects to be conducted under the provisions of Section 13 for General Permits. The Section 13 requirements limit impacts to Waters of the U.S. to 0.50 acres per crossing. If impacts of a single crossing are less than 0.10 acres, work may be able to be performed under the "non-reporting" conditions of Section 13. Under "non-reporting" conditions, the formal permit process is waived unless COE determines that unique habitat or environmental conditions warrant a formal permit process.

Based on current knowledge of the project limits and prior delineations, work at the Switzer Canyon Wash will be performed in an area of jurisdictional delineation. Therefore, it is recommended that a copy of the prior jurisdictional delineation be secured and confirmed with the COE. If impacts to the delineated areas can be minimized to a "non-reporting" limit, no subsequent permit application will be required. Non-reported work will still need to be internally reviewed and documented and performed to meet the intent of the 404 Permit process.

It is also recommended that a jurisdictional delineation be secured for the tributary adjacent Fourth Street and the limits of delineation confirmed with the COE. Similar impact thresholds noted above would apply to work in this drainage if it is determined to be jurisdictional.

Currently, the COE does not interpret the 100 year floodplain as the limits of the "typical high water level" and delineations approved by the COE typically fall within a smaller boundary limit. Work in the flood plain beyond the limits of the Waters of the U.S. is not considered part of the 404 Permit impact areas.

### **401 Certification Needs**

The Arizona Department of Environmental Quality (ADEQ) oversees the 401 Certification requirements for qualifying projects. Typically, ADEQ only responds to Certification requests made by government entities providing a primary clearinghouse role in the project. The COE policy is to request a 401 Certification review if an Individual Permit is required for a project or if special aquatic or riparian habitat conditions are present. Impacts to drainage ways on Fourth Street are not expected to exceed the 0.5 acre threshold for Individual Permits and no special habitat conditions were identified during the review. A 401 Certification request for this project is not anticipated.

## **8.3 Structures**

Alternative 3A will require the roadway capacity to be increased at the I-40 bridges. The structures belong to the ADOT transportation system. Significant coordination is anticipated between the City of Flagstaff and ADOT to determine the preferred improvement and cost sharing opportunities.

Based on input from ADOT Flagstaff District and Bridge Design Section, the existing I-40



underpasses will be replaced for the future I-40 widening. ADOT will require a Bridge Selection Report be prepared to determine the preferred bridge type. Potential replacement structures may be two new simple-span precast prestressed AASHTO Type Super VI Modified girder bridges, as shown in Figure 4.3-2.

For cost estimating purposes, this study assumed that I-40 will be widened by two lanes in each direction and that Fourth Street will cross I-40 utilizing two independent single-span structures. The cost breakdown for the bridge replacement options, bridge lengthening only and bridge lengthening and widening, are provided as follows:

- 1) Bridge replacement utilizing the existing Fourth Street roadway section:
  - Width = 46’-10”
  - Length = 150’-0”
  - Unit Cost = \$150 per square foot
  - Replacement Cost = \$1,100,000 per bridge
  - Total Replacement Cost is \$2,200,000 (construction only)
  
- 2) Bridge replacement utilizing the proposed Fourth Street roadway section:
  - Width = 94’-4”
  - Length = 150’-0”
  - Unit Cost = \$150 per square foot
  - Replacement Cost is \$2,100,000 per bridge
  - Total Replacement Cost is \$4,200,000 (construction only)

This study approached estimating the City of Flagstaff’s share of the bridge replacement costs as the difference between the replacement options, which is approximately \$2,000,000, excluding contingencies.

## 8.4 Utilities

Conflicts with future improvements range from relocation of hydrants located within the ultimate roadway section to impacting drainage structure design alternatives where Switzer Wash crosses Fourth Street. Based on a GIS-level review of existing utilities, the locations for the greatest risk of conflicts are the Fourth Street intersections with Sparrow and Butler Avenues. Specific conflicts within the project corridor are summarized in the following table.

**Table 8.4: Potential Utility Conflicts**

Facility	Preliminary Determination
UniSource linear facility: ±200’ north of Fourth/Sparrow intersection to North Warm Springs Trail – gas main along west side of Fourth Street	Potential conflict; vertical adjustment of surface facilities
UniSource linear facility: Fourth/Trickling Springs intersection to Fourth/Butler Intersection – gas main along west side of Fourth Street	Potential conflict; vertical adjustment of surface facilities



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Facility	Preliminary Determination
UniSource linear facility: Conflict with proposed 2-10' x5' RCBC	Remove approximately ±145' of UniSource Gas line, revised alignment requires ±160' of UniSource Gas line
UniSource lateral facility: Fourth/Sparrow intersection – gas main crosses Fourth Street	Little or no conflict
Water main linear facility: ±200' north of Fourth/Sparrow intersection to Fourth/Butler Intersection – water main along west side of street	Potential conflict - reset water valves or provide new valves.
Water main linear facility: ±50' east of Fourth/Solier intersection – 6-inch line to fire hydrant on south side of Soliere	Potential conflict– reset existing water valve
Water main linear facility: Conflict with proposed 2-10' x5' RCBC	Remove approximately ±145' of 8" water main, revised alignment requires ±145' of 8" water main
Water main lateral facility: Fourth/Solier intersection – water main crosses Fourth Street	Little or no conflict
Water main lateral facility: Fourth/Sparrow intersection – water main crosses Fourth Street	Potential conflict– reset existing water valve
Water main lateral facility: ±150' north of Fourth/Warm Springs intersection – 6-inch line to fire hydrant on east side of Fourth Street	Little or no conflict
Water main lateral facility: Fourth/Warm Springs intersection – water main crosses Fourth Street	Little or no conflict
Water main lateral facility: Fourth/Pinehurst intersection – 6-inch line to fire hydrant on east side of Fourth Street	Potential conflict reset water valves and/or provide new valves; potential vertical realignment if longitudinal road grade changes
Water main lateral facility: Fourth/Butler intersection – water main along north side of Butler	Potential conflict reset water valves and/or provide new valves; potential vertical realignment if longitudinal road grade changes
Sewer main linear facility: Fourth/Trickling Springs intersection to Fourth/Butler Intersection – sewer main along west side of Fourth Street	Potential conflict reset sanitary sewer manhole rim
Sewer main linear facility: Conflict with proposed 2-10' x5' RCBC	Remove approximately ±160' of 8" sewer, remove existing sewer manhole, revised alignment requires ±170' new 8" sewer and reconstruct existing manhole in Butler Avenue
Sewer main lateral facility: Fourth/Solier intersection – sewer main crosses Fourth Street	Potential conflict reset sanitary sewer manhole rim
Sewer main lateral facility: Fourth/Sparrow intersection – sewer main crosses Fourth Street	Potential conflict reset sanitary sewer manhole rim
APS linear facility: entire project limits except from Soliere to I-40 – APS line along west side	Potential conflict; reset APS infrastructure
APS linear facility: Conflict with proposed 2-10' x5' RCBC	Remove approximately ±140' of APS Line, re-alignment requires ±200' of new APS Line
Qwest linear facility: Fourth/Solier to Fourth/Butler – Qwest line along east side of Fourth Street	Little or no conflict



Future design project shall note that any utility work encountering transite piping is to be stopped. Transite piping often contains regulated asbestos and removal and disposal of the pipe must be performed by personnel trained in handling asbestos materials unless the piping is tested to prove it does not contain regulated levels of asbestos.

## **8.5 Access Management**

### **8.5.1 Overview**

Access management is a tool that can be used to shape the nature and usage of a roadway, as well as the neighboring land uses. Access management focuses on techniques that increase the capacity, manage congestion, and reduce crashes. The methods used are:

- Increasing spacing between signals and interchanges
- Driveway location, spacing, and design
- Use of exclusive turning lanes
- Median treatments

An appropriate level of access is allowed depending on the type and purpose of a roadway. Major regional routes should have less access in order to increase the flow of traffic and minimize accidents.

The access management approach for the preferred alignment corridor acknowledges that the corridor will serve to both carry a large volume of traffic through the region but also to destinations along the corridor, such as homes, schools, and workplaces. The access management approach includes intersection configuration, median opening and driveway spacing recommendations to properly balance the traffic flow and congestion with land use access needs.

### **8.5.2 Intersections**

Between Butler Avenue and Huntington/Industrial Drive, four crossroads intersect Fourth Street. Traffic signals along the Fourth Street corridor will be located at major crossroads to optimize traffic flow and decrease congestion. “Positive Offset Turn-lanes” will be utilized where possible along this roadway. The intersection design will also address transit and pedestrian needs through phase-protected pedestrian cross-walks and near or far side bus pullouts. The proposed signalized intersections are at:

- Butler Avenue
- Sparrow Avenue
- Soliere Avenue
- Huntington/Industrial Drive

A fourth leg is planned for intersection of Fourth Street and Soliere Avenue (eastbound approach) to accommodate future development of vacant parcels surrounding this location.

There are no un-signalized intersections within the corridor.



### **8.5.3 Driveway Location, Spacing, and Design**

Driveway access to side activities at inappropriate locations can reduce the carrying capacity of the roadway and create conflicts that can impair motorist safety. Fewer driveways spaced further apart allow for more orderly merging of traffic and present fewer challenges to drivers. Driveway location and spacing should be in accordance with the City of Flagstaff Engineering Standards and Table 10-07-003-002 of the Land Development Code. Design should be in accordance with the current MAG Standards and Details. Single family driveways are prohibited on a minor arterial.

#### **Future Access Considerations**

The City of Flagstaff granted future access to the parcel immediately north of the Northland Preparatory Academy site, Parcel Number 10716008S, during the condemnation process when Soliere Avenue was extended to Fourth Street. The future access will include one access point to Fourth Street and one access point to Soliere Avenue. Neither of these access points is in place.

The FUSD has expressed interest in attaining an access point from Fourth Street, south of the Sparrow Avenue intersection. A formal access request has not yet been made, however initial discussions indicate that the City will be favorable to this request. The new access point would need to meet the spacing requirements from the Sparrow Avenue intersection.

In response to recent City of Flagstaff discussions with Gore, alternative driveway locations have been investigated as part of this study. The alternative locations are provided for informational purposes only and not considered essential to the *FSCS – South* study.

Gore facilities are currently accessed from Fourth Street between I-40 and Huntington/Industrial Drive. The existing traffic volumes on Fourth Street have impacted ingress and egress from this location. Access will become more challenging with the projected traffic increase.

Access to the west Gore campus from Huntington Drive was explored at a conceptual level. The City's preferred location for future full directional access is shown in Figure 8.5-1. This location would provide a desirable spacing from the Fourth Street intersection and align with the Horizon Drive. The topography requires steep driveway grades. The preferred option would require a maximum 8.5% grade to meet the existing pavement elevation. According to City Standards, the maximum grade allowable is 10%.

The preferred location for potential access to the east Gore campus from Industrial Drive is shown in Figure 8.5-2. This access would utilize the existing access point for the Guidance Center and would require a joint agreement between the two private property owners. The preferred location would reduce the number of access points to the collector street, therefore improving operational efficiency. The topography in this area is gentler where the maximum profile grade required to meet the existing pavement elevation would be 2.5%.



## Fourth Street – South Butler Avenue to Huntington / Industrial Drive Final Corridor Study

Figure 8.5-1: Gore (West Campus) Access from Huntington Drive



Figure 8.5-2: Gore (East Campus) Access from Industrial Drive





#### **8.5.4 Median Treatments**

Median treatments can restrict access to driveways and local streets, while consequently increasing roadway speed and safety. A 15-foot raised landscaped median will be constructed from Butler Avenue to Soliere Avenue with periodic breaks to allow for turns. The median will provide a refuge for crossing pedestrians, access control and landscaping opportunities. In addition to the key intersection locations, median breaks will be provided at the main entrances to the Pinehurst Apartment Complex and Forest Springs Condominiums (Sandstone Drive). All other access points will be right-in / right-out.

### **8.6 Intelligent Transportation Systems (ITS)**

As traffic volumes and congestion increase throughout the metropolitan area, the City of Flagstaff is seeking ways to operate and manage their infrastructure more efficiently. Traffic congestion, road closures and traffic-related incidents can be better managed through application ITS. ITS tools such as cameras, traffic detectors, dynamic message signs and traffic signal interconnected by fiber-optic lines all help to provide real-time travel information for both travelers and traffic managers. As the Fourth Street corridor and regional roadway infrastructure is developed, consideration should be given to deploying intelligent transportation systems.

### **8.7 FUTS**

The Fourth Street FUTS trail will be complete from the Route 66 Trail to the Switzer Wash Trail with the proposed improvements. On Fourth Street between Huntington/Industrial Drive and I-40, the existing western 5-foot sidewalk will be widened to a 10-foot trail adjacent to the Gore property. The trail will be parallel to Fourth Street and remain within the existing right-of-way. This alignment will require the removal of Ponderosa pine trees and the relocation of a large electric cabinet.

The new I-40 underpass bridges will include the FUTS trail on the west side. A concrete barrier will be constructed between the roadway and the trail for position separation.

South of the I-40 crossing to Sparrow Avenue, the FUTS trail will remain on the west side of Fourth Street separated from the roadway by a 5-foot parkway, per City of Flagstaff standard typical section. It will connect to the existing meandering trail constructed from Sparrow Avenue to Trickling Springs Trail, approximately 1,000 feet.

At the south end of the corridor study area, the trail construction with this project will resume at Trickling Springs Trail through to Butler Avenue at the 5-foot parkway offset. The FUTS trail will cross Butler Avenue at-grade to connect with the Switzer Wash FUTS Trail. As a result, the trail will cross two legs of the future Butler Avenue intersection. The impact of wide intersections and long crossing distances on trail users should be considered during design and mitigated with crossing islands when necessary.



Opportunities to modify the FUTS trail concept during the design phase may be desirable should existing constraints change. Considerations include:

- Providing an alternative trail alignment adjacent to the Gore property that keeps the trees and the utility cabinet in place. Additional right-of-way from Gore as well parking lot modification will be required.
- Creating a landscape buffer of 30-40 feet between the roadway and trail rather than set behind a consistent 5-foot parkway. This arrangement may enhance aesthetics, eliminate issues with plowing snow and cinders onto the trail, and provide a more pleasant experience for trail users. Additional property rights for trail and landscape buffer have been identified as a potential acquisition to be funded by the 2004 voter approved FUTS/Neighborhood Open Space bond authorization.
- Constructing a grade separated crossing at Butler Avenue. The profile would need to be raised an additional 3 feet to accommodate a crossing structure.

## 8.8 Transit

Transit improvements are recommended for the Fourth Street corridor and must be coordinated with NAIPTA. All bus stops should be located on the departure side of the intersection, preferably in bus pullouts. The location of Stop 23 at Sparrow Avenue is undesirable and should be moved to the north side of the intersection if the current route remains.

In the short to medium-term, NAIPTA is considering a realignment of Route 3 to use Sparrow Avenue, Foxglenn Street, and Butler Avenue in place of Fourth Street between Sparrow Avenue and Butler Avenue. With this route change, the two Fourth Street stops would be relocated to Sparrow Avenue. Stop 23 would be relocated to the south side of Sparrow Avenue just east of Fourth Street. Stop 9 would be relocated to the north side of Sparrow Avenue, just east of Fourth Street. This change would eliminate the need for students from Northland Preparatory Academy and Sinagua High School to cross Fourth Street to access Stop 23. Residents of the neighborhoods on the west side of Fourth Street would still have to cross Fourth Street to get to or from the bus stops. NAIPTA has some concerns about how congestion on Sparrow Avenue, resulting from school drop-off and pick-up, may affect the timing of their realigned route.

In the longer term, Fourth Street may be used for other transit routes and may include additional stops; depending on future development of Canyon del Rio and the extension of Fourth Street to J.W. Powell Boulevard, as well as other changes in development patterns in the area. Continual coordination with NAIPTA is recommended through the design phase to optimize corridor transit opportunities.

## 8.9 Right-of-Way

The proposed right-of-way width is 107 feet for the corridor, centered about the existing roadway centerline. Additional width is needed for at the intersections to accommodate turn



lanes and sight triangles. Approximately 1.2 acres of new right-of-way will be required. Slope and drainage easements will also be required. Table 8.9 summarizes the approximate area needed per parcel.

**Table 8.9: Right-of-Way and Easement Needs**

<b>Owner</b>	<b>Parcel Number</b>	<b>Parcel Area (SF)</b>	<b>Right-of-Way Area (SF)</b>	<b>Easement Area (SF)</b>
Flagstaff Unified School District #1	10608002M	203,861	5,174	2,437
Flagstaff Unified School District #1	10608002T	2,042,093	6,176	8,046
Butler/Fourth Venture LLC	10608005J	594,594	4,130	7,840
Flagstaff Family Associates	10608005K	294,030	6,646	10,198
Soliere Street LLC	10716008S	127,195	14,030	3,237
Fourth Street (Flagstaff) LLC	10716008T	217,800	5,048	6,179
Northland Preparatory Academy	10723034A	169,448	487	36
Tract "A" Open Space Summit Park Condominiums	10738000A	173,369	3,780	1,002
Forest Springs LLC	10744054	96,268	3,218	3,352

Any acquisition of property by the City of Flagstaff will require a Phase I investigation before the property is acquired. New right-of-ways or easements will require an internal environmental site assessment by City Environmental Management staff. Any properties acquired by the City will require surveys for asbestos and lead-based paint.

## **8.10 Environmental Considerations**

Environmental documentation for the corridor improvements will be addressed during the design phase through a general environmental assessment that follows the basic content and guidelines of NEPA. In addition, a NEPA document will be required for any work associated with the Fourth Street / I-40 underpass structures. ADOT is preparing a NEPA document (either EA or CE, yet to be determined) as part of the I-40 DCR that includes lengthening these structures. It is recommended that the City of Flagstaff request ADOT to include widening the structures as well as lengthening as part of their environmental process. Coordination with Jerry Monks (ADOT Environmental Planning Group) is required to get the bridge widening included in the current ADOT NEPA document. If ADOT includes the bridge widening work as well, the City would not be able to make any improvements to the structures until the ADOT environmental process is complete, which is estimated to take approximately three years. The FHWA contacts for this project are Steve Thomas (Environmental) and Manuel Sanchez (Highways).



## 8.11 Other Considerations

While *FSCS – South* examines Fourth Street and the immediate approaches of its crossroads, the study team has considered the impact of the study recommendations on surrounding areas to ensure existing conditions are not worsened. Some of the concerns expressed to date include issues on Sparrow Avenue like speeds in excess of posted limit, lack of sidewalks, lack of crosswalks, and excessive queue length for westbound traffic. The improvements described in Section 8 will not adversely impact the existing traffic conditions in surrounding areas. It is probable that the surrounding areas will experience some relief with the improved capacity and efficiency of Fourth Street.

## 8.12 Implementation Plan

Both interim and ultimate improvements have been identified by the *FSCS – South*. Funding for the ultimate improvements on Fourth Street will need to be programmed in the CIP or pursued as bond initiatives due to the cost magnitude. During the short to medium-term, smaller projects can be constructed that will provide immediate benefit to the community.

### 8.13.1 Interim Improvements

Interim improvements identified by the study team, stakeholders and public include:

**Table 8.13: Potential Interim Improvements**

Item	Benefit	Considerations
Temporary signal at Sparrow Avenue	Improve traffic operations at the intersection.	This improvement is currently in the design phase. Signal installation is targeted for Fall 2010.
Tree removal and re-grading of westerly shoulder between Soliere and Sparrow Avenues	Improve sight distance for the Sparrow Avenue intersection which would provide better visibility for traffic turning left out of Summit Park Condominiums and for pedestrians crossing Fourth Street.	Easy to implement and relatively low cost. Work can be performed by City maintenance staff.
Prohibit parking along the easterly shoulder between Soliere and Sparrow Avenues using either a positive barrier or signage	Improve traffic efficiency, safety and visibility issues at the Sparrow Avenue intersection.	Easy to moderate to implement depending on preferred method. Signage is easy to install, but may not be as effective as curb or barrier.



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Item	Benefit	Considerations
Relocate NAIPTA Stop 23 to downstream side of Sparrow Avenue intersection	Improve traffic efficiency of Fourth Street and the Sparrow Avenue intersection.	Moderate implementation needs and cost. The new bus stop would need to be designed and the existing infrastructure would require removal. Also, the bus route may change. Coordination with NAIPTA is required.
Crossing guards for students walking across Fourth Street	Improve safety for children crossing Fourth Street from their homes or the bus stop.	Requires coordination with FUSD and involves ongoing costs.
Flashing beacon at existing Gore crosswalk	Improve pedestrian safety and decrease wait time to cross Fourth Street.	Implementation requires coordination with Gore and moderate costs.
Sidewalk on bridge deck	Improve pedestrian safety by providing positive separation between pedestrians and vehicles.	Implementation requires coordination with ADOT and moderate costs. Must evaluate additional loading on structure and pedestrian barrier/fencing requirements.

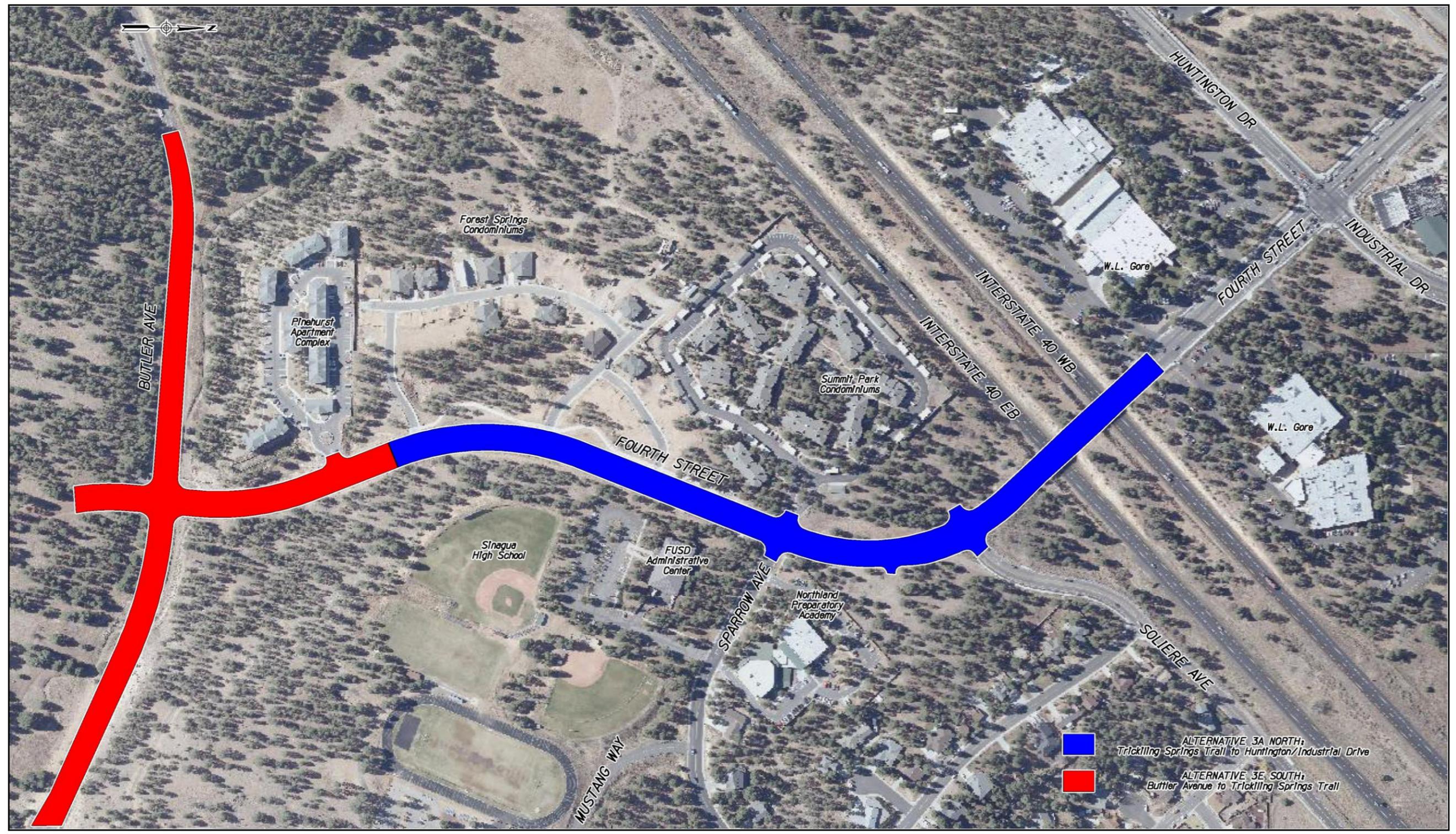
### 8.13.2 Ultimate Improvements

The ultimate Fourth Street improvement is to construct two travel lanes in each direction separated by a raised median from Butler Avenue to the previously widened roadway section north of I-40. Pedestrian and bicycle traffic will be accommodated on both sides of the roadway between Butler Avenue and Huntington/Industrial Drive, including the FUTS trail. The critical implementation features of the ultimate improvements are replacing the Fourth Street underpass structures and raising Butler Avenue intersection. While these features will provide the greatest corridor benefit, they involve significant project costs and coordination with other projects. To provide a comprehensive cost estimate for future planning and flexibility on Fourth Street, the ultimate improvements have been divided into two projects, *Alternative 3A – South (Butler Avenue to Trickling Springs Trail)* and *Alternative 3A – North (Trickling Springs Trail to Huntington / Industrial Drive)*. The projects can be constructed in any order.

Project *Alternative 3A - South* reconstructs the Fourth Street and Butler Avenue intersection including approach roadways on Fourth Street and Butler Avenue. The intersection improvements were developed for the Butler Avenue DCR and the 2003 Tentative Plat for Canyon del Rio by Shephard Wesnitzer, Inc., see Appendix G. Approximately 750 lineal feet along Fourth Street will be improved as previously described. The preliminary improvement costs on the Fourth Street approach have been estimated as part of the *FSCS - South*. On Butler Avenue, the “East Segment” portion of the tentative plat has been broken out for estimating purposes, including the major work items of raising and widening 1,750 lineal feet of Butler Avenue (same recommended typical section as Fourth Street, see Figure 8.1-1), installing a new



Figure 8.13: Project Implementation





traffic signal, and installing 130 feet prefabricated utility vault structure crossing Butler Avenue approximately 300 feet east of the intersection. A 200 foot taper to the existing roadway on the west end is required. The only modification to the 2003 estimate made by the *FSCS - South* was to update unit costs. One consideration to scale back project costs would be to shortening the improvement limits on Butler Avenue. The improvement length of 1,750 lineal feet associated with the “East Segment” was dictated by City of Flagstaff frontage improvement requirements. A roadway segment of approximately 1,300 lineal feet could meet the objective of raising the intersection out of the 100-year storm event (900 feet of profile change plus 200 foot tapers at both ends).

Project *Alternative 3A - North* includes all of the ultimate improvements on Fourth Street from Trickling Springs Trail to Huntington / Industrial Drive. The Fourth Street underpass structure replacement will involve ADOT participation and NEPA environmental documentation. ADOT’s improvement needs on I-40 will likely be further in the future than the City’s needs on Fourth Street. Continued City participation on the *I-40 Bellemont to Winona DCR* is recommended, as well as early discussions on potential improvement schedules and cost sharing opportunities. Section 8.3 describes how the City’s structure costs were estimated.

### **8.13 Constructability**

Project *Alternative 3A – South* can be constructed in two phases and will require roadway closures. Due to drainage improvements immediately north of the intersection, Fourth Street will likely need to be closed for a short duration. One possible scenario would be to close the roadway between Butler Avenue and the Pinehurst Apartment entrance, install the prefabricated 2-10’ x 5’ RCBC and construct the full roadway improvements. The approximate duration would be 1 to 2 months and should consider the school year schedule. The remaining work on Fourth Street could be phased to minimize impact to the local and through traffic. Construction on Butler Avenue could also be phased to maintain traffic on the existing roadway. The north side of Butler Avenue could be constructed first while traffic remains on the existing roadway. Temporary widening may be required. Traffic could then be switched to construct the south side of Butler Avenue.

Construction of project *Alternative 3A - North* will require phasing in order to maintain traffic on Fourth Street. Phase 1 will involve constructing the east side of the street while maintaining two-way traffic on the west side. The existing pavement will be sawcut and widened in all areas except near Butler Avenue and Soliere Avenue where full reconstruction is necessary. For the bridge construction, the first phase will require the removal of the easternmost exterior girder which still allows for two 11-foot lanes plus 1-foot shy distance to the barriers plus a 4-foot sidewalk on the existing structures. Phase 1 construction will build 35’-6” of the eastern most bridge replacement. Phase 2 construction will shift traffic onto the newly built roadway and structure. Demolition of the remaining existing structure will be completed along with construction of the remaining portion of the new bridge. After constructing both sides of Fourth Street, the full roadway width will be overlaid and striped for the four-lane configuration. Maintaining access to local residences is a key consideration.



## 8.14 Preliminary Cost Estimate

The preliminary total project cost is \$6,570,000 for *Alternative 3A – South* (Table 8.14-1) and \$7,560,000 for *Alternative 3A – North* (Table 8.14-2). The preliminary estimates include design, construction, construction management, new right-of-way and utility relocation costs.

**Table 8.14-1: Preliminary Cost Estimate for Preferred Alternative 3A – South**  
*(Butler Avenue to Trickling Springs Trail)*

Description	Cost
Construction	\$4,870,000
Design (10% of Construction Value)	\$490,000
Construction Management (15% of Construction Value)	\$730,000
New Right-of-Way	\$275,000
Utility Relocation (10% of Construction Value)	\$205,000
<b>TOTAL COST</b>	<b>\$6,570,000</b>

**Table 8.14-2: Preliminary Cost Estimate for Preferred Alternative 3A – North**  
*(Trickling Springs Trail to Huntington/Industrial Drive)*

Description	Cost
Construction	\$5,570,000
Design (10% of Construction Value)	\$560,000
Construction Management (15% of Construction Value)	\$835,000
New Right-of-Way	\$480,000
Utility Relocation (2% of Construction Value)	\$115,000
<b>TOTAL COST</b>	<b>\$7,560,000</b>

Preliminary cost estimates are provided in Appendix A. Assumptions made in developing the estimates include:

- City of Flagstaff unit prices were utilized.
- Costs for the work on Butler Avenue were based on the 2003 Tentative Plat for Canyon del Rio, “East Segment” preliminary estimate. Right-of-way and easement acquisition costs were not included in the estimate. Unit prices were adjusted to match those used for the *FSCS - South*. Quantities were not verified as part of this study. The estimate is provided in Appendix A.
- Bridge costs consider cost sharing with ADOT as outlined in Section 8.3.



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- Earthwork quantities are based on contours since survey information was not obtained for this study.
- FUTS trail quantities were included in the sidewalk quantities.
- Right-of-way costs were estimated at \$8 per square foot. While the total area of new right-of-way was included in the estimate, there is a possibility that a portion of the right-of-way needed may be dedicated to the City as part of the development process.
- Slope and drainage easements are required to construct cut/fill slope and drainage improvements. The easement cost was estimated at 100% of the right-of-way costs.
- Landscaping items were estimated at a lump sum cost of \$40,000 (south project) and \$100,000 (north project) for Fourth Street only. This amount assumed trees and mulch in the median and adjacent parkways along with temporary irrigation. Landscaping costs were not included in the 2003 Tentative Plat for Canyon del Rio, “East Segment” preliminary estimate.
- Four future access points for three properties within the corridor were not included in the preliminary cost estimate (private property in the northeast quadrant of Fourth Street and Butler Avenue, FUSD property and private property in the southeast quadrant of Fourth Street and Soliere Avenue).
- Alternative Gore driveways from Huntington/Industrial Drive were not included in the preliminary cost estimate.
- Preliminary cost estimate includes 25% contingency.



## Public Involvement Overview

*FSCS - South* conducted two public information meetings during the study process, along with one presentation to City Council at a work session. The public meetings were held in an “open house” format, which provided a free, open and accurate exchange of information between area residents with specific issues and questions and the study team. Summary reports were prepared by KDA Creative, see Appendix B. A brief overview of the public involvement process and meetings is provided in this section.

### 9.1 Outreach Methods

The following outreach methods were used to inform and notify the general public and impacted residents about the study, public input meeting dates and locations and additional opportunities or means for input:

- Media release
- Newspaper advertisement
- City of Flagstaff website
- Postcards to adjacent property owners

### 9.2 Public Information Meetings and Council Work Session

#### Scoping and Alternatives Analysis Phase Public Meeting

*Meeting Purpose:* Gather public comment regarding the study area, existing conditions, current corridor deficiencies, future transportation needs and public review of overall Study Goals and Objectives. Graphics, aerials and display exhibits displayed corridor alternatives and study information. Study Fact Sheets and Comment Sheets were distributed to all those in attendance. Public comments received at the meeting are provided in Appendix A of the Summary Report.

5:30 – 7:30 p.m., September 9, 2009

Aquaplex Community Meeting Room, 1702 North Fourth Street, Flagstaff, Arizona

Attendance: 28

#### Findings and Recommendations Phase Public Meeting

*Meeting Purpose:* Gather public comment regarding study findings and “Preferred Alternative”, recommended access management strategies and improvement phasing timeline. Presentation provided in addition to display boards of relevant study information. Similar to the first meeting, Study Fact Sheets and Comment Sheets were distributed to all those in attendance. Public comments received at the second meeting are provided in Appendix A of the respective Summary Report.

6:00 – 7:30 p.m., December 9, 2009

FUSD Administration Center, 3285 East Sparrow Avenue, Flagstaff, Arizona

Attendance: 6



### **Presentation of Preliminary Recommendations to City Council**

*Meeting Purpose:* Obtain Council’s input on the preliminary study recommendations. Study progress, schedule, stakeholder and public involvement, technical analyses and alternatives were review. The Council concurred with the study team recommendations.

5:30 p.m., January 26, 2010

City Hall, 3285 East Sparrow Avenue, Flagstaff, Arizona

Following completion, the Final *FSCS - South* Report will be submitted to the City’s Planning and Development Services Section for evaluation and Council consideration as an amendment to the Transportation Element of the Regional Plan.

### **9.3 Recommendations**

It is recommended that future project development build upon the public involvement program established during this study and continue as a comprehensive program progression.

For more information about the study, contact Bret Petersen, City of Flagstaff Capital Improvements, at (928) 226-4860 or Kimberly Ott, City of Flagstaff Public Information Officer, at (928) 779-7603.



## 10 Appendices

- Appendix A: Preliminary Cost Estimates
- Appendix B: Public Involvement Report
- Appendix C: Traffic Analysis
- Appendix D: Structural Analysis
- Appendix E: Drainage Analysis
- Appendix F: Utility Information
- Appendix G: Butler Avenue Plans and Estimate



# APPENDIX A

## Preliminary Cost Estimates

**Preliminary Cost Estimate**  
**Fourth Street Corridor Study - Preferred Alternative 3A - North**  
**(Trickling Springs Trail to Huntington / Industrial Drive)**

<i>Alternative 3, Partial Reconstruction with Raised Median and Conventional Intersections</i>				
<i>Item Description</i>	<i>Unit</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total</i>
Community Relations	Lump Sum	1	\$10,000	\$10,000
Roadway Excavation	C YD	20,000	\$9.00	\$180,000
Borrow	C YD	20,000	\$9.00	\$180,000
Subgrade Preparation	SQ YD	10,055	\$8.00	\$80,440
Aggregate Base Course	C YD	2,235	\$39.00	\$87,165
Asphalt Concrete	C YD	1,404	\$140.00	\$196,560
Concrete Curb & Gutter	LF	3,250	\$20.00	\$65,000
Single Curb, MAG 222	LF	3,844	\$20.00	\$76,880
Concrete Sidewalk Ramp Std Det 231, Type "A"	EA	8	\$1,800	\$14,400
Concrete Sidewalk Std Det 230	SQ FT	24,024	\$7.00	\$168,168
Saw cut Asphalt Pavement	LF	1,175	\$2.00	\$2,350
Traffic Signing & Striping - 5 lanes	LF	2,500	\$7.50	\$18,750
Traffic Signal or Roundabout	EA	2	\$250,000	\$500,000
Drainage	Lump Sum	1	\$100,000	\$100,000
New Bridges	EA	2	\$1,000,000	\$2,000,000
Landscaping	Lump Sum	1	\$100,000	\$100,000
Lighting	Lump Sum	1	\$60,000	\$60,000
Transit	Lump Sum	1	\$150,000	\$150,000
Pedestrian Actuated Beacon	Lump Sum	1	\$25,000	\$25,000
<b><i>Roadway &amp; Structures Subtotal</i></b>				<b>\$4,014,713</b>
Removal of Existing Improvements @ 4%	Lump Sum	1	\$160,589.00	\$160,589
Mobilization/Demobilization @ 4%	Lump Sum	1	\$160,589.00	\$160,589
Traffic Control @ 3%	Lump Sum	1	\$120,441.00	\$120,441
<b><i>Construction Subtotal</i></b>				<b>\$4,456,332</b>
<b><i>Alternative 3A North Construction Subtotal</i></b>				<b>\$4,456,332</b>

Alternative 3A North Construction Subtotal		\$4,456,332
Contingency	25%	\$1,114,083
Estimated Construction Cost		<u>\$5,570,415</u>

Construction Management (15% of Construction Cost)	15%	\$835,562
Engineering Design (10% of Construction Cost)	10%	\$557,042
		<u>\$1,392,604</u>

Utility Relocations (2% of Construction Cost)	2%	\$111,408
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Right-of-Way	SQ FT	38,922	\$8	\$311,376
Slope Easement	SQ FT	20,952	\$8	\$167,616
				<u>\$478,992</u>

Project Total: **\$7,553,419**

**Preliminary Cost Estimate**  
**Fourth Street Corridor Study - Preferred Alternative 3A - South**  
**(Butler Avenue to Tricking Springs Trail)**

<i>Alternative 3, Partial Reconstruction with Raised Median and Conventional Intersections</i>				
<i>Item Description</i>	<i>Unit</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total</i>
Community Relations	Lump Sum	1	\$10,000	\$10,000
Roadway Excavation	C YD	5,000	\$9.00	\$45,000
Borrow	C YD	30,000	\$9.00	\$270,000
Subgrade Preparation	SQ YD	5,450	\$8.00	\$43,600
Aggregate Base Course	C YD	1,211	\$39.00	\$47,229
Asphalt Concrete	C YD	605	\$140.00	\$84,700
Concrete Curb & Gutter	LF	1,390	\$20.00	\$27,800
Single Curb, MAG 222	LF	924	\$20.00	\$18,480
Concrete Sidewalk Ramp Std Det 231, Type "A"	EA	4	\$1,800	\$7,200
Concrete Sidewalk Std Det 230	SQ FT	9,880	\$7.00	\$69,160
Traffic Signing & Striping - 5 lanes	LF	700	\$7.50	\$5,250
Drainage	Lump Sum	1	\$275,000	\$275,000
Landscaping	Lump Sum	1	\$40,000	\$40,000
Lighting	Lump Sum	1	\$17,500	\$17,500
<i>Roadway &amp; Structures Subtotal</i>				\$960,919
Removal of Existing Improvements @ 4%	Lump Sum	1	\$38,437.00	\$38,437
Mobilization/Demobilization @ 4%	Lump Sum	1	\$38,437.00	\$38,437
Traffic Control @ 3%	Lump Sum	1	\$28,828.00	\$28,828
<i>Construction Subtotal</i>				\$1,066,621
<i>Alternative 3A South Construction Subtotal</i>				\$1,066,621

Alternative 3A South Construction Subtotal		\$1,066,621
Contingency	25%	\$266,655
Estimated Construction Cost		\$1,333,276
Construction Management (15% of Construction Cost)	15%	\$199,991
Engineering Design (10% of Construction Cost)	10%	\$133,328
		\$333,319
Utility Relocations (10% of Construction Cost)	10%	\$133,328
Right-of-Way	SQ FT	13,078
Slope Easement	SQ FT	21,392
		\$8
		\$8
		\$104,624
		\$171,136
		\$275,760
Total:		\$2,075,683
Butler Avenue Improvements		\$4,490,000
<b>Project Total:</b>		<b>\$6,565,683</b>

# Fourth Street Corridor Study - Butler Avenue Engineer's Estimate of Probable Construction Costs Not for Construction

<i>Butler Avenue Cost Estimate</i>				
<i>Item Description</i>	<i>Unit</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total</i>
Clear and Grub	ACRE	9	\$3,500	\$31,500
5" A.C. Pavement (145 lb/cf, 103360sf-excludes ex AC)	Tons	3,120	\$72	\$224,640
14" A.B.C. (103360sf)	C YD	4,470	\$39	\$174,330
Cement Treatment of A.B.C.	C YD	4,470	\$7	\$31,290
Signalization of Butler/4th intersection	EA	1	\$250,000	\$250,000
Traffic Signing & Striping - 5 lanes	Lump Sum	1,970	\$8	\$15,760
Micro Seal (Including ex AC)	SQ YD	1	\$15,000	\$15,000
6" Vertical Curb and Gutter	LF	3,280	\$20	\$65,600
Single Curb	LF	1,950	\$20	\$39,000
Sidewalk	SQ FT	16,400	\$7	\$114,800
Sidewalk Ramps	EA	2	\$1,800	\$3,600
Hydro-Seeding	ACRE	2	\$4,000	\$8,000
Street Light	EA	7	\$3,800	\$26,600
Manhole Adjustments	EA	2	\$550	\$1,100
Water Valve Adjustments (F.H., blow offs included)	EA	12	\$500	\$6,000
10' Gravel FUTS	LF	1,270	\$17	\$21,590
24" CMP Storm Drain	LF	250	\$70	\$17,500
Catch Basin w/wings	EA	6	\$6,500	\$39,000
headwalls	EA	2	\$3,500	\$7,000
riprap	C YD	10	\$120	\$1,200
2-Barrel, 10'x5' Reinforced concrete box w/headwalls	LF	130	\$1,150	\$149,500
Build 2 bypass lanes to construct box culverts	EA	2	\$66,500	\$133,000
Channel Liner	SQ FT	16,000	\$8	\$128,000
Handrail	LF	1,500	\$50	\$75,000
Roadway Retaining Wall	SQ FT	4,500	\$30	\$135,000
Channel Excavation	C YD	2,500	\$9	\$22,500
Channel Retaining Wall	SQ FT	3,000	\$30	\$90,000
Cut	C YD	34,300	\$9	\$308,700
Fill	C YD	19,240	\$9	\$173,160
Cut (export)	C YD	15,060	\$3	\$45,180
Subgrade Prep	SQ YD	11,485	\$8	\$91,880
<i>Subtotal Construction Items</i>				\$2,445,430

# Fourth Street Corridor Study - Butler Avenue Engineer's Estimate of Probable Construction Costs Not for Construction

<b>200-LF TAPER</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total</b>
Clear and Grub	ACRE	0.20	\$3,500	\$700
5" A.C. Pavement (145 lb/cf, 9400sf-excludes ex AC)	Tons	280	\$72	\$20,160
14" A.B.C. (9400sf)	C YD	410	\$39	\$15,990
Cement Treatment of A.B.C.	C YD	410	\$7	\$2,870
Subgrade Prep	SQ YD	1,040	\$8	\$8,320
<b>Subtotal Construction Items w/ 200 LF Taper</b>				<b>\$48,040</b>
<b>Subtotal Construction Items</b>				<b>\$2,493,470</b>
<b>Miscellaneous</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total</b>
Removal of Existing Improvements @ 2%	Lump Sum	1	\$49,869	\$49,869
Mobilization/Demobilization @ 4%	Lump Sum	1	\$99,739	\$99,739
Traffic Control @ 3%	Lump Sum	1	\$74,804	\$74,804
<b>Subtotal Miscellaneous</b>				<b>\$224,412</b>
<b>Butler Avenue Subtotal</b>				<b>\$2,717,882</b>
Contingency			30%	\$815,365
Estimated Construction Cost				\$3,533,247
Construction Management (15% of Construction Cost)			15%	\$529,987
Engineering Design (10% of Construction Cost)			10%	\$353,325
Utility Relocations (2% of Construction Cost)			2%	\$70,665
<b>CM, Engineering, &amp; Utility Reloc. Subtotal</b>				<b>\$953,977</b>
<b>Grand Total</b>				<b>\$4,487,223</b>

**General Notes:**

1. There are no new sewer facilities associated with the construction of Butler Ave.
2. Landscaping costs are not included in this cost estimate
3. Source of unit prices: City of Flagstaff (COF) unit price list used for estimating permit fees. Recent bid tabs were used
4. Quantities are based on the roadway section depicted in the 2003 Canyon del Rio Tentative Plat
5. Right-of-way and easement acquisition costs not included
6. The structural section was assumed and is not based on a geotechnical evaluation

**Preliminary Cost Estimate  
Fourth Street Corridor Study - South  
Alternative 1 - Widen with Flush Median**

<i>Item Description</i>	<i>Unit</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total</i>
Community Relations	Lump Sum	1	\$10,000.00	\$10,000
Roadway Excavation	C YD	25,000	\$9.00	\$225,000
Borrow	C YD	50,000	\$9.00	\$450,000
Subgrade Preparation	SQ YD	10,771	\$8.00	\$86,168
Pavement Structural Section (4" AC and 8" ABC)	SQ YD	10,771	\$25.00	\$269,275
1 1/2" Overlay (Existing Roadway)	TON	1,040	\$35.00	\$36,400
Curb and Gutter, Type "A" Vertical	LF	3,375	\$20.00	\$67,500
Concrete Sidewalk Ramp Std Det 231, Type "A"	EA	12	\$1,800.00	\$21,600
Concrete Sidewalk Std Det 230	SQ FT	27,810	\$7.00	\$194,670
Sawcut Asphalt Pavement	LF	1,690	\$2.00	\$3,380
Traffic Signing & Striping - 5 lanes	LF	3,200	\$7.50	\$24,000
Traffic Signal or Roundabout	EA	2	\$250,000.00	\$500,000
Drainage	Lump Sum	1	\$375,000.00	\$375,000
New Bridges	EA	2	\$1,000,000.00	\$2,000,000
Landscaping	Lump Sum	1	\$140,000.00	\$140,000
Lighting	Lump Sum	1	\$77,500.00	\$77,500
Transit	Lump Sum	1	\$150,000.00	\$150,000
Pedestrian Actuated Beacon	Lump Sum	1	\$25,000.00	\$25,000
<b>Roadway &amp; Structures Subtotal</b>				<b>\$4,655,493</b>
Removal of Existing Improvements @ 2%	Lump Sum	1	\$93,110.00	\$93,110
Mobilization/Demobilization @ 4%	Lump Sum	1	\$186,220.00	\$186,220
Traffic Control @ 3%	Lump Sum	1	\$139,665.00	\$139,665
<b>Construction Subtotal</b>				<b>\$5,074,488</b>
<b>Alternative 1 Construction Subtotal</b>				<b>\$5,074,488</b>

Alternative 1 Construction Subtotal		\$5,074,488
Contingency	25%	<u>\$1,268,622</u>
Estimated Construction Cost		\$6,343,110
Construction Management (15% of Construction Cost)	15%	\$951,467
Engineering Design (10% of Construction Cost)	10%	<u>\$634,311</u>
		\$1,585,778
Utility Relocations (4% of Construction Cost)	4%	\$253,724
Right-of-Way	SQ FT	30,070
Slope Easement	SQ FT	13,532
		\$8
		<u>\$240,560</u>
		<u>\$108,252</u>
		\$348,812
Project Total:		<b>\$8,531,424</b>

**Preliminary Cost Estimate**  
**Fourth Street Corridor Study - South**  
**Alternative 2 - Partial Reconstruct with Flush Median**

<i>Item Description</i>	<i>Unit</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total</i>
Community Relations	Lump Sum	1	\$10,000.00	\$10,000
Roadway Excavation	C YD	25,000	\$9.00	\$225,000
Borrow	C YD	50,000	\$9.00	\$450,000
Subgrade Preparation	SQ YD	15,615	\$8.00	\$124,920
Pavement Structural Section (4" AC and 8" ABC)	SQ YD	15,615	\$25.00	\$390,375
1 1/2" Overlay (Existing Roadway)	TON	645	\$35.00	\$22,575
Concrete Curb & Gutter	LF	3,675	\$20.00	\$73,500
Concrete Sidewalk Ramp Std Det 231, Type "A"	EA	12	\$1,800.00	\$21,600
Concrete Sidewalk Std Det 230	SQ FT	30,240	\$7.00	\$211,680
Traffic Signing & Striping - 5 lanes	LF	3,200	\$7.50	\$24,000
Traffic Signal or Roundabout	EA	2	\$250,000.00	\$500,000
Drainage	Lump Sum	1	\$375,000.00	\$375,000
New Bridges	EA	2	\$1,000,000.00	\$2,000,000
Landscaping	Lump Sum	1	\$140,000.00	\$140,000
Lighting	Lump Sum	1	\$77,500.00	\$77,500
Transit	Lump Sum	1	\$150,000.00	\$150,000
Pedestrian Actuated Beacon	Lump Sum	1	\$25,000.00	\$25,000
<b>Roadway &amp; Structures Subtotal</b>				<b>\$4,821,150</b>
Removal of Existing Improvements @ 2%	Lump Sum	1	\$96,423.00	\$96,423
Mobilization/Demobilization @ 4%	Lump Sum	1	\$192,846.00	\$192,846
Traffic Control @ 3%	Lump Sum	1	\$144,635.00	\$144,635
<b>Construction Subtotal</b>				<b>\$5,255,054</b>
<b>Alternative 2 Construction Subtotal</b>				<b>\$5,255,054</b>

Alternative 2 Construction Subtotal		\$5,255,054
Contingency	25%	\$1,313,764
Estimated Construction Cost		\$6,568,818
Construction Management (15% of Construction Cost)	15%	\$985,323
Engineering Design (10% of Construction Cost)	10%	\$656,882
		\$1,642,204
Utility Relocations (4% of Construction Cost)	4%	\$262,753
Right-of-Way	SQ FT	33,092
Slope Easement	SQ FT	14,891
		\$8.00
		\$119,131
		\$383,867
Project Total:		<b>\$8,857,642</b>

**Preliminary Cost Estimate**  
**Fourth Street Corridor Study - South**  
**Alternative 3 - Partial Reconstruct with Raised Median**

<i>Item Description</i>	<i>Unit</i>	<i>Quantity</i>	<i>Unit Cost</i>	<i>Total</i>
Community Relations	Lump Sum	1	\$10,000.00	\$10,000
Roadway Excavation	C YD	25,000	\$9.00	\$225,000
Borrow	C YD	50,000	\$9.00	\$450,000
Subgrade Preparation	SQ YD	13,550	\$8.00	\$108,400
Pavement Structural Section (4" AC and 8" ABC)	SQ YD	13,550	\$25.00	\$338,750
1 1/2" Overlay (Existing Roadway)	TON	570	\$35.00	\$19,950
Concrete Curb & Gutter	LF	5,715	\$20.00	\$114,300
Single Curb, MAG 222	LF	4,700	\$20.00	\$94,000
Concrete Sidewalk Ramp Std Det 231, Type "A"	EA	12	\$1,800.00	\$21,600
Concrete Sidewalk Std Det 230	SQ FT	35,100	\$7.00	\$245,700
Sawcut Asphalt Pavement	LF	1,175	\$2.00	\$2,350
Traffic Signing & Striping - 5 lanes	LF	3,200	\$7.50	\$24,000
Traffic Signal or Roundabout	EA	2	\$250,000.00	\$500,000
Drainage	Lump Sum	1	\$375,000.00	\$375,000
New Bridges	EA	2	\$1,000,000.00	\$2,000,000
Landscaping	Lump Sum	1	\$140,000.00	\$140,000
Lighting	Lump Sum	1	\$77,500.00	\$77,500
Transit	Lump Sum	1	\$150,000.00	\$150,000
Pedestrian Actuated Beacon	Lump Sum	1	\$25,000.00	\$25,000
<b>Roadway &amp; Structures Subtotal</b>				<b>\$4,921,550</b>
Removal of Existing Improvements @ 4%	Lump Sum	1	\$196,862.00	\$196,862
Mobilization/Demobilization @ 4%	Lump Sum	1	\$196,862.00	\$196,862
Traffic Control @ 3%	Lump Sum	1	\$147,647.00	\$147,647
<b>Construction Subtotal</b>				<b>\$5,462,921</b>
<b>Alternative 3 Construction Subtotal</b>				<b>\$5,462,921</b>

Alternative 3 Construction Subtotal		\$5,462,921
Contingency	25%	<u>\$1,365,730</u>
Estimated Construction Cost		\$6,828,651
Construction Management (15% of Construction Cost)	15%	\$1,024,298
Engineering Design (10% of Construction Cost)	10%	<u>\$682,865</u>
		\$1,707,163
Utility Relocations (4% of Construction Cost)	4%	\$273,146
Right-of-Way	SQ FT	\$416,008
Slope Easement	SQ FT	<u>\$330,736</u>
		\$746,744
Project Total:		<b>\$9,555,704</b>

**Preliminary Cost Estimate  
Fourth Street Corridor Study - South  
Sub-Alternatives 3A, 3B, 3C and 3D**

<b>Alternative 3, Partial Reconstruction with Raised Median</b>				
<b>Item Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total</b>
Community Relations	Lump Sum	1	\$10,000.00	\$10,000
Roadway Excavation	C YD	62,500	\$9.00	\$562,500
Borrow	C YD	38,900	\$9.00	\$350,100
Subgrade Preparation	SQ YD	13,550	\$8.00	\$108,400
Pavement Structural Section (Alternative 1)	SQ YD	13,550	\$25.00	\$338,750
1 1/2" Overlay (Existing Roadway)	TON	570	\$35.00	\$19,950
Concrete Curb & Gutter	LF	5,715	\$20.00	\$114,300
Single Curb, MAG 222	LF	4,700	\$20.00	\$94,000
Concrete Sidewalk Ramp Std Det 231, Type "A"	EA	7	\$1,800.00	\$12,600
Concrete Sidewalk Std Det 230	SQ FT	35,100	\$7.00	\$245,700
Saw cut Asphalt Pavement	LF	1,175	\$2.00	\$2,350
Traffic Signing & Striping - 5 lanes	LF	3,200	\$7.50	\$24,000
Drainage	Lump Sum	1	\$375,000.00	\$375,000
New Bridges	EA	2	\$1,000,000.00	\$2,000,000
Landscaping	Lump Sum	1	\$140,000.00	\$140,000
Lighting	Lump Sum	1	\$77,500.00	\$77,500
Transit	Lump Sum	1	\$150,000.00	\$150,000
Pedestrian Actuated Beacon	Lump Sum	1	\$25,000.00	\$25,000
<b>Subtotal Roadway &amp; Structures</b>				<b>\$4,650,150</b>
Right-of-Way	SQ FT	52,001	\$8	\$416,008
Slope Easement	SQ FT	41,342	\$8	\$330,736
<b>Subtotal Right-of-Way</b>				<b>\$746,744</b>
<b>Alternative A: Conventional Intersection</b>				
Traffic Signal, Full Intersection	EA	2	\$230,000.00	\$460,000
Interconnect/Traffic Signals	LF	3200	\$17.00	\$54,400
Contingency @ 36%**	Lump Sum	1	\$1,859,238.00	\$1,859,238
<b>Alternative 3A Subtotal*</b>				<b>\$7,770,532</b>
<b>Alternative B: Roundabout Intersections at Soliere, Sparrow</b>				
Roundabout	EA	2	\$250,000.00	\$500,000
Contingency @ 36%**	Lump Sum	1	\$1,854,054.00	\$1,854,054
<b>Alternative 3B Subtotal*</b>				<b>\$7,750,948</b>
<b>Alternative C: Roundabout at Soliere, Conventional Sparrow</b>				
Traffic Signal, Full Intersection	EA	1	\$230,000.00	\$230,000
Roundabout	EA	1	\$250,000.00	\$250,000
Contingency @ 36%**	Lump Sum	1	\$1,846,854.00	\$1,846,854
<b>Alternative 3C Subtotal*</b>				<b>\$7,723,748</b>
<b>Alternative D: Roundabout Sparrow, Conventional Soliere</b>				
Traffic Signal, Full Intersection	EA	1	\$230,000.00	\$230,000
Roundabout	EA	1	\$250,000.00	\$250,000
Contingency @ 36%**	Lump Sum	1	\$1,846,854.00	\$1,846,854
<b>Alternative 3D Subtotal*</b>				<b>\$7,723,748</b>

\* Subtotal includes Construction and Right-of-Way costs.

\*\*36% Contingency includes 4% for Removal of Improvements, 4% for Mobilization/Demobilization, 3% for Traffic Control and Contingency at 25%.



# APPENDIX B

## Public Open House Summaries



# Fourth Street Corridor Study - South

## **City of Flagstaff**

Fourth Street Corridor Study- South  
Public Open House Summary  
Wednesday, September 9, 2009



# Fourth Street Corridor Study - South

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# Fourth Street Corridor Study - South

## Introduction

The City of Flagstaff is evaluating a section of Fourth Street between Butler Avenue and Huntington Drive/Industrial Drive to define the future multi-modal facility. As an early and important part of the Study, the City is hosting an Open House to collect public input.

The Study will address critical concerns of the local community and the City of Flagstaff; define a viable alignment, roadway footprint and intersection configurations (Sparrow and Soliere avenues) between Butler Avenue and Huntington Drive/Industrial Drive; and establish the basis for detailed design that will meet the City of Flagstaff's needs for circulation and traffic control.

## Public Open House Overview

As an important early part of the study, the City hosted an Open House on Wednesday, September 9, 2009 to provide the community with information about the study and hear feedback. The community was invited to visit with project team members, view displays, ask questions, and provide input between 5:30 p.m. and 7:30 p.m. at Aquaplex Community Meeting Room located at 1702 N. Fourth Street. . Approximately 28 people attended the public open house.

<b>Public Open House Attendance</b>		
<b>Date/Time</b>	<b>Location</b>	<b>Attendees*</b>
September 9, 2009 5:30 p.m. to 7:30 p.m.	Aquaplex	28

\*Attendance is based upon the number of people who signed the sign-in sheet.

The Public Open House was held in an informal format which gave attendees the opportunity view displays and talk to team members one on one. Attendees were given a comment form and were given the option to submit their comment form at the end of the open house or to complete it and send it to the project team. A summary of comments received can be found in **Appendix A: Public Open House Comment Summary** and all open house materials can be found in **Appendix B: Public Open House Materials**.



# Fourth Street Corridor Study - South

## **Publicity**

Publicity efforts for the Public Open House included a newspaper advertisement, media release, and postcards.

### **Newspaper:**

Daily Sun      Wednesday, August 26, 2009

### **Media Release:**

The media release was distributed August 24, 2009.

### **Postcard Distribution:**

The project team distributed Public Open House announcement postcards to approximately 100 affected community members on August 24, 2009. A distribution list was generated by KDA Creative using residential information from the Coconino County GIS System.



# Fourth Street Corridor Study - South

## Appendix A: Public Open House Comment Summary

\*Comments received after comment due date.



# Fourth Street Corridor Study - South

## **Please tell us how you use Fourth Street between Butler Avenue and Industrial Drive:**

- Drop off children at NPA, Sinagua, and Knoles.
- It is the entrance to our condo at Summit Park (our second home).
- I live at Seventh and King. I use Butler to Huntington to get on Soliare and access Country Club and go west on Butler to get on Highway 40.
- Right now I only occasionally bike ride it. I avoid as I feel very unsafe among all the traffic.
- Drive to work; take kids to school, and Aquaplex.
- I live at Summit Park and leave for my job downtown usually at 7:45am. I can not turn left onto Fourth Street; it typically clears up around 8:10am. Otherwise, Fourth Street is my main travel route to get anywhere.
- Drive.
- Route to get to Milton.
- I travel both roads all the time.
- To get to Butler east and west.
- I do not use this stretch of roadway very much, but I want to see it working as well as it can for those who do.
- I live at Summit Park Condos and go to and from Sinagua High School every morning. Plus of course, all the errands I run.
- Mostly Fourth Street north to Route 66.
- Grandchildren walk to Knoles School.
- Home is in Summit Park Condos.
- I use it to connect between work and home. I live in Ponderosa Trails.
- Four to six times a day.
- O often jog and use the shoulders and sidewalks between Route 66 and Butler. Also, I commute over the Fourth Street Bridge daily.
- I live on Fourth Street and (Summit Park Condos) so I use Fourth Street in both directions (to Butler and to Industrial) to go everywhere.
- We used as a through route between I-40 continental and Route 66.
- I drive to Aquaplex and also into town from Fourth Street to Butler.
- **To go to and from home in directions, vehicle and/or bicycle mostly but also on foot.**
- **To get to and from my condo at Summit Park.**
- **I drive from my condo north across the bridge to Route 66 or south to Butler from Fourth Street. I do not use Industrial Drive; it is a challenge to turn on to Fourth Street from Summit Park.**

## **If you walk in this corridor, where do you cross Fourth Street? Do you have any concerns with crossing? If so, what are your concerns?**

- I do not walk and will not allow my children for fear of their life.
- Do not walk on Fourth Street.
- Need roundabouts to slow traffic cross at Aquaplex intersection.
- Looking at your diagrams it seems it would be best to have an overhead crossing around the area of the school.
- At Gore and cross Butler at Industrial for Aquaplex.
- From Summit Park over to Sparrow.
- I do not walk here, but I think it is dangerous to cross at Sparrow.
- No.
- I do not normally cross Fourth Street.
- Not applicable; would never walk due to no sidewalks.
- I do not walk here but I suppose you have to limit crossings to the "least dangerous" arms of the intersection.



# Fourth Street Corridor Study - South

- Sparrow and Fourth are a big concern being hit by a car.
- I cross by Gore, riding a bike is also risky across the I-40 Bridges.
- Priority should be sidewalks for safety and security. You are forcing the parents to drive,
- I bike, sight distance is short so crossing to other side is challenging.
- No concerns.
- I cross at the light at Soliere because there is a light but the “pinching” at the bridge at the freeway makes the roadway narrow for pedestrians.
- Usually at Industrial sometimes to Soliere.
- I have more concerns about walking on Fourth Street than crossing because much of it has no sidewalks. I like to walk to the Aquaplex and crossing the I-40 bridges is scary. I also like to walk to the Park and trails that are south of Butler and there is portion of Fourth Street in that direction that does not have sidewalks.
- I cross Fourth Street from west to east to catch the bus and in the evening to walk down to the Fox Glen Park. Due to car speed and incline of road I can not anticipate traffic.
- **I cross at Soliere or just north of Butler.**
- **I cross Fourth Street at Sparrow to use the bus if going to the mall and also when I walk over to Fox Glen Park.**
- **Pedestrians as well as auto traffic during early morning hours as well as 3 p.m. hours is heavy due to the two schools on northeast and southeast corners of Sparrow and Fourth Street.**

## **How do you feel about using roundabouts to keep traffic moving through intersections?**

- Great if implemented with pedestrian safer crossings and training for drivers.
- The proposed one are too small, they are dangerous.
- Do it.
- I am still getting comfortable, but I like the idea once Americans learn to navigate them safely.
- I do not mind roundabouts; need to be big enough for snow plows and fire trucks. I am worried about my kids riding their bikes through them.
- As I understand it that would be a great solution.
- I do not like roundabouts; I have no experience driving them. If I would get used to them or not, I do not know.
- A workable solution.
- They are a good idea but since the traffic flow would be continuous, how would school students and others cross the street safely.
- Love them, they work great.
- Ok at Fourth and Butler and Lights at Sparrow.
- Good idea.
- In general, I am ok with them but not where pedestrians need to cross (school kids crossing from bus stop on Fourth Street to walk along Sparrow to school). On further examination, I see that roundabouts can accommodate pedestrian crossing.
- I personally like roundabouts.
- Much better than nothing on Sparrow and Fourth Street. Not as good as a traffic light.
- It is an excellent option to mitigate traffic problems at Fourth Street and Sparrow/Solier. Still I have concerns about pedestrian crossing at Fourth Street and Sparrow because of the bus stop.
- I am not keen on them in this location. It would be difficult to come out of Summit Park Condos across from Sparrow and try to get into the roundabout to make an immediate left. When school is in session, traffic is very heavy. If Fourth Street is widened and eventually extended, traffic will be even worse (volume will increase). At school start/end times and at



# Fourth Street Corridor Study - South

rush hour, can be very hard to make a left out of Summit Park. And sight distance is not good, especially with the curve to the north and the hill to the south.

- We prefer roundabouts as they are after than lights and ease traffic flow.
- Not receptive, yes traffic would be slowed but only as a gimmick requiring drivers to wrestle with a distraction. Sedona's roundabouts are horrible.
- **Okay but two in close proximity will confuse and intimidate drivers, one and a stop light at Sparrow would be better.**
- **I think roundabouts would be a great improvement. Currently it is very difficult to get out of Summit Park.**
- **While a roundabout would slow traffic it is a lightweight solution to a heavily used road.**

## **What is the most important improvement that you feel needs to be made to Fourth Street between Butler Avenue and Industrial Drive?**

- Safety between the school campuses of Knoles, Sinagua, and NPA. Training for children and drivers to create a safer neighborhood; separate commuters out of the mix.
- Light at entrance to Summit Park.
- Widen road across Highway 40 and slow traffic (roundabouts).
- Solving the congestion to and from the school NPA, somehow having another entrance/exit for NPA.
- No homeless shelter, improve the I-40 Bridge for foot and bike traffic.
- Traffic control with school traffic and expanding the I-40 overpass to two lanes with pedestrian lane and or sidewalk.
- The traffic backs up at peak traffic times; I think traffic needs to flow more freely. It is hard to cross Fourth Street at Sparrow.
- Widen northbound two lanes continues.
- Traffic needs to slow down so people from Summit Park can exit left in the morning. There is so much school traffic it is almost impossible to turn left.
- Sidewalks and intersections (roundabouts).
- Sidewalks, bike paths, traffic lights at Sparrow and Fourth.
- Widening the bridges over I-40 and Fourth Street.
- Sidewalks, school flashing lights on Sparrow and Fourth Street.
- Add sidewalks and bike paths along the entire length of this area.
- Widening and adding median. Roundabouts a close second.
- Enlarge bridge, especially southbound.
- Light at Sparrow.
- Sidewalks heading to both extremities to Butler and to Soliere.
- Roundabouts at Soliere a light would be better at Sparrow for pedestrian traffic crossing at Fourth Street.
- Something to improve ability to make a left out of Summit Park and sidewalks.
- Widening the bridge over I-40 to Soliere.
- Prohibiting commercial trucks and easing the blind intersection at Sparrow and Fourth Street due to incline and curve approaching Industrial.
- **Traffic light at Sparrow/Summit Park and relocate school drop-off and pickup.**
- **A roundabout at Sparrow.**



# Fourth Street Corridor Study - South

## What additional information would be helpful to you?

- **Knowing when John Wesley Powell will connect to Butler and Futs connections in that corridor.**
- What will the cost be? Where is the money coming from?
- How would people cross the street near Summit Park and Sparrow?
- All good.
- I would like to know what other projects are on the table whenever being presented a project.
- A time frame as to construction information proposed changes happen.
- **Progress in city plans for area.**

## How did you hear about this meeting?

- Word of mouth.
- Condo News.
- Martin Ince email.
- Sign on Fourth Street.
- Flyer left on my door.
- Open House Sign.
- City notices.
- Newspaper.
- Pamphlet at Summit Park.
- NPR.

## Do you have suggestions that can help us improve our outreach to the community about the Fourth Street Corridor Study South?

- Parallel multiuse trail by Mustang Lane in lieu of sidewalks around campus.
- Listen to suggestions (reroute Fourth Street).
- Do not know what all you did but a mail out to all the families using the schools and FUSD facilities would be wise.
- Make it easy to see the public meetings on your website and publicize at Gore.
- The flyers were good and the sign advertising it.
- No.
- Painted crosswalks.
- Traffic sign announcing meetings are a great idea. Offer multiple meeting evening options for same open house to accommodate schedule conflicts.
- No.
- More meetings like this one.
- **No, thank you for your outreach.**
- **Moving the light at intersection of Soliere and Fourth Street to Sparrow and Fourth Street.**

## Was the project team helpful in answering your questions?

- Yes, excellent.
- Yes, seems like a “done deal” and this is just public relations.
- They were great.
- Yes, thanks for the opportunity to respond.
- Yes, great.
- Yes, thank you.
- Yes, except no one would give me any answers at all.
- Very.



# Fourth Street Corridor Study - South

- Yes.
- Yes.
- Yes, excellent.
- Yes.

## **Additional comments received:**

- Bus Charter School Students; work our tax money in this state.
- Reduce driving parents to charters.
- Will Wal-Mart (new) help pay for the widening?
- Another concern is if I-40 is widened on the outside of existing lanes but that probably is beyond your study and control.
- I am a resident of the Summit Park Condominiums residing in Building 3, which is directly parallel to Fourth Street. This position in the complex allows me to see traffic/pedestrian patterns throughout each day. Currently there are many NPA students who use the bus systems, which do pick ups in front of my condo. I have observed the corner of Sparrow and Summit Park entrance to become extremely congested, including students running across the street to the school/schools (Sinagua), and Summit Park resident's turning right as their only alternative, then making U-turns on 4th Street before they hit Butler. It is an extremely dangerous corner, particularly at prime school/work hours. It is my understanding that a traffic "circle" may be installed at the corner of Sparrow and the Summit Park Entrance. Since students cross "anywhere" due to their immaturity, they will no doubt try to cross a traffic circle to get to the bus stops. Increasing the danger, vehicles heading south on 4th Street have a "blind" approach after Soliare, over the I-40 overpass, to the Sparrow/Summit Park intersection. If students are crossing the "traffic circle," they will get hit by these vehicles. Additionally these vehicles are usually speeding; I would endorse a 15 mile an hour speed limit during Mon thru Fri 700 am until 700 pm with heavy police ticketing to "train" the public. I propose a traffic "circle" be installed at Soliare and I-40 overpass, with a traffic signal at Sparrow and Summit Park Entrance. This would accomplish five goals: 1) slow the vehicles that are speeding on 4th street; 2) keep the trucks off 4th street so that the trucks will use the Butler/industrial traffic circle; 3) keep students from jumping a traffic circle if one is located at the school intersection; 4) allow students to cross safely to bus stops by using a traffic signal located at Sparrow and Summit Park Entrance; 5) allow safe exit for Summit Park residents who are currently U-turning on the south end of 4th street. A traffic "circle" located at Sparrow and Summit Park Entrance will only complicate exits for Summit Park residents.
- The access thru an to Sinagua High School is bad (no sidewalk along Mustang Way)
- Northland Prep. School traffic is a mess.
- We need more bus stops along Butler Avenue – especially east of 4th Street
- What about adding a 5-ft wrought iron fence along the median to keep kids from crossing 4th Street?
- Sight visibility is a problem; entering 4th Street across from Sparrow and entering Soliere from Fox Lair and Falcon Road.
- We need an underpass or bridge between the two Gore campuses.
- Access from Gore campuses to Fourth Street is difficult..
- Turning left from Summit Park Condominiums to Fourth Street is impossible during the morning.



# Fourth Street Corridor Study - South

- Pedestrians are at risk at the Fourth Street-Sparrow Avenue intersection because of no crosswalks and sharp curve in the SB direction ahead of intersection.
- Is a roundabout better for pedestrians than a traffic signal?
- Build an interchange with I-40 at Fourth Street.
- Are you going to extend the FUTS along Fourth Street?
- Are you going to widen the bridges across I-40?
- Will there be a sidewalk and FUTS across I-40?
- Why are you looking at an elevated [raised] median?
- Are there any advantages to raised median over a flush median?
- Requested upgrades to existing NAIPTA facilities, i.e.: trash receptacles, bike racks, benches, covered shelters.
- Suggested moving NAIPTA sites further south away from the intersection.
- Prohibit use of dirt lot for parking, drop-off/pick-up.
- Turn Sparrow into a One-way street, no preferred direction defined.
- Install a cul-de-sac on Sparrow prohibiting thru movement between Fourth and Foxglenn.
- Move Soliere signal south to Sparrow, and place roundabout at Soliere/Fourth.
- Interim improvements: remove trees and shave the hill to improve site distance.
- Implement traffic calming techniques along Fourth Street; pavement markings, delineators, etc.
- Widen driveway at Summit Park to accommodate striped a dedicated left turn lane and thru/right turn lane.
- Place sidewalk or FUTS path on each side of the roadway.
- Enforce speed limit in the area.
- Why was one developer treated differently (not required to extend sidewalk) than another south of Summit Park site?
- Provide dedicated crossing location with "flashing yellow warning lights" at Sparrow/Fourth for pedestrians.
- How much right-of-way would be necessary to construct a roundabout?
- Route NAIPTA bus route closer to the school during the morning and afternoon peak traffic hours.



# Fourth Street Corridor Study - South

## Appendix B: Public Open House Materials



# South Fourth Street Corridor Study

## Public Open House

### Aquaplex

Wednesday, September 9, 2009  
5:30 p.m. to 7:30 p.m.  
Community Meeting Room  
1702 N. Fourth Street  
Flagstaff, Arizona 86004

The purpose of the study is to evaluate the South Fourth Street corridor needs and provide a definition of the future multimodal facility. Additionally, the project team will:

- Ensure the study addresses the critical concerns of the local community and the City of Flagstaff;
- Define a viable alignment, roadway footprint and intersection configurations (Sparrow and Soliere Avenues) between Butler Avenue and Huntington Drive/ Industrial Drive; and
- Establish the basis for detailed design that will meet the City of Flagstaff's needs for circulation and traffic control.

The public is encouraged to attend the open house to learn more about the study, view preliminary concepts, and provide input.

### Project and Meeting Locations



For more information regarding the open house please contact Bret Petersen at 928.226.4860 or [bpetersen@flagstaffaz.gov](mailto:bpetersen@flagstaffaz.gov).

City of Flagstaff Website  
[www.flagstaff.az.gov](http://www.flagstaff.az.gov)



# South Fourth Street Corridor Study

## Public Open House

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City of Flagstaff Website  
[www.flagstaff.az.gov](http://www.flagstaff.az.gov)

Postcard

Monday, August 24, 2009



**South Fourth Street  
Corridor Study**

Public Open House

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# Aquaplex

Wednesday, September 9, 2009  
5:30 p.m. to 7:30 p.m.  
Community Meeting Room  
1702 N. Fourth Street  
Flagstaff, Arizona 86004

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South Fourth Street Corridor Study  
c/o KDA Creative  
4545 E. Shea Blvd., Ste 210  
Phoenix, AZ, 85028



# South Fourth Street Corridor Study

## Public Open House

The purpose of the Study is to evaluate the South Fourth Street corridor needs and provide a definition of the future multimodal facility. Additionally, the project team will:

- Ensure the study addresses the critical concerns of the local community and the City of Flagstaff;
- Define a viable alignment, roadway footprint and intersection configurations (Sparrow and Soliere Avenues) between Butler Avenue and Huntington Drive/Industrial Drive; and
- Establish the basis for detailed design that will meet the City of Flagstaff's needs for circulation and traffic control.

The public is encouraged to attend the open house to learn more about the study, view preliminary concepts, and provide input.

### Project and Meeting Locations





## **City of Flagstaff**

For Immediate Release, August 24, 2009

Contact Kimberly Ott, Assistant to City Manager for Communications

Phone: 928-779-7603

# **NEWS**

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## **City to Host Open House for Fourth Street Corridor South Study**

FLAGSTAFF – The City of Flagstaff is evaluating a section of Fourth Street between Butler Avenue and Huntington Drive/Industrial Drive to define the future multi-modal facility. As an early and important part of the Study, the City is hosting an Open House on Wednesday, September 9 to provide the community with information about the Study. The community is invited to visit with project team members, view displays, ask questions, and provide input between 5:30 and 7:30 p.m. at the Aquaplex Community Meeting Room located at 1702 N. Fourth Street.

The Study will address critical concerns of the local community and the City of Flagstaff; define a viable alignment, roadway footprint and intersection configurations (Sparrow and Soliere avenues) between Butler Avenue and Huntington Drive/Industrial Drive; and establish the basis for detailed design that will meet the City of Flagstaff's needs for circulation and traffic control.

For more information regarding this Study or the Open House, please contact Bret Petersen with the City of Flagstaff at 928-226-4860 or visit [www.flagstaffaz.gov](http://www.flagstaffaz.gov).

**###**



# South Fourth Street Corridor Study

Fourth Street Corridor Study - South  
Butler Avenue to Industrial Drive

Community Open House—September 9, 2009  
5:30 to 7:30 p.m.

## Purpose of the Study

The City of Flagstaff is conducting the Fourth Street Corridor Study – South to evaluate the Fourth Street corridor needs and provide definition of the future multimodal facility.

## Goals and Objectives of the Study

- Ensure the project addresses the critical concerns of the local community and the City of Flagstaff.
- Define a viable alignment, roadway footprint and intersection configurations (Sparrow and Soliere Avenues) between Butler Avenue and Industrial Drive.
- Establish the basis for detailed design that will meet the City of Flagstaff’s needs for circulation and traffic control.
- Keep the community informed and involved as we move forward together in completing this study.

## Information on Display

- Aerial map showing project issues the team identified to be reviewed during the study process
- Preliminary concepts of widening Fourth Street and improving intersections
- Study schedule
- Roundabout information

## Please Give Us Your Feedback!

Please tell us how you use Fourth Street between Butler Avenue and Industrial Drive:

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If you walk in this corridor, where do you cross Fourth Street? Do you have any concerns with crossing? If so, what are your concerns?

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# South Fourth Street Corridor Study

How do you feel about using roundabouts to keep traffic moving through intersections?

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What is the most important improvement that you feel needs to be made to Fourth Street between Butler Avenue and Industrial Drive?

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What additional information would be helpful to you?

How did you hear about this meeting?

Do you have suggestions that can help us improve our outreach to the community about the Fourth Street Corridor Study South?

Was the project team helpful in answering your questions?

**Help us stay in touch with you!**

Your name \_\_\_\_\_

Your address \_\_\_\_\_

Your email address \_\_\_\_\_

Please return this comment form to our study team tonight or send to:

Bret Petersen, c/o KDA Creative

4545 E. Shea Blvd., Suite 210, Phoenix, AZ 85028

[bpetersen@flagstaffaz.gov](mailto:bpetersen@flagstaffaz.gov)

602-368-9645 (fax)

**Thank you for coming tonight!**



# South Fourth Street Corridor Study

## **City of Flagstaff**

South Fourth Street Corridor Study  
Public Open House #2 Summary  
Wednesday, December 9, 2009



# South Fourth Street Corridor Study

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Appendix A: Public Open House Comment Summary.....	5
Appendix B: Public Open House Materials.....	8
Appendix C: Additional Comments Received.....	12



# South Fourth Street Corridor Study

## Introduction

The City of Flagstaff is evaluating a section of Fourth Street between Butler Avenue and Huntington Drive/Industrial Drive to define the future multi-modal facility. The Study will address critical concerns of the local community and the City of Flagstaff; define a viable alignment, roadway footprint and intersection configurations (Sparrow and Soliere avenues) between Butler Avenue and Huntington Drive/Industrial Drive; and establish the basis for detailed design that will meet the City of Flagstaff's needs for circulation and traffic control.

## Public Open House Overview

The City hosted a second Open House on Wednesday, December 9, 2009 to provide the community with information about the study and hear feedback. The community was invited to visit with project team members, view displays, ask questions, and provide input between 6:00p.m. and 7:30 p.m. at Flagstaff Unified School District Administration Center located at 3285 E. Sparrow Avenue. Approximately 6 people attended the public open house.

<b>Public Open House Attendance</b>		
<b>Date/Time</b>	<b>Location</b>	<b>Attendees*</b>
December 9, 2009 6:00 p.m. to 7:30 p.m.	Flagstaff Unified School District Administration Center	6

\*Attendance is based upon the number of people who signed the sign-in sheet.

The Public Open House was held in an informal format which gave attendees the opportunity view displays and talk to team members one on one. Attendees were given a comment form and were given the option to submit their comment form at the end of the open house or to complete it and send it to the project team. A summary of comments received can be found in **Appendix A: Public Open House Comment Summary** and all open house materials can be found in **Appendix B: Public Open House Materials**.



# South Fourth Street Corridor Study

## **Publicity**

Publicity efforts for the Public Open House included a media release and postcards.

### **Media Release:**

The media release was distributed November 30, 2009.

### **Postcard Distribution:**

The project team distributed Public Open House announcement postcards to approximately 100 adjacent community members on December 1, 2009. A distribution list was generated by KDA Creative using residential information from the Coconino County GIS System. The postcard was also emailed to the attendees of the first open house.



# South Fourth Street Corridor Study

## Appendix A: Public Open House Comment Summary



# South Fourth Street Corridor Study

**What function is most important to you at the intersections of Soliere and Sparrow Avenues and why? (i.e. traffic, pedestrians, bikes, etc.):**

- Auto traffic coming out of and going to Summit Park Condo's.
- Adequate vehicular capacity so that school-bound motorists do not need to divert through local neighborhoods.

**After reviewing the intersection displays, do you prefer a traditional or roundabout intersection for Soliere and Sparrow Avenues?**

- Whichever permits the greatest left, turn capacity from southbound Fourth Street and eastbound Sparrow during peak school start/end times.
- I am used to signals while I can see benefits with roundabouts.

**Additional Comments:**

- A temporary light is needed immediately at Sparrow.
- In conjunction with these intersection improvements, we request a no left turn sign on westbound Soliere at Falcon Road. Our neighborhood on Falcon will seek this, so the Fourth Street project should anticipate handling the extra traffic that is currently cutting through the residential street.
- I cannot attend the upcoming forum on the 9th, but I do have an issue that I am hoping you might be willing to consider as part of the ongoing 4th Street Corridor process. There are quite a few pedestrians, depending on time of day and day of week that cross the 4th Street bridges over I-40. This includes children and young adults that attend schools south of I-40, or visit the City Aquaplex. My perspective is that of a parent whose own children cross the bridges to go to the Aquaplex, but I am writing on behalf of all pedestrians who use the route. There is no grade separation between the pedestrian area and the roadway. I am not sure if one could be placed, and, if so, it would really only be needed on one side of the bridges. Another factor is the guardrails, which come close to the roadway and force pedestrians to walk right next to cars. The truth is, my boys frequently walk that route, and it is important to me. I realize that the bridges belong to ADOT and that one of these years, they might widen them. But that could be in the distant future. I encourage the City to assess what could be done sooner, as part of a small project, rather than later, as part of a larger project (which may take many years to fund, design, permit and construct).
- A roundabout is needed close in proximity to the entry of Summit Park condos. Peak traffic times are early morning, when Northland Prep and Sinagua students are dropped off or picked up from schools, and evenings after work. Summit Park Condos support Alternative 3A or 3C. Both of these alternatives have a stop light at the intersection of 4<sup>th</sup> Street and Sparrow Avenue. Summit Park does not support a roundabout at the intersection of Sparrow Avenue and 4<sup>th</sup> Street. A stoplight signal at this intersection is the preferred alternative and is supported by the residents and board of directors.

**What additional information would be helpful to you?**

- None.

**How did you hear about this open house?**

- Mail.

**Do you have suggestions that can help us improve our outreach to the community about the South Fourth Street Corridor Study?**

- None.



# South Fourth Street Corridor Study

**Was the project team helpful in answering your questions?**

- Yes.



# South Fourth Street Corridor Study

## Appendix B: Public Open House Materials



## **City of Flagstaff**

For Immediate Release, December 1, 2009

Contact Kimberly Ott, Assistant to City Manager for Communications

Phone: 928-779-7603

# **NEWS**

---

## **City to Host Second Open House for South Fourth Street Corridor Study**

FLAGSTAFF – The City of Flagstaff is evaluating a section of Fourth Street between Butler Avenue and Huntington Drive/Industrial Drive to define the future multi-modal facility. As a follow up to comments received from the September open house, the City is hosting a final Open House on Wednesday, December 9 to provide the community with the study findings to date and request additional input on the Sparrow Avenue and Soliere Avenue intersections. The community is invited to visit with project team members, view displays, ask questions, and provide input between 6:00 and 7:30 p.m. at the Flagstaff Unified School District Administrative Center, 3285 E. Sparrow Avenue in the Governing Board Room. A brief presentation will begin at 6:15 p.m. with the open house to follow.

The Study will address critical concerns of the local community and the City of Flagstaff; define future capacity needs, roadway footprint and intersection configurations (Sparrow and Soliere Avenues) between Butler Avenue and Huntington Drive/Industrial Drive; and provide detailed design that meets the City of Flagstaff's needs for circulation and traffic control.

For more information regarding this Study or the Open House, please contact Bret Petersen with the City of Flagstaff at 928-226-4860 or [bpetersen@flagstaffaz.gov](mailto:bpetersen@flagstaffaz.gov).

**###**



# South Fourth Street Corridor Study

## Public Open House #2

The purpose of the Study is to evaluate the South Fourth Street corridor needs and provide a definition of the future multimodal facility. Additionally, the project team will:

- Ensure the study addresses the critical concerns of the local community and the City of Flagstaff;
- Define future capacity needs, roadway footprint and intersection configurations (Sparrow and Soliere Avenues) between Butler Avenue and Huntington Drive/Industrial Drive; and
- Provide detailed design that meets the City of Flagstaff's needs for circulation and traffic control.

The public is encouraged to attend the open house to learn more about the study findings to date and provide additional input on the Sparrow Avenue and Soliere Avenue intersections.

### Project and Open House Location





# South Fourth Street Corridor Study

## Public Open House #2

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### **Flagstaff Unified School District Administration Center**

Wednesday, December 9, 2009

6:00 p.m. to 7:30 p.m.

Brief presentation at 6:15 p.m.

Governing Board Room

3285 E. Sparrow Avenue

Flagstaff, Arizona 86004

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For more information regarding  
the open house, please contact  
Bret Petersen at 928.226.4860  
or [bpetersen@flagstaffaz.gov](mailto:bpetersen@flagstaffaz.gov).

City of Flagstaff Website  
**[www.flagstaff.az.gov](http://www.flagstaff.az.gov)**

South Fourth Street Corridor Study  
c/o KDA Creative  
4545 E. Shea Blvd., Ste 210  
Phoenix, AZ 85028



# South Fourth Street Corridor Study

## Appendix C: Additional Comments Received

# South Fourth Street Corridor

Page 1

## II. ISSUES FOR SUMMIT PARK CONDIMINIUM OWNERS

Peak traffic times are early morning, when Northland Prep and Sinagua students are dropped off or picked up from schools, and evenings after work.

- a. Current traffic flow on 4<sup>th</sup> Street often exceeds the speed limit and there is poor visibility for the intersection at Summit Park Condominiums and Sparrow Avenue. Summit Park Condominiums are located at the top of rise on 4<sup>th</sup> Street which does not allow traffic on 4<sup>th</sup> Street to see the upcoming intersection at Sparrow Avenue and Summit Park Condominiums. Summit Park residents that want to turn left onto 4<sup>th</sup> Street during the peak traffic times, first have to turn right and execute an illegal U-Turn to head North on 4<sup>th</sup> Street.
- b. Pedestrians and Bicycle traffic cross 4<sup>th</sup> Street at Sparrow Avenue and Summit Park Condominiums, and there are Bus Stops on both sides of 4<sup>th</sup> Street. Currently, there are no Pedestrian Cross Walk Markings, School Signage, or Flashing Lights to indicate that there is an intersection ahead.
- c. Parents of children being picked up and let off for Northland Prep Academy currently have no parking area. Therefore parents drop off and pick up students at the dirt area located on 4<sup>th</sup> Street, forcing them to pull into and out of traffic on 4<sup>th</sup> Street. Parents also wait in the Summit Park Complex, requiring students to cross 4<sup>th</sup> Street.
- d. Some residents at Summit Park Condominiums are elderly. Pulling out onto 4<sup>th</sup> Street is an increasing source of anxiety for them.

## III. ALTERNATE COMMENTS

Summit Park Condominiums support Alternatives 3A or 3C. Both of these alternatives have a Stop Light at the intersection of 4<sup>th</sup> Street and Sparrow Avenue.

- a. The 4<sup>th</sup> Street Intersection at Sparrow Avenue has multiple users: vehicles, pedestrians, bicyclists, and bus riders. A Stop Light would best suit this multiple-user scenario. Currently, pedestrians and bicyclists cross 4<sup>th</sup> Street if vehicles are not present. This isn't safe for users or vehicle drivers. Children are taught to wait for a clear signal to indicate that it is safe to cross an intersection and vehicle drivers expect to see pedestrians in a clearly marked pedestrian crossing.
- b. Driving a Roundabout like a Traditional Intersection Instructions: (1) Approach roundabout slowly, (2) Yield to the left, (3) Wait for a gap, (4) Proceed slowly, (5) Use signal for turns.  
From my Personal experience with driving double and single lane Roundabouts, the main road vehicles DO NOT Yield to side vehicles to allow entry into the Roundabout during periods of high traffic. I have experienced long backups and sat in traffic for over an hour at roundabouts. Summit Park is concerned about the Level of Service for their Vehicle Traffic if a Roundabout is at their entry. There

## South Fourth Street Corridor Page 2

also is concern that pedestrians (especially if handicapped or in a wheelchair) and bicyclists will not be able to safely cross the intersection with a Roundabout.

- c. (See attached map). If a Roundabout is installed at the Entry of Summit Park the current Entry Way would need to be reconfigured. Building 3 and entry to units 113, 114, 213, and 214 would be dramatically affected as they would have continuous traffic right outside of their front doors and windows, 24 hours per day. This would affect the Property Values of their Condominiums, as they would become less desirable because of the traffic and increased noise levels.
- d. We also are concerned that the Property Values for all of Summit Park would decrease. A Roundabout for a major Traffic Artery in Flagstaff as The Entryway into the Complex would detract from the Park-like and Natural landscaping that has become a hallmark of the Complex. Summit Park Condominiums is very fiscally responsible and has worked hard to maintain landscaping with low-water plants, native species, and good care of the existing Ponderosa Pines on the property.
- e. The only comment about a Roundabout at Soliere Avenue is that the Bridge over I-40 may not be able to be widened to accommodate this long-term plan.

IV. SUMMIT PARK CONDOMINIUMS DO NOT SUPPORT A ROUNDABOUT AT THE INTERSECTION OF SPARROW AVENUE AND 4<sup>TH</sup> STREET. A STOP LIGHT SIGNAL AT 4<sup>TH</sup> STREET AND SPARROW AVENUE IS THE PREFERRED ALTERNATIVE AND IS SUPPORTED BY THE RESIDENTS AND BOARD OF DIRECTORS.

TEMPORARY SOLUTIONS FOR THE TRAFFIC SAFETY AND CONGESTION AT SPARROW AVENUE AND 4<sup>TH</sup> STREET:

### V. CURRENT SUGGESTIONS FOR TRAFFIC SOLUTIONS

- a. Install a temporary Traffic Signal at Sparrow Avenue and 4<sup>th</sup> Street, similar to what was at 4<sup>th</sup> Street and Butler
- f. Install flashing warning lights on 4th Street on either side of the rise to warn drivers to slow down as they cannot see the approaching Intersection and Schools.
- b. Install Curb on 4<sup>th</sup> Street in front of Northland Prep Academy to block the current dirt area from being used as an area for parents to drop off or pick up students and as a parking lot for Northland Prep.

# SUMMIT PARK COMMUNITY SITE PLAN



**LEGEND**

123A  
 FIRST OR SECOND LEVEL — FLOOR PLAN TYPE  
 UNIT NO.

— DENOTES EXISTING PONDEROSA PINE TREE

\*- 100 NUMBERS ON GARDEN LEVEL  
 200 NUMBERS ON SECOND LEVEL



*Pond located close proximity to entry of condos*

SPARROW AVENUE  
 MAIL  
 PHASE I  
 STREET



# APPENDIX C

## Traffic Analysis

### Flagstaff Fourth Street South Study

#### VISSIM-Intersection LOS

#### Soliere Conventional

#### Sparrow Roundabout

Intersection Name	Approach Movement	SB			NB			EB			WB			ALL
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
Fourth St @ Soliere (Conventional Intersection)	Demand Volume	577	1166	7	9	823	208	13	2	7	198	2	362	3374
	Served Volume	240	526	3	3	789	199	13	3	7	191	1	346	2321
	% of Demand Served	41.6%	45.1%	48.6%	28.9%	95.8%	95.9%	99.2%	130.0%	100.0%	96.5%	50.0%	95.7%	68.8%
	Delay	48.7	20.7	7.8	10.74	23.29	15.68	62.65	50.06	10.77	54.82	28.18	23.03	27.3
	LOS	D	C	A	B	C	B	E	D	B	D	C	C	C
	Avg Queue	953	953	0	127	127	126	4	4	2	99	99	99	216
	Max Queue	1431	1431	0	449	449	450	64	64	100	407	407	407	1431
Fourth St @ Sparrow (Roundabout)	Demand Volume	364	941	66	9	763	64	13	2	7	8	2	264	2503
	Served Volume	188	504	36	7	743	60	0	0	6	8	2	254	1807
	% of Demand Served	51.6%	53.6%	53.9%	73.3%	97.3%	93.1%	0.0%	0.0%	90.0%	105.0%	80.0%	96.3%	72.2%
	Delay	3.3	5.2	7.1	6.3	12.3	7.9	0.0	0.0	28.7	18.9	14.5	14.2	9.4
	LOS	A	A	A	A	B	A	--	--	C	B	B	B	A
	Avg Queue	11	11	11	31	31	31	0	0	0	39	39	39	20
	Max Queue	176	176	176	339	339	339	11	11	11	240	240	240	339

**Flagstaff Fourth Street South Study**

VISSIM-Intersection LOS

2 Roundabouts

Intersection Name	Approach Movement	SB			NB			EB			WB			ALL
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
Fourth St @ Soliere (Roundabout)	Demand Volume	577	1166	7	9	823	208	13	2	7	198	2	362	3374
	Served Volume	569	1171.6	14.5	0	817	205	11	0	7	195	1	355	3345
	% of Demand Served	98.7%	100.5%	207.1%	0.0%	99.2%	98.4%	83.1%	0.0%	100.0%	98.2%	50.0%	98.0%	99.1%
	Delay	17.2	14.74	17.2	0	14.99	10.76	39.2	0	22.95	12.04	6.12	6.66	14.1
	LOS	B	B	B	--	B	B	D	--	C	B	A	A	B
	Avg Queue	148	148	148	35	35	35	0	0	0	4	4	4	47
	Max Queue	1260	1260	1260	437	437	437	25	25	25	176	176	176	1260
Fourth St @ Sparrow (Roundabout)	Demand Volume	364	941	66	9	763	64	13	2	7	8	2	264	2503
	Served Volume	369	940	65	7	747	60	13	2	6	8	1	262	2480
	% of Demand Served	101.3%	99.9%	97.7%	74.4%	97.9%	93.8%	101.5%	115.0%	91.4%	102.5%	70.0%	99.1%	99.1%
	Delay	3.1	2.8	2.7	5.5	6.9	6.9	11.3	8.4	6.3	13.9	8.9	9.2	4.9
	LOS	A	A	A	A	A	A	B	A	A	B	A	A	A
	Avg Queue	2	2	2	4	4	4	0	0	0	2	2	2	2
	Max Queue	189	189	189	200	200	200	4	4	4	100	100	100	200

**Flagstaff Fourth Street South Study**

VISSIM-Intersection LOS

Soliere Roundabout

Sparrow Conventional

Intersection Name	Approach Movement	SB			NB			EB			WB			ALL
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
Fourth St @ Soliere (Roundabout)	Demand Volume	577	1166	7	9	823	208	13	2	7	198	2	362	3374
	Served Volume	572	1161	7	8.1	806	205	11	2	7	193	1	355	3329
	% of Demand Served	99.1%	99.6%	105.7%	90.0%	97.9%	98.7%	86.9%	105.0%	100.0%	97.6%	50.0%	98.1%	98.7%
	Delay	13.8	12.28	13.5	13.7	13.05	8.32	30.9	15.87	17.93	9.23	3.64	3.11	11.3
	LOS	B	B	B	B	B	A	C	B	B	A	A	A	B
	Avg Queue	101	101	101	29	29	29	0	0	0	2	2	2	33
	Max Queue	1048	1048	1048	418	418	418	21	21	21	160	160	160	1048
Fourth St @ Sparrow (Conventional Intersection)	Demand Volume	364	941	66	9	763	64	13	2	7	8	2	264	2503
	Served Volume	365	933	64	7	746	60	13	2	6	8	1	262	2469
	% of Demand Served	100.2%	99.1%	97.3%	78.9%	97.8%	93.9%	101.5%	120.0%	91.4%	103.8%	70.0%	99.2%	98.6%
	Delay	15.3	3.7	4.4	18.7	13.0	14.4	36.6	37.5	37.3	34.2	22.5	5.5	9.0
	LOS	B	A	A	B	B	B	D	D	D	C	C	A	A
	Avg Queue	27	27	27	29	29	29	4	4	4	2	2	0	15
	Max Queue	350	350	350	322	322	322	57	57	57	93	93	49	350

### Flagstaff Fourth Street South Study

VISSIM-Intersection LOS

Soliere Conventional

Sparrow Roundabout

Intersection Name	Approach Movement	SB			NB			EB			WB			ALL
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
Fourth St @ Soliere (Conventional Intersection)	Demand Volume	577	1166	7	9	823	208	13	2	7	198	2	362	3374
	Served Volume	240	526	3	3	789	199	13	3	7	191	1	346	2321
	% of Demand Served	41.6%	45.1%	48.6%	28.9%	95.8%	95.9%	99.2%	130.0%	100.0%	96.5%	50.0%	95.7%	68.8%
	Delay	48.7	20.7	7.8	10.74	23.29	15.68	62.65	50.06	10.77	54.82	28.18	23.03	27.3
	LOS	D	C	A	B	C	B	E	D	B	D	C	C	C
	Avg Queue	953	953	0	127	127	126	4	4	2	99	99	99	216
	Max Queue	1431	1431	0	449	449	450	64	64	100	407	407	407	1431
Fourth St @ Sparrow (Roundabout)	Demand Volume	364	941	66	9	763	64	13	2	7	8	2	264	2503
	Served Volume	188	504	36	7	743	60	0	0	6	8	2	254	1807
	% of Demand Served	51.6%	53.6%	53.9%	73.3%	97.3%	93.1%	0.0%	0.0%	90.0%	105.0%	80.0%	96.3%	72.2%
	Delay	3.3	5.2	7.1	6.3	12.3	7.9	0.0	0.0	28.7	18.9	14.5	14.2	9.4
	LOS	A	A	A	A	B	A	--	--	C	B	B	B	A
	Avg Queue	11	11	11	31	31	31	0	0	0	39	39	39	20
	Max Queue	176	176	176	339	339	339	11	11	11	240	240	240	339

### 4th St and Sparrow Rodel Output

19:11:09 4th St and Sparrow Tempe AZ 50% CL

E (m)	8.53	4.26	8.53	4.26	TIME PERIOD	min	90
L' (m)	8.00	8.00	8.00	8.00	TIME SLICE	min	15
V (m)	7.20	3.65	7.20	3.65	RESULTS PERIOD	min	15 75
RAD (m)	22.86	22.86	22.86	22.86	TIME COST	\$/hr	15.00
PHI (d)	30.00	30.00	30.00	30.00	FLOW PERIOD	min	15 75
DIA (m)	48.77	48.77	48.77	48.77	FLOW TYPE	pcu/veh	VEH
GRAD SEP	0	0	0	0	FLOW PEAK	am/op/pm	PM

LEG NAME	PCU	TURNS (1st exit, 2nd..U)				FLOF	CL	FLOW RATIO			FLOW TIME		
4th St N	1.02	66	941	364	0	1.00	50	0.75	1.125	0.75	15	45	75
Sparrow W	1.02	7	2	13	0	1.00	50	0.75	1.125	0.75	15	45	75
4th St S	1.02	9	763	64	0	1.00	50	0.75	1.125	0.75	15	45	75
Sparrow E	1.02	264	2	8	0	1.00	50	0.75	1.125	0.75	15	45	75

MODE 2

FLOW	veh	1371	22	836	274	AVEDEL	s	3.7
CAPACITY	veh	2355	539	2123	791	LOS SIG		A
AVE DELAY	secs	3.7	7.0	2.8	6.9	LOS UNSIG		A
MAX DELAY	secs	5.2	9.8	3.7	9.8	VEHIC HRS		2.6
AVE QUEUE	veh	1.4	0.0	0.7	0.5	COST	\$	39
MAX QUEUE	veh	1.8	0.1	0.8	0.7			

19:11:09 4th St and Sparrow 85% CL

E (m)	8.53	4.26	8.53	4.26	TIME PERIOD	min	90
L' (m)	8.00	8.00	8.00	8.00	TIME SLICE	min	15
V (m)	7.20	3.65	7.20	3.65	RESULTS PERIOD	min	15 75
RAD (m)	22.86	22.86	22.86	22.86	TIME COST	\$/hr	15.00
PHI (d)	30.00	30.00	30.00	30.00	FLOW PERIOD	min	15 75
DIA (m)	48.77	48.77	48.77	48.77	FLOW TYPE	pcu/veh	VEH
GRAD SEP	0	0	0	0	FLOW PEAK	am/op/pm	PM

LEG NAME	PCU	TURNS (1st exit, 2nd..U)				FLOF	CL	FLOW RATIO			FLOW TIME		
4th St N	1.02	66	941	364	0	1.00	85	0.75	1.125	0.75	15	45	75
Sparrow W	1.02	7	2	13	0	1.00	85	0.75	1.125	0.75	15	45	75
4th St S	1.02	9	763	64	0	1.00	85	0.75	1.125	0.75	15	45	75
Sparrow E	1.02	264	2	8	0	1.00	85	0.75	1.125	0.75	15	45	75

MODE 2

FLOW	veh	1371	22	836	274	AVEDEL	s	5.1
CAPACITY	veh	2152	336	1920	588	LOS SIG		A
AVE DELAY	secs	4.7	11.9	3.3	11.8	LOS UNSIG		A
MAX DELAY	secs	6.8	17.9	4.5	17.8	VEHIC HRS		3.5
AVE QUEUE	veh	1.8	0.1	0.8	0.9	COST	\$	53
MAX QUEUE	veh	2.3	0.1	0.9	1.2			

### 4th St and Soliere Rodel Output - Currently Proposed Design

19:11:09		4th St and Soliere 50% CL							
E	(m)	8.53	4.26	8.53	4.26	TIME PERIOD	min 90		
L'	(m)	10.00	10.00	8.00	10.00	TIME SLICE	min 15		
V	(m)	7.20	3.65	7.20	3.65	RESULTS PERIOD	min 15 75		
RAD	(m)	30.48	22.86	22.86	22.86	TIME COST	\$/hr 15.00		
PHI	(d)	30.00	30.00	30.00	30.00	FLOW PERIOD	min 15 75		
DIA	(m)	48.77	48.77	48.77	48.77	FLOW TYPE	pcu/veh VEH		
GRAD SEP		0	0	0	0	FLOW PEAK	am/op/pm PM		
-----									
LEG NAME	PCU	TURNS (1st exit, 2nd..U)				FLOF	CL	FLOW RATIO	FLOW TIME
4th St N	1.02	7	1166	577	0	1.00	50	0.75 1.125 0.75	15 45 75
Soliere W	1.02	7	2	13	0	1.00	50	0.75 1.125 0.75	15 45 75
4th St S	1.02	208	823	9	0	1.00	50	0.75 1.125 0.75	15 45 75
Soliere E	1.02	362	2	198	0	1.00	50	0.75 1.125 0.75	15 45 75
-----									
MODE 2									
FLOW	veh	1750	22	1040	562			AVEDEL	s 8.2
CAPACITY	veh	2295	209	1961	793			LOS	SIG A
AVE DELAY	secs	7.3	27.4	3.9	18.0			LOS UNSIG	A
MAX DELAY	secs	12.0	50.5	5.7	30.9				
AVE QUEUE	veh	3.7	0.2	1.2	2.9			VEHIC HRS	7.7
MAX QUEUE	veh	5.3	0.3	1.5	4.4			COST	\$ 115

19:11:09		4th St and Soliere Tempe AZ 85% CL							
E	(m)	8.53	4.26	8.53	4.26	TIME PERIOD	min 90		
L'	(m)	10.00	10.00	8.00	10.00	TIME SLICE	min 15		
V	(m)	7.20	3.65	7.20	3.65	RESULTS PERIOD	min 15 75		
RAD	(m)	30.48	22.86	22.86	22.86	TIME COST	\$/hr 15.00		
PHI	(d)	30.00	30.00	30.00	30.00	FLOW PERIOD	min 15 75		
DIA	(m)	48.77	48.77	48.77	48.77	FLOW TYPE	pcu/veh VEH		
GRAD SEP		0	0	0	0	FLOW PEAK	am/op/pm PM		
-----									
LEG NAME	PCU	TURNS (1st exit, 2nd..U)				FLOF	CL	FLOW RATIO	FLOW TIME
4th St N	1.02	7	1166	577	0	1.00	85	0.75 1.125 0.75	15 45 75
Soliere W	1.02	7	2	13	0	1.00	85	0.75 1.125 0.75	15 45 75
4th St S	1.02	208	823	9	0	1.00	85	0.75 1.125 0.75	15 45 75
Soliere E	1.02	362	2	198	0	1.00	85	0.75 1.125 0.75	15 45 75
-----									
MODE 2									
FLOW	veh	1750	22	1040	562			AVEDEL	s 32.9
CAPACITY	veh	2096	48	1760	591			LOS	SIG C
AVE DELAY	secs	12.6	681.7	5.1	122.5			LOS UNSIG	D
MAX DELAY	secs	22.7	1590.1	7.5	243.3				
AVE QUEUE	veh	6.3	4.2	1.5	20.9			VEHIC HRS	30.9
MAX QUEUE	veh	10.1	10.7	1.9	41.0			COST	\$ 463

### 4th St and Soliere Rodel Output - Modified Design

20:11:09		4th St and Soliere 50% CL						
E (m)	8.53	8.53	8.53	8.53	TIME PERIOD	min	90	
L' (m)	10.00	8.00	8.00	8.00	TIME SLICE	min	15	
V (m)	7.20	3.65	7.20	3.65	RESULTS PERIOD	min	15 75	
RAD (m)	30.48	22.86	22.86	22.86	TIME COST	\$/hr	15.00	
PHI (d)	30.00	30.00	30.00	30.00	FLOW PERIOD	min	15 75	
DIA (m)	48.77	48.77	48.77	48.77	FLOW TYPE	pcu/veh	VEH	
GRAD SEP	0	0	0	0	FLOW PEAK	am/op/pm	PM	
LEG NAME	PCU	TURNS (1st exit, 2nd..U)			FLOF	CL	FLOW RATIO	FLOW TIME
4th St N	1.02	7	1166	577	0	1.00	50 0.75 1.125 0.75	15 45 75
Soliere W	1.02	7	2	13	0	1.00	50 0.75 1.125 0.75	15 45 75
4th St S	1.02	208	823	9	0	1.00	50 0.75 1.125 0.75	15 45 75
Soliere E	1.02	362	2	198	0	1.00	50 0.75 1.125 0.75	15 45 75
MODE 2								
FLOW	veh	1750	22	1040	562		AVEDEL s	6.3
CAPACITY	veh	2295	422	1961	1078		LOS SIG	A
AVE DELAY	secs	7.3	9.7	3.9	7.1		LOS UNSIG	A
MAX DELAY	secs	12.0	15.5	5.7	10.6			
AVE QUEUE	veh	3.7	0.1	1.2	1.1		VEHIC HRS	5.9
MAX QUEUE	veh	5.3	0.1	1.5	1.5		COST \$	88

20:11:09		4th St and Soliere 85% CL						
E (m)	8.53	8.53	8.53	8.53	TIME PERIOD	min	90	
L' (m)	10.00	8.00	8.00	8.00	TIME SLICE	min	15	
V (m)	7.20	3.65	7.20	3.65	RESULTS PERIOD	min	15 75	
RAD (m)	30.48	22.86	22.86	22.86	TIME COST	\$/hr	15.00	
PHI (d)	30.00	30.00	30.00	30.00	FLOW PERIOD	min	15 75	
DIA (m)	48.77	48.77	48.77	48.77	FLOW TYPE	pcu/veh	VEH	
GRAD SEP	0	0	0	0	FLOW PEAK	am/op/pm	PM	
LEG NAME	PCU	TURNS (1st exit, 2nd..U)			FLOF	CL	FLOW RATIO	FLOW TIME
4th St N	1.02	7	1166	577	0	1.00	85 0.75 1.125 0.75	15 45 75
Soliere W	1.02	7	2	13	0	1.00	85 0.75 1.125 0.75	15 45 75
4th St S	1.02	208	823	9	0	1.00	85 0.75 1.125 0.75	15 45 75
Soliere E	1.02	362	2	198	0	1.00	85 0.75 1.125 0.75	15 45 75
MODE 2								
FLOW	veh	1750	22	1040	562		AVEDEL s	10.8
CAPACITY	veh	2092	219	1759	876		LOS SIG	B
AVE DELAY	secs	13.5	26.4	5.1	12.5		LOS UNSIG	B
MAX DELAY	secs	24.9	50.6	7.6	20.4			
AVE QUEUE	veh	6.7	0.2	1.5	2.0		VEHIC HRS	10.2
MAX QUEUE	veh	11.1	0.3	2.0	2.9		COST \$	152

# HCM Signalized Intersection Capacity Analysis

2030 PM

## 3: Soliere & 4th St

10/12/2009



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	198	362	832	208	577	1173
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.16	1.00
Satd. Flow (perm)	1770	1583	3539	1583	293	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	215	393	904	226	627	1275
RTOR Reduction (vph)	0	331	0	69	0	0
Lane Group Flow (vph)	215	62	904	157	627	1275
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2		6
Actuated Green, G (s)	18.9	18.9	43.1	43.1	93.1	93.1
Effective Green, g (s)	18.9	18.9	43.1	43.1	93.1	93.1
Actuated g/C Ratio	0.16	0.16	0.36	0.36	0.78	0.78
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	279	249	1271	569	794	2746
v/s Ratio Prot	c0.12		0.26		c0.30	0.36
v/s Ratio Perm		0.04		0.10	c0.31	
v/c Ratio	0.77	0.25	0.71	0.28	0.79	0.46
Uniform Delay, d1	48.5	44.3	33.1	27.4	21.9	4.7
Progression Factor	1.00	1.00	0.81	0.66	0.16	0.16
Incremental Delay, d2	12.4	0.5	3.2	1.1	3.4	0.4
Delay (s)	60.8	44.8	30.1	19.3	6.8	1.1
Level of Service	E	D	C	B	A	A
Approach Delay (s)	50.5		27.9			3.0
Approach LOS	D		C			A

### Intersection Summary

HCM Average Control Delay	18.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

2030 PM

## 4: Sparrow & 4th

10/12/2009



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↕		↕	↕		↕	↕↕		↕	↕↕	
Volume (vph)	13	2	7	8	2	264	9	763	64	364	941	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.96		1.00	0.85		1.00	0.99		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1729		1770	1585		1770	3498		1770	3504	
Flt Permitted		0.36		0.74	1.00		0.23	1.00		0.30	1.00	
Satd. Flow (perm)		633		1381	1585		423	3498		562	3504	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	2	8	9	2	287	10	829	70	396	1023	72
RTOR Reduction (vph)	0	7	0	0	266	0	0	2	0	0	2	0
Lane Group Flow (vph)	0	17	0	9	23	0	10	897	0	396	1093	0
Turn Type	Perm			Perm			pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		8.9		8.9	8.9		82.9	82.9		97.8	97.8	
Effective Green, g (s)		8.9		8.9	8.9		82.9	82.9		97.8	97.8	
Actuated g/C Ratio		0.07		0.07	0.07		0.69	0.69		0.82	0.82	
Clearance Time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		47		102	118		307	2417		621	2856	
v/s Ratio Prot					0.01		0.00	c0.26		c0.09	0.31	
v/s Ratio Perm		c0.03		0.01			0.02			c0.43		
v/c Ratio		0.35		0.09	0.20		0.03	0.37		0.64	0.38	
Uniform Delay, d1		52.8		51.8	52.2		6.2	7.7		8.6	3.0	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.06	1.25	
Incremental Delay, d2		4.5		0.4	0.8		0.0	0.4		1.9	0.1	
Delay (s)		57.3		52.1	53.0		6.3	8.1		11.1	3.8	
Level of Service		E		D	D		A	A		B	A	
Approach Delay (s)		57.3			53.0			8.1			5.7	
Approach LOS		E			D			A			A	

### Intersection Summary

HCM Average Control Delay	12.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

2030 PM

## 5: Butler & 4th

10/12/2009



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	608	682	10	2	322	116	91	73	36	252	32	856
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	3531		1770	3399		1770	1770		1770	1863	1583
Flt Permitted	0.95	1.00		0.37	1.00		0.73	1.00		0.49	1.00	1.00
Satd. Flow (perm)	3433	3531		682	3399		1368	1770		910	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	661	741	11	2	350	126	99	79	39	274	35	930
RTOR Reduction (vph)	0	1	0	0	44	0	0	24	0	0	0	359
Lane Group Flow (vph)	661	751	0	2	432	0	99	94	0	274	35	571
Turn Type	Prot			Perm			Perm			pm+pt		Perm
Protected Phases	1	6			2			4		3		8
Permitted Phases				2			4			8		8
Actuated Green, G (s)	16.0	36.6		16.6	16.6		11.6	11.6		29.9	29.9	29.9
Effective Green, g (s)	16.0	36.6		16.6	16.6		11.6	11.6		29.9	29.9	29.9
Actuated g/C Ratio	0.21	0.49		0.22	0.22		0.16	0.16		0.40	0.40	0.40
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	737	1735		152	757		213	276		530	748	635
v/s Ratio Prot	c0.19	0.21			c0.13			0.05		0.10	0.02	
v/s Ratio Perm				0.00			0.07			0.11		c0.36
v/c Ratio	0.90	0.43		0.01	0.57		0.46	0.34		0.52	0.05	0.90
Uniform Delay, d1	28.4	12.2		22.6	25.8		28.6	28.0		16.0	13.6	20.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	13.5	0.8		0.2	3.1		1.6	0.7		0.9	0.0	15.6
Delay (s)	42.0	13.0		22.7	28.9		30.2	28.8		16.8	13.6	36.5
Level of Service	D	B		C	C		C	C		B	B	D
Approach Delay (s)		26.6			28.9			29.4			31.5	
Approach LOS		C			C			C			C	

### Intersection Summary

HCM Average Control Delay	28.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	74.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
3: Soliere & 4th St

2030 PM  
10/12/2009



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	215	393	904	226	627	1275
v/c Ratio	0.77	0.68	0.71	0.35	0.79	0.46
Control Delay	66.6	10.7	30.9	11.7	9.4	1.2
Queue Delay	0.0	0.0	0.8	0.0	0.0	0.0
Total Delay	66.6	10.7	31.8	11.7	9.4	1.2
Queue Length 50th (ft)	159	0	323	65	36	38
Queue Length 95th (ft)	242	91	206	45	m33	m34
Internal Link Dist (ft)	463		370			387
Turn Bay Length (ft)	250			100	150	
Base Capacity (vph)	325	611	1271	637	793	2746
Starvation Cap Reductn	0	0	139	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.64	0.80	0.35	0.79	0.46

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues  
4: Sparrow & 4th

2030 PM  
10/12/2009



Lane Group	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Group Flow (vph)	24	9	289	10	899	396	1095
v/c Ratio	0.44	0.09	0.75	0.03	0.36	0.66	0.37
Control Delay	62.0	50.2	18.9	9.4	8.7	14.4	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total Delay	62.0	50.2	18.9	9.4	8.7	14.5	4.2
Queue Length 50th (ft)	12	7	2	2	101	88	140
Queue Length 95th (ft)	39	22	84	12	272	98	78
Internal Link Dist (ft)	36		104		182		370
Turn Bay Length (ft)		50		100		150	
Base Capacity (vph)	138	288	557	369	2512	911	2951
Starvation Cap Reductn	0	0	0	0	0	50	732
Spillback Cap Reductn	0	0	1	0	15	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.03	0.52	0.03	0.36	0.46	0.49

Intersection Summary

Queues  
5: Butler & 4th

2030 PM  
10/12/2009



Lane Group	SEL	SET	NWL	NWT	NEL	NET	SWL	SWT	SWR
Lane Group Flow (vph)	661	752	2	476	99	118	274	35	930
v/c Ratio	0.88	0.43	0.01	0.59	0.41	0.35	0.52	0.05	0.94
Control Delay	45.7	14.3	26.0	27.6	32.9	24.3	19.1	12.8	26.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.7	14.3	26.0	27.6	32.9	24.3	19.1	12.8	26.2
Queue Length 50th (ft)	170	132	1	101	41	37	86	9	152
Queue Length 95th (ft)	#276	180	7	152	88	84	141	25	#474
Internal Link Dist (ft)		721		234		151		406	
Turn Bay Length (ft)	300		50		100		150		
Base Capacity (vph)	757	1754	152	804	311	425	553	924	1088
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.87	0.43	0.01	0.59	0.32	0.28	0.50	0.04	0.85

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.



# APPENDIX D

## Structural Analysis



# APPENDIX E

## Drainage Analysis

# **APPENDIX A**

## **EXISTING CONDITIONS HYDROLOGIC CALCULATIONS**

---

BASIN - 1X



Addlink 10



CP - 1X

BASIN - 2X



Addlink 20



CP - 2X

BASIN - 3X



Addlink 30



CP - 3X

BASIN - 4X



Addlink 40



CP - 4X

BASIN - 5X



Addlink 50



CP - 5X

BASIN - 6X



Addlink 60



CP - 6X

BASIN - ~~7X~~



Addlink 70



CP - 7X

---

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Executive Summary (Nodes) ..... 2.03  
Executive Summary (Links) ..... 2.04

Watershed..... 100  
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\*\*\*\*\* DESIGN STORMS SUMMARY \*\*\*\*\*

City of Flagstaf Design Storms ..... 3.01

\*\*\*\*\* RAINFALL DATA \*\*\*\*\*

TypeII 24hr.... 2  
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TypeII 24hr.... 10  
Synthetic Cumulative Depth ..... 4.03

TypeII 24hr.... 100  
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MASTER DESIGN STORM SUMMARY

Network Storm Collection: City of Flagstaf

Return Event	Total Depth in	Rainfall Type	RNF ID	
2	1.9200	Synthetic Curve	TypeII	24hr
10	2.8800	Synthetic Curve	TypeII	24hr
100	4.5600	Synthetic Curve	TypeII	24hr

MASTER NETWORK SUMMARY  
SCS Unit Hydrograph Method

(\*Node=Outfall; +Node=Diversion;)  
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
BASIN - 1X	AREA	2	.422		12.2500	3.39		
BASIN - 1X	AREA	10	1.001		12.2500	9.16		
BASIN - 1X	AREA	100	2.245		12.2500	21.29		
BASIN - 2X	AREA	2	.298		12.5000	1.87		
BASIN - 2X	AREA	10	.643		12.4000	4.30		
BASIN - 2X	AREA	100	1.344		12.4000	9.25		
BASIN - 3X	AREA	2	.162		12.0500	2.39		
BASIN - 3X	AREA	10	.297		12.0500	4.31		
BASIN - 3X	AREA	100	.547		12.0500	7.71		
BASIN - 4X	AREA	2	.020		11.9500	.35		
BASIN - 4X	AREA	10	.043		11.9500	.77		
BASIN - 4X	AREA	100	.090		11.9000	1.62		
BASIN - 5X	AREA	2	1.387		12.0500	19.45		
BASIN - 5X	AREA	10	2.583		12.0500	36.11		
BASIN - 5X	AREA	100	4.833		12.0500	66.13		

MASTER NETWORK SUMMARY  
SCS Unit Hydrograph Method

(\*Node=Outfall; +Node=Diversion;)  
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
BASIN - 6X	AREA	2	.430		12.1000	5.56		
BASIN - 6X	AREA	10	.886		12.0500	11.78		
BASIN - 6X	AREA	100	1.794		12.0500	23.93		
BASIN - 7X	AREA	2	.042		11.9000	.71		
BASIN - 7X	AREA	10	.066		11.9000	1.09		
BASIN - 7X	AREA	100	.108		11.9000	1.74		
*CP - 1X	JCT	2	.422		12.2500	3.39		
*CP - 1X	JCT	10	1.001		12.2500	9.16		
*CP - 1X	JCT	100	2.245		12.2500	21.29		
*CP - 2X	JCT	2	.298		12.5000	1.87		
*CP - 2X	JCT	10	.643		12.4000	4.30		
*CP - 2X	JCT	100	1.344		12.4000	9.25		
*CP - 3X	JCT	2	.162		12.0500	2.39		
*CP - 3X	JCT	10	.297		12.0500	4.31		
*CP - 3X	JCT	100	.547		12.0500	7.71		
*CP - 4X	JCT	2	.020		11.9500	.35		
*CP - 4X	JCT	10	.043		11.9500	.77		
*CP - 4X	JCT	100	.090		11.9000	1.62		
*CP - 5X	JCT	2	1.387		12.0500	19.45		
*CP - 5X	JCT	10	2.583		12.0500	36.11		
*CP - 5X	JCT	100	4.833		12.0500	66.13		
*CP - 6X	JCT	2	.430		12.1000	5.56		
*CP - 6X	JCT	10	.886		12.0500	11.78		
*CP - 6X	JCT	100	1.794		12.0500	23.93		
*CP - 7X	JCT	2	.042		11.9000	.71		
*CP - 7X	JCT	10	.066		11.9000	1.09		
*CP - 7X	JCT	100	.108		11.9000	1.74		

Type.... Executive Summary (Nodes)  
 Name.... Watershed  
 File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
 Storm... TypeII 24hr Tag: 2

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 Event: 2 yr

NETWORK SUMMARY -- NODES  
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = City of Flagstaf

Storm Tag Name = 2

Data Type, File, ID = Synthetic Storm TypeII 24hr  
 Storm Frequency = 2 yr  
 Total Rainfall Depth= 1.9200 in  
 Duration Multiplier = 1  
 Resulting Duration = 24.0000 hrs  
 Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Node ID	Type	HYG Vol ac-ft	Qpeak Trun. hrs	Qpeak cfs	Max WSEL ft
BASIN - 1X	AREA	.422	12.2500	3.39	
BASIN - 2X	AREA	.298	12.5000	1.87	
BASIN - 3X	AREA	.162	12.0500	2.39	
BASIN - 4X	AREA	.020	11.9500	.35	
BASIN - 5X	AREA	1.387	12.0500	19.45	
BASIN - 6X	AREA	.430	12.1000	5.56	
BASIN - 7X	AREA	.042	11.9000	.71	
Outfall CP - 1X	JCT	.422	12.2500	3.39	
Outfall CP - 2X	JCT	.298	12.5000	1.87	
Outfall CP - 3X	JCT	.162	12.0500	2.39	
Outfall CP - 4X	JCT	.020	11.9500	.35	
Outfall CP - 5X	JCT	1.387	12.0500	19.45	
Outfall CP - 6X	JCT	.430	12.1000	5.56	
Outfall CP - 7X	JCT	.042	11.9000	.71	

Type.... Executive Summary (Links)  
 Name.... Watershed  
 File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
 Storm... TypeII 24hr Tag: 2

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 Event: 2 yr

NETWORK SUMMARY -- LINKS  
 (UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)  
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = City of Flagstaf

Storm Tag Name = 2

Data Type, File, ID = Synthetic Storm TypeII 24hr  
 Storm Frequency = 2 yr  
 Total Rainfall Depth= 1.9200 in  
 Duration Multiplier = 1  
 Resulting Duration = 24.0000 hrs  
 Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Peak Time Trun. hrs	Peak Q cfs	End Points
ADDLINK 10	ADD	UN	.422	12.2500	3.39	BASIN - 1X
		DL	.422	12.2500	3.39	
		DN	.422	12.2500	3.39	CP - 1X
ADDLINK 20	ADD	UN	.298	12.5000	1.87	BASIN - 2X
		DL	.298	12.5000	1.87	
		DN	.298	12.5000	1.87	CP - 2X
ADDLINK 30	ADD	UN	.162	12.0500	2.39	BASIN - 3X
		DL	.162	12.0500	2.39	
		DN	.162	12.0500	2.39	CP - 3X
ADDLINK 40	ADD	UN	.020	11.9500	.35	BASIN - 4X
		DL	.020	11.9500	.35	
		DN	.020	11.9500	.35	CP - 4X
ADDLINK 50	ADD	UN	1.387	12.0500	19.45	BASIN - 5X
		DL	1.387	12.0500	19.45	
		DN	1.387	12.0500	19.45	CP - 5X
ADDLINK 60	ADD	UN	.430	12.1000	5.56	BASIN - 6X
		DL	.430	12.1000	5.56	
		DN	.430	12.1000	5.56	CP - 6X
ADDLINK 70	ADD	UN	.042	11.9000	.71	BASIN - 7X
		DL	.042	11.9000	.71	
		DN	.042	11.9000	.71	CP - 7X

NETWORK SUMMARY -- NODES

(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = City of Flagstaf

Storm Tag Name = 10

Data Type, File, ID = Synthetic Storm TypeII 24hr  
 Storm Frequency = 10 yr  
 Total Rainfall Depth= 2.8800 in  
 Duration Multiplier = 1  
 Resulting Duration = 24.0000 hrs  
 Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Node ID	Type	HYG Vol ac-ft	Qpeak Trun. hrs	Qpeak cfs	Max WSEL ft
BASIN - 1X	AREA	1.001	12.2500	9.16	
BASIN - 2X	AREA	.643	12.4000	4.30	
BASIN - 3X	AREA	.297	12.0500	4.31	
BASIN - 4X	AREA	.043	11.9500	.77	
BASIN - 5X	AREA	2.583	12.0500	36.11	
BASIN - 6X	AREA	.886	12.0500	11.78	
BASIN - 7X	AREA	.066	11.9000	1.09	
Outfall CP - 1X	JCT	1.001	12.2500	9.16	
Outfall CP - 2X	JCT	.643	12.4000	4.30	
Outfall CP - 3X	JCT	.297	12.0500	4.31	
Outfall CP - 4X	JCT	.043	11.9500	.77	
Outfall CP - 5X	JCT	2.583	12.0500	36.11	
Outfall CP - 6X	JCT	.886	12.0500	11.78	
Outfall CP - 7X	JCT	.066	11.9000	1.09	

NETWORK SUMMARY -- LINKS

(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)

(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = City of Flagstaf

Storm Tag Name = 10

Data Type, File, ID = Synthetic Storm TypeII 24hr

Storm Frequency = 10 yr

Total Rainfall Depth= 2.8800 in

Duration Multiplier = 1

Resulting Duration = 24.0000 hrs

Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Peak Time Trun. hrs	Peak Q cfs	End Points
ADDLINK 10	ADD	UN	1.001	12.2500	9.16	BASIN - 1X
		DL	1.001	12.2500	9.16	
		DN	1.001	12.2500	9.16	CP - 1X
ADDLINK 20	ADD	UN	.643	12.4000	4.30	BASIN - 2X
		DL	.643	12.4000	4.30	
		DN	.643	12.4000	4.30	CP - 2X
ADDLINK 30	ADD	UN	.297	12.0500	4.31	BASIN - 3X
		DL	.297	12.0500	4.31	
		DN	.297	12.0500	4.31	CP - 3X
ADDLINK 40	ADD	UN	.043	11.9500	.77	BASIN - 4X
		DL	.043	11.9500	.77	
		DN	.043	11.9500	.77	CP - 4X
ADDLINK 50	ADD	UN	2.583	12.0500	36.11	BASIN - 5X
		DL	2.583	12.0500	36.11	
		DN	2.583	12.0500	36.11	CP - 5X
ADDLINK 60	ADD	UN	.886	12.0500	11.78	BASIN - 6X
		DL	.886	12.0500	11.78	
		DN	.886	12.0500	11.78	CP - 6X
ADDLINK 70	ADD	UN	.066	11.9000	1.09	BASIN - 7X
		DL	.066	11.9000	1.09	
		DN	.066	11.9000	1.09	CP - 7X

Type.... Executive Summary (Nodes)  
 Name.... Watershed  
 File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
 Storm... TypeII 24hr Tag: 100

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 Event: 100 yr

NETWORK SUMMARY -- NODES  
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = City of Flagstaf

Storm Tag Name = 100

-----  
 Data Type, File, ID = Synthetic Storm TypeII 24hr  
 Storm Frequency = 100 yr  
 Total Rainfall Depth= 4.5600 in  
 Duration Multiplier = 1  
 Resulting Duration = 24.0000 hrs  
 Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Node ID	Type	HYG Vol ac-ft	Qpeak Trun. hrs	Qpeak cfs	Max WSEL ft
-----	-----	-----	-----	-----	-----
BASIN - 1X	AREA	2.245	12.2500	21.29	
BASIN - 2X	AREA	1.344	12.4000	9.25	
BASIN - 3X	AREA	.547	12.0500	7.71	
BASIN - 4X	AREA	.090	11.9000	1.62	
BASIN - 5X	AREA	4.833	12.0500	66.13	
BASIN - 6X	AREA	1.794	12.0500	23.93	
BASIN - 7X	AREA	.108	11.9000	1.74	
Outfall CP - 1X	JCT	2.245	12.2500	21.29	
Outfall CP - 2X	JCT	1.344	12.4000	9.25	
Outfall CP - 3X	JCT	.547	12.0500	7.71	
Outfall CP - 4X	JCT	.090	11.9000	1.62	
Outfall CP - 5X	JCT	4.833	12.0500	66.13	
Outfall CP - 6X	JCT	1.794	12.0500	23.93	
Outfall CP - 7X	JCT	.108	11.9000	1.74	

Type.... Executive Summary (Links)  
 Name.... Watershed  
 File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
 Storm... TypeII 24hr Tag: 100

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 Event: 100 yr

NETWORK SUMMARY -- LINKS

(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)  
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = City of Flagstaf

Storm Tag Name = 100

Data Type, File, ID = Synthetic Storm TypeII 24hr  
 Storm Frequency = 100 yr  
 Total Rainfall Depth= 4.5600 in  
 Duration Multiplier = 1  
 Resulting Duration = 24.0000 hrs  
 Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Peak Time hrs	Peak Q cfs	End Points
ADDLINK 10	ADD	UN	2.245	12.2500	21.29	BASIN - 1X
		DL	2.245	12.2500	21.29	
		DN	2.245	12.2500	21.29	CP - 1X
ADDLINK 20	ADD	UN	1.344	12.4000	9.25	BASIN - 2X
		DL	1.344	12.4000	9.25	
		DN	1.344	12.4000	9.25	CP - 2X
ADDLINK 30	ADD	UN	.547	12.0500	7.71	BASIN - 3X
		DL	.547	12.0500	7.71	
		DN	.547	12.0500	7.71	CP - 3X
ADDLINK 40	ADD	UN	.090	11.9000	1.62	BASIN - 4X
		DL	.090	11.9000	1.62	
		DN	.090	11.9000	1.62	CP - 4X
ADDLINK 50	ADD	UN	4.833	12.0500	66.13	BASIN - 5X
		DL	4.833	12.0500	66.13	
		DN	4.833	12.0500	66.13	CP - 5X
ADDLINK 60	ADD	UN	1.794	12.0500	23.93	BASIN - 6X
		DL	1.794	12.0500	23.93	
		DN	1.794	12.0500	23.93	CP - 6X
ADDLINK 70	ADD	UN	.108	11.9000	1.74	BASIN - 7X
		DL	.108	11.9000	1.74	
		DN	.108	11.9000	1.74	CP - 7X

Type.... Network Calcs Sequence  
Name.... Watershed  
File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
Storm... TypeII 24hr Tag: 100

Page 2.07  
Event: 100 yr

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NETWORK RUNOFF NODE SEQUENCE

Runoff Data	Apply to Node	Receiving Link
SCS UH BASIN - 1X	Subarea BASIN - 1X	Add Hyd BASIN - 1X
SCS UH BASIN - 2X	Subarea BASIN - 2X	Add Hyd BASIN - 2X
SCS UH BASIN - 3X	Subarea BASIN - 3X	Add Hyd BASIN - 3X
SCS UH BASIN - 4X	Subarea BASIN - 4X	Add Hyd BASIN - 4X
SCS UH BASIN - 5X	Subarea BASIN - 5X	Add Hyd BASIN - 5X
SCS UH BASIN - 6X	Subarea BASIN - 6X	Add Hyd BASIN - 6X
SCS UH BASIN - 7X	Subarea BASIN - 7X	Add Hyd BASIN - 7X

Type.... Network Calcs Sequence  
Name.... Watershed  
File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
Storm... TypeII 24hr Tag: 100

Page 2.08  
Event: 100 yr

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NETWORK ROUTING SEQUENCE

Link Operation	UPstream Node	DNstream Node
Add Hyd ADDLINK 70	Subarea BASIN - 7X	Jct CP - 7X
Add Hyd ADDLINK 60	Subarea BASIN - 6X	Jct CP - 6X
Add Hyd ADDLINK 50	Subarea BASIN - 5X	Jct CP - 5X
Add Hyd ADDLINK 40	Subarea BASIN - 4X	Jct CP - 4X
Add Hyd ADDLINK 30	Subarea BASIN - 3X	Jct CP - 3X
Add Hyd ADDLINK 20	Subarea BASIN - 2X	Jct CP - 2X
Add Hyd ADDLINK 10	Subarea BASIN - 1X	Jct CP - 1X

Type.... Design Storms  
Name.... City of Flagstaf

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

---

Title... Project Date: 9/21/2009  
Project Engineer: cmj  
Project Title: 4th st  
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File, ID = City of Flagstaf

Storm Tag Name = 2

-----  
Data Type, File, ID = Synthetic Storm TypeII 24hr  
Storm Frequency = 2 yr  
Total Rainfall Depth= 1.9200 in  
Duration Multiplier = 1  
Resulting Duration = 24.0000 hrs  
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 10

-----  
Data Type, File, ID = Synthetic Storm TypeII 24hr  
Storm Frequency = 10 yr  
Total Rainfall Depth= 2.8800 in  
Duration Multiplier = 1  
Resulting Duration = 24.0000 hrs  
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 100

-----  
Data Type, File, ID = Synthetic Storm TypeII 24hr  
Storm Frequency = 100 yr  
Total Rainfall Depth= 4.5600 in  
Duration Multiplier = 1  
Resulting Duration = 24.0000 hrs  
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Type.... Synthetic Cumulative Depth  
 Name.... TypeII 24hr Tag: 2  
 File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
 Storm... TypeII 24hr Tag: 2

Page 4.01  
 Event: 2 yr

CUMULATIVE RAINFALL DEPTHS (in)						
Output Time increment = .1000 hrs						
Time hrs	Time on left represents time for first value in each row.					
.0000	.0000	.0019	.0039	.0059	.0078	
.5000	.0098	.0119	.0139	.0160	.0181	
1.0000	.0202	.0223	.0244	.0266	.0288	
1.5000	.0310	.0332	.0354	.0377	.0400	
2.0000	.0422	.0446	.0469	.0492	.0516	
2.5000	.0540	.0564	.0588	.0613	.0638	
3.0000	.0662	.0688	.0713	.0738	.0764	
3.5000	.0790	.0816	.0842	.0868	.0895	
4.0000	.0922	.0949	.0976	.1004	.1032	
4.5000	.1061	.1090	.1119	.1149	.1179	
5.0000	.1210	.1241	.1272	.1303	.1336	
5.5000	.1368	.1401	.1434	.1468	.1502	
6.0000	.1536	.1571	.1606	.1641	.1677	
6.5000	.1714	.1750	.1787	.1825	.1863	
7.0000	.1901	.1939	.1978	.2018	.2057	
7.5000	.2098	.2138	.2179	.2220	.2262	
8.0000	.2304	.2347	.2392	.2439	.2488	
8.5000	.2539	.2592	.2647	.2703	.2762	
9.0000	.2822	.2884	.2945	.3007	.3068	
9.5000	.3130	.3193	.3259	.3328	.3400	
10.0000	.3475	.3554	.3638	.3726	.3819	
10.5000	.3917	.4020	.4132	.4251	.4378	
11.0000	.4512	.4659	.4825	.5010	.5212	
11.5000	.5434	.5891	.6804	.8271	1.0903	
12.0000	1.2730	1.3094	1.3414	1.3690	1.3923	
12.5000	1.4112	1.4274	1.4426	1.4568	1.4700	
13.0000	1.4822	1.4937	1.5046	1.5150	1.5248	
13.5000	1.5341	1.5429	1.5514	1.5594	1.5671	
14.0000	1.5744	1.5814	1.5883	1.5951	1.6017	
14.5000	1.6083	1.6146	1.6208	1.6269	1.6329	
15.0000	1.6387	1.6444	1.6500	1.6554	1.6607	
15.5000	1.6659	1.6709	1.6758	1.6805	1.6851	
16.0000	1.6896	1.6940	1.6983	1.7026	1.7069	
16.5000	1.7111	1.7152	1.7193	1.7234	1.7274	
17.0000	1.7314	1.7353	1.7391	1.7430	1.7467	
17.5000	1.7504	1.7541	1.7577	1.7613	1.7648	
18.0000	1.7683	1.7718	1.7751	1.7785	1.7818	
18.5000	1.7850	1.7882	1.7913	1.7944	1.7975	
19.0000	1.8005	1.8034	1.8063	1.8092	1.8120	
19.5000	1.8148	1.8175	1.8201	1.8228	1.8253	
20.0000	1.8278	1.8303	1.8328	1.8353	1.8377	
20.5000	1.8402	1.8426	1.8451	1.8475	1.8499	
21.0000	1.8523	1.8547	1.8571	1.8595	1.8618	
21.5000	1.8642	1.8665	1.8689	1.8712	1.8735	

Type.... Synthetic Cumulative Depth  
Name.... TypeII 24hr Tag: 2  
File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
Storm... TypeII 24hr Tag: 2

Page 4.02  
Event: 2 yr

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CUMULATIVE RAINFALL DEPTHS (in)  
Output Time increment = .1000 hrs  
Time on left represents time for first value in each row.

Time hrs					
22.0000	1.8758	1.8781	1.8804	1.8827	1.8850
22.5000	1.8872	1.8895	1.8917	1.8940	1.8962
23.0000	1.8984	1.9006	1.9028	1.9050	1.9072
23.5000	1.9093	1.9115	1.9136	1.9158	1.9179
24.0000	1.9200				

CUMULATIVE RAINFALL DEPTHS (in)  
Output Time increment = .1000 hrs

Time on left represents time for first value in each row.

Time hrs					
.0000	.0000	.0029	.0058	.0088	.0118
.5000	.0148	.0178	.0209	.0240	.0271
1.0000	.0302	.0334	.0366	.0399	.0431
1.5000	.0465	.0498	.0531	.0565	.0599
2.0000	.0634	.0668	.0703	.0739	.0774
2.5000	.0810	.0846	.0883	.0919	.0956
3.0000	.0994	.1031	.1069	.1107	.1146
3.5000	.1185	.1223	.1263	.1302	.1342
4.0000	.1382	.1423	.1464	.1506	.1548
4.5000	.1591	.1635	.1679	.1723	.1769
5.0000	.1814	.1861	.1908	.1955	.2003
5.5000	.2052	.2101	.2151	.2201	.2252
6.0000	.2304	.2356	.2409	.2462	.2516
6.5000	.2570	.2625	.2681	.2737	.2794
7.0000	.2851	.2909	.2968	.3027	.3086
7.5000	.3146	.3207	.3269	.3330	.3393
8.0000	.3456	.3521	.3588	.3659	.3732
8.5000	.3809	.3888	.3970	.4055	.4143
9.0000	.4234	.4326	.4418	.4510	.4602
9.5000	.4694	.4789	.4888	.4992	.5100
10.0000	.5213	.5331	.5457	.5590	.5729
10.5000	.5875	.6031	.6198	.6376	.6566
11.0000	.6768	.6989	.7238	.7514	.7819
11.5000	.8150	.8837	1.0206	1.2407	1.6354
12.0000	1.9094	1.9640	2.0121	2.0536	2.0885
12.5000	2.1168	2.1411	2.1639	2.1852	2.2050
13.0000	2.2234	2.2405	2.2569	2.2724	2.2872
13.5000	2.3011	2.3144	2.3270	2.3391	2.3507
14.0000	2.3616	2.3722	2.3825	2.3927	2.4026
14.5000	2.4124	2.4219	2.4313	2.4404	2.4494
15.0000	2.4581	2.4666	2.4750	2.4831	2.4910
15.5000	2.4988	2.5063	2.5136	2.5207	2.5277
16.0000	2.5344	2.5410	2.5475	2.5540	2.5603
16.5000	2.5666	2.5728	2.5790	2.5851	2.5911
17.0000	2.5970	2.6029	2.6087	2.6144	2.6201
17.5000	2.6257	2.6312	2.6366	2.6420	2.6473
18.0000	2.6525	2.6576	2.6627	2.6677	2.6726
18.5000	2.6775	2.6823	2.6870	2.6916	2.6962
19.0000	2.7007	2.7052	2.7095	2.7138	2.7180
19.5000	2.7221	2.7262	2.7302	2.7341	2.7380
20.0000	2.7418	2.7455	2.7492	2.7529	2.7566
20.5000	2.7603	2.7640	2.7676	2.7713	2.7749
21.0000	2.7785	2.7821	2.7857	2.7892	2.7928
21.5000	2.7963	2.7998	2.8033	2.8068	2.8103

Type.... Synthetic Cumulative Depth

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Name.... TypeII 24hr Tag: 10

Event: 10 yr

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

Storm... TypeII 24hr Tag: 10

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CUMULATIVE RAINFALL DEPTHS (in)  
Output Time increment = .1000 hrs  
Time on left represents time for first value in each row.

Time hrs	-----				
22.0000	2.8138	2.8172	2.8206	2.8241	2.8275
22.5000	2.8309	2.8342	2.8376	2.8409	2.8443
23.0000	2.8476	2.8509	2.8542	2.8575	2.8607
23.5000	2.8640	2.8672	2.8704	2.8736	2.8768
24.0000	2.8800				

Type.... Synthetic Cumulative Depth  
 Name.... TypeII 24hr Tag: 100  
 File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
 Storm... TypeII 24hr Tag: 100

Page 4.05  
 Event: 100 yr

CUMULATIVE RAINFALL DEPTHS (in)						
Output Time increment = .1000 hrs						
Time	Time on left represents time for first value in each row.					
hrs						
.0000	.0000	.0046	.0092	.0139	.0186	
.5000	.0234	.0282	.0331	.0379	.0429	
1.0000	.0479	.0529	.0580	.0632	.0683	
1.5000	.0736	.0788	.0841	.0895	.0949	
2.0000	.1003	.1058	.1114	.1170	.1226	
2.5000	.1283	.1340	.1398	.1456	.1514	
3.0000	.1573	.1633	.1693	.1753	.1814	
3.5000	.1876	.1937	.2000	.2062	.2125	
4.0000	.2189	.2253	.2318	.2384	.2451	
4.5000	.2519	.2588	.2658	.2729	.2800	
5.0000	.2873	.2946	.3021	.3096	.3172	
5.5000	.3249	.3327	.3406	.3486	.3566	
6.0000	.3648	.3731	.3814	.3898	.3984	
6.5000	.4070	.4157	.4245	.4334	.4424	
7.0000	.4514	.4606	.4699	.4792	.4886	
7.5000	.4982	.5078	.5175	.5273	.5372	
8.0000	.5472	.5575	.5682	.5793	.5910	
8.5000	.6031	.6156	.6286	.6420	.6560	
9.0000	.6703	.6849	.6995	.7141	.7287	
9.5000	.7433	.7582	.7739	.7903	.8075	
10.0000	.8254	.8441	.8640	.8850	.9071	
10.5000	.9302	.9549	.9813	1.0096	1.0397	
11.0000	1.0716	1.1066	1.1460	1.1898	1.2379	
11.5000	1.2905	1.3392	1.6159	1.9644	2.5894	
12.0000	3.0233	3.1097	3.1858	3.2515	3.3067	
12.5000	3.3516	3.3901	3.4262	3.4599	3.4913	
13.0000	3.5203	3.5475	3.5734	3.5980	3.6214	
13.5000	3.6434	3.6644	3.6845	3.7036	3.7219	
14.0000	3.7392	3.7559	3.7723	3.7884	3.8041	
14.5000	3.8196	3.8347	3.8495	3.8640	3.8781	
15.0000	3.8920	3.9055	3.9187	3.9316	3.9441	
15.5000	3.9564	3.9683	3.9799	3.9912	4.0022	
16.0000	4.0128	4.0232	4.0335	4.0438	4.0538	
16.5000	4.0638	4.0737	4.0834	4.0931	4.1026	
17.0000	4.1120	4.1213	4.1304	4.1395	4.1485	
17.5000	4.1573	4.1660	4.1746	4.1831	4.1915	
18.0000	4.1998	4.2079	4.2159	4.2239	4.2317	
18.5000	4.2394	4.2470	4.2544	4.2618	4.2690	
19.0000	4.2761	4.2832	4.2900	4.2968	4.3035	
19.5000	4.3101	4.3165	4.3228	4.3290	4.3351	
20.0000	4.3411	4.3470	4.3529	4.3588	4.3646	
20.5000	4.3705	4.3763	4.3821	4.3878	4.3936	
21.0000	4.3993	4.4050	4.4106	4.4163	4.4219	
21.5000	4.4275	4.4331	4.4386	4.4441	4.4496	

Type.... Synthetic Cumulative Depth  
Name.... TypeII 24hr Tag: 100  
File.... P:\2009\09051\HYD\PondPack\prelim.ppw  
Storm... TypeII 24hr Tag: 100

Page 4.06  
Event: 100 yr

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CUMULATIVE RAINFALL DEPTHS (in)  
Output Time increment = .1000 hrs  
Time on left represents time for first value in each row.

Time hrs						
22.0000		4.4551	4.4606	4.4660	4.4714	4.4768
22.5000		4.4822	4.4875	4.4929	4.4982	4.5035
23.0000		4.5087	4.5139	4.5191	4.5243	4.5295
23.5000		4.5346	4.5398	4.5449	4.5499	4.5550
24.0000		4.5600				

.....  
TIME OF CONCENTRATION CALCULATOR  
.....

-----  
Segment #1: Tc: TR-55 Sheet

Mannings n            .2400  
Hydraulic Length    166.00 ft  
2yr, 24hr P         1.9200 in  
Slope                .018000 ft/ft

Avg.Velocity         .10 ft/sec

Segment #1 Time:     .4804 hrs

-----  
Segment #2: Tc: TR-55 Shallow

Hydraulic Length    216.00 ft  
Slope                .019000 ft/ft  
Unpaved

Avg.Velocity         2.22 ft/sec

Segment #2 Time:     .0270 hrs

-----  
Segment #3: Tc: TR-55 Shallow

Hydraulic Length    362.00 ft  
Slope                .155000 ft/ft  
Unpaved

Avg.Velocity         6.35 ft/sec

Segment #3 Time:     .0158 hrs

Type.... Tc Calcs  
Name.... BASIN - 1X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

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Segment #4: Tc: TR-55 Shallow

Hydraulic Length 336.00 ft  
Slope .060000 ft/ft  
Unpaved

Avg.Velocity 3.95 ft/sec

Segment #4 Time: .0236 hrs

-----

=====  
Total Tc: .5468 hrs  
=====

Type.... Tc Calcs  
Name.... BASIN - 1X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

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-----  
Tc Equations used...  
-----

==== SCS TR-55 Sheet Flow =====

$$Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))$$

Where: Tc = Time of concentration, hrs  
n = Mannings n  
Lf = Flow length, ft  
P = 2yr, 24hr Rain depth, inches  
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow =====

Unpaved surface:  
V = 16.1345 \* (Sf\*\*0.5)

Paved surface:  
V = 20.3282 \* (Sf\*\*0.5)

$$Tc = (Lf / V) / (3600sec/hr)$$

Where: V = Velocity, ft/sec  
Sf = Slope, ft/ft  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

.....  
TIME OF CONCENTRATION CALCULATOR  
.....

-----  
Segment #1: Tc: TR-55 Sheet

Mannings n           .2400  
Hydraulic Length    276.00 ft  
2yr, 24hr P         1.9200 in  
Slope                .011000 ft/ft

Avg.Velocity         .09 ft/sec

Segment #1 Time:     .8786 hrs

-----  
Segment #2: Tc: TR-55 Shallow

Hydraulic Length    133.00 ft  
Slope                .211000 ft/ft  
Unpaved

Avg.Velocity         7.41 ft/sec

Segment #2 Time:     .0050 hrs

-----  
Segment #3: Tc: TR-55 Shallow

Hydraulic Length    150.00 ft  
Slope                .080000 ft/ft  
Unpaved

Avg.Velocity         4.56 ft/sec

Segment #3 Time:     .0091 hrs

-----  
Total Tc:            .8927 hrs  
=====

-----  
Tc Equations used...  
-----

==== SCS TR-55 Sheet Flow =====

$$Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))$$

Where: Tc = Time of concentration, hrs  
n = Mannings n  
Lf = Flow length, ft  
P = 2yr, 24hr Rain depth, inches  
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow =====

Unpaved surface:  
 $V = 16.1345 * (Sf**0.5)$

Paved surface:  
 $V = 20.3282 * (Sf**0.5)$

$$Tc = (Lf / V) / (3600sec/hr)$$

Where: V = Velocity, ft/sec  
Sf = Slope, ft/ft  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

Type.... Tc Calcs  
Name.... BASIN - 3X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

.....  
TIME OF CONCENTRATION CALCULATOR  
.....

-----  
Segment #1: Tc: TR-55 Sheet

Mannings n            .1300  
Hydraulic Length    117.00 ft  
2yr, 24hr P         1.9200 in  
Slope                 .034000 ft/ft

Avg.Velocity           .19 ft/sec

Segment #1 Time:     .1724 hrs

-----  
Segment #2: Tc: TR-55 Shallow

Hydraulic Length   1114.00 ft  
Slope                 .052000 ft/ft  
Paved

Avg.Velocity           4.64 ft/sec

Segment #2 Time:     .0668 hrs

-----  
=====  
Total Tc:             .2392 hrs  
=====

Type.... Tc Calcs  
Name.... BASIN - 3X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

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-----  
Tc Equations used...  
-----

==== SCS TR-55 Sheet Flow =====

$$Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))$$

Where: Tc = Time of concentration, hrs  
n = Mannings n  
Lf = Flow length, ft  
P = 2yr, 24hr Rain depth, inches  
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow =====

Unpaved surface:

$$V = 16.1345 * (Sf**0.5)$$

Paved surface:

$$V = 20.3282 * (Sf**0.5)$$

$$Tc = (Lf / V) / (3600sec/hr)$$

Where: V = Velocity, ft/sec  
Sf = Slope, ft/ft  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

Type.... Tc Calcs  
Name.... BASIN - 4X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

.....  
TIME OF CONCENTRATION CALCULATOR  
.....

-----  
Segment #1: Tc: TR-55 Sheet

Mannings n           .1300  
Hydraulic Length    87.00 ft  
2yr, 24hr P        1.9200 in  
Slope               .195000 ft/ft

Avg.Velocity        .36 ft/sec

Segment #1 Time:    .0676 hrs  
-----

Segment #2: Tc: TR-55 Shallow

Hydraulic Length    88.00 ft  
Slope               .102000 ft/ft  
Unpaved

Avg.Velocity        5.15 ft/sec

Segment #2 Time:    .0047 hrs  
-----

=====  
Total Tc:           .0724 hrs  
  
Calculated Tc < Min.Tc:  
Use Minimum Tc...  
Use Tc =            .0833 hrs  
=====

-----  
Tc Equations used...  
-----

==== SCS TR-55 Sheet Flow =====

$$Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))$$

Where: Tc = Time of concentration, hrs  
n = Mannings n  
Lf = Flow length, ft  
P = 2yr, 24hr Rain depth, inches  
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow =====

Unpaved surface:  
 $V = 16.1345 * (Sf**0.5)$

Paved surface:  
 $V = 20.3282 * (Sf**0.5)$

$$Tc = (Lf / V) / (3600sec/hr)$$

Where: V = Velocity, ft/sec  
Sf = Slope, ft/ft  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

.....  
TIME OF CONCENTRATION CALCULATOR  
.....

-----  
Segment #1: Tc: TR-55 Sheet

Mannings n           .1300  
Hydraulic Length    100.00 ft  
2yr, 24hr P        1.9200 in  
Slope                .020000 ft/ft

Avg.Velocity        .15 ft/sec

Segment #1 Time:    .1880 hrs

-----  
Segment #2: Tc: TR-55 Shallow

Hydraulic Length    677.00 ft  
Slope                .056000 ft/ft  
Unpaved

Avg.Velocity        3.82 ft/sec

Segment #2 Time:    .0493 hrs

-----  
Segment #3: Tc: TR-55 Channel

Flow Area           5.0000 sq.ft  
Wetted Perimeter    10.20 ft  
Hydraulic Radius    .49 ft  
Slope                .053000 ft/ft  
Mannings n         .0250  
Hydraulic Length   1052.00 ft

Avg.Velocity        8.53 ft/sec

Segment #3 Time:    .0343 hrs

-----  
=====  
Total Tc:           .2715 hrs  
=====

Type.... Tc Calcs  
Name.... BASIN - 5X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

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-----  
Tc Equations used...  
-----

==== SCS TR-55 Sheet Flow =====

$$Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))$$

Where: Tc = Time of concentration, hrs  
n = Mannings n  
Lf = Flow length, ft  
P = 2yr, 24hr Rain depth, inches  
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow =====

Unpaved surface:  
V = 16.1345 \* (Sf\*\*0.5)

Paved surface:  
V = 20.3282 \* (Sf\*\*0.5)

$$Tc = (Lf / V) / (3600sec/hr)$$

Where: V = Velocity, ft/sec  
Sf = Slope, ft/ft  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

Type.... Tc Calcs  
Name.... BASIN - 5X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

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==== SCS Channel Flow =====

$$R = Aq / Wp$$
$$V = (1.49 * (R^{2/3}) * (Sf^{-0.5})) / n$$
$$Tc = (Lf / V) / (3600\text{sec/hr})$$

Where: R = Hydraulic radius  
Aq = Flow area, sq.ft.  
Wp = Wetted perimeter, ft  
V = Velocity, ft/sec  
Sf = Slope, ft/ft  
n = Mannings n  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

Type.... Tc Calcs  
Name.... BASIN - 6X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

.....  
TIME OF CONCENTRATION CALCULATOR  
.....

-----  
Segment #1: Tc: TR-55 Sheet

Mannings n            .1300  
Hydraulic Length    241.00 ft  
2yr, 24hr P         1.9200 in  
Slope                 .046000 ft/ft

Avg.Velocity           .25 ft/sec

Segment #1 Time:     .2723 hrs  
-----

Segment #2: Tc: TR-55 Shallow

Hydraulic Length    338.00 ft  
Slope                 .047000 ft/ft  
Unpaved

Avg.Velocity           3.50 ft/sec

Segment #2 Time:     .0268 hrs  
-----

=====  
Total Tc:             .2992 hrs  
=====

-----  
Tc Equations used...  
-----

==== SCS TR-55 Sheet Flow =====

$$Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))$$

Where: Tc = Time of concentration, hrs  
n = Mannings n  
Lf = Flow length, ft  
P = 2yr, 24hr Rain depth, inches  
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow =====

Unpaved surface:  
 $V = 16.1345 * (Sf**0.5)$

Paved surface:  
 $V = 20.3282 * (Sf**0.5)$

$$Tc = (Lf / V) / (3600sec/hr)$$

Where: V = Velocity, ft/sec  
Sf = Slope, ft/ft  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

Type.... Tc Calcs  
Name.... BASIN - 7X

File.... P:\2009\09051\HYD\PondPack\prelim.ppw

.....  
TIME OF CONCENTRATION CALCULATOR  
.....

-----  
Segment #1: Tc: TR-55 Sheet

Mannings n            .0110  
Hydraulic Length     84.00 ft  
2yr, 24hr P         1.9200 in  
Slope                 .018000 ft/ft

Avg.Velocity           .99 ft/sec

Segment #1 Time:     .0237 hrs  
-----

Segment #2: Tc: TR-55 Shallow

Hydraulic Length     245.00 ft  
Slope                 .018000 ft/ft  
Paved

Avg.Velocity           2.73 ft/sec

Segment #2 Time:     .0250 hrs  
-----

=====  
Total Tc:             .0486 hrs

Calculated Tc < Min.Tc:  
Use Minimum Tc...  
Use Tc =             .0833 hrs  
=====

-----  
Tc Equations used...  
-----

==== SCS TR-55 Sheet Flow =====

$$Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))$$

Where: Tc = Time of concentration, hrs  
n = Mannings n  
Lf = Flow length, ft  
P = 2yr, 24hr Rain depth, inches  
Sf = Slope, %

==== SCS TR-55 Shallow Concentrated Flow =====

Unpaved surface:

$$V = 16.1345 * (Sf**0.5)$$

Paved surface:

$$V = 20.3282 * (Sf**0.5)$$

$$Tc = (Lf / V) / (3600sec/hr)$$

Where: V = Velocity, ft/sec  
Sf = Slope, ft/ft  
Tc = Time of concentration, hrs  
Lf = Flow length, ft

Index of Starting Page Numbers for ID Names

---

----- B -----

BASIN - 1X... 5.01  
BASIN - 2X... 5.04  
BASIN - 3X... 5.06  
BASIN - 4X... 5.08  
BASIN - 5X... 5.10  
BASIN - 6X... 5.13  
BASIN - 7X... 5.15

----- C -----

City of Flagstaf... 3.01, 4.01,  
4.03, 4.05

----- W -----

Watershed... 1.01, 2.01, 2.02, 2.03,  
2.04, 2.05, 2.06, 2.07

## **APPENDIX B**

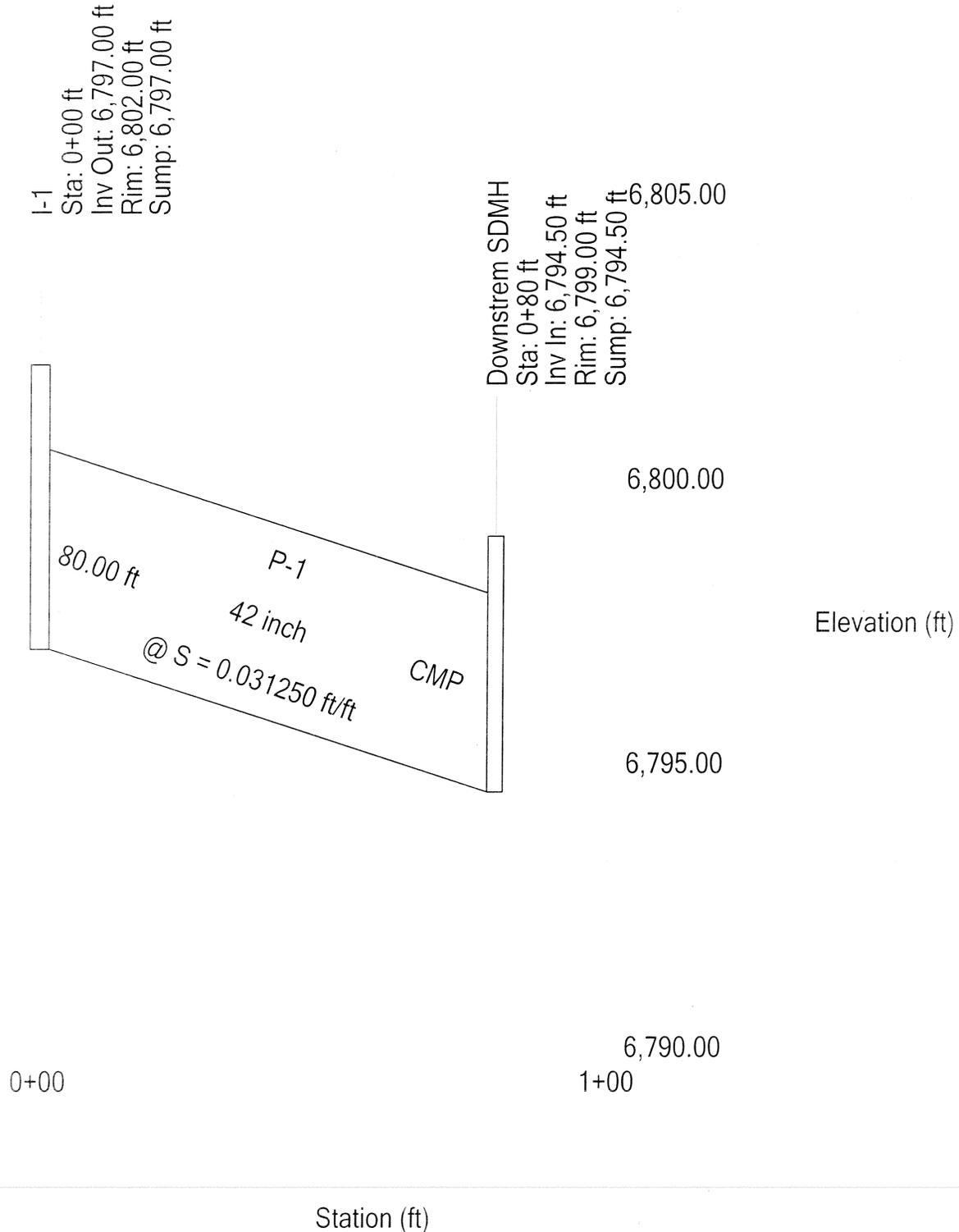
# **SOUTH STORMDRAIN HYDRAULIC CALCULATIONS**

---

Profile  
Scenario: Base

# Profile: Profile - 1

## Scenario: Base



# Calculation Results Summary

=====  
 Scenario: Base

>>> Info: Subsurface Network Rooted by: Downstream SDMH  
 >>> Info: Subsurface Analysis iterations: 1  
 >>> Info: Convergence was achieved.

CALCULATION SUMMARY FOR SURFACE NETWORKS

Label	Inlet Type	Inlet	Total Intercepted Flow (cfs)	Total Bypassed Flow (cfs)	Capture Efficiency (%)	Gutter Spread (ft)	Gutter Depth (ft)	
I-1	Generic Inlet	Generic Default	100%	0.00	0.00	100.0	0.00	0.00

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: Downstream SDMH

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-1	1	42 inch	Circular	80.00	106.00	11.02	6,800.64	6,797.63

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Downstream SDMH	106.00	6,799.00	6,794.50	6,794.50
I-1	106.00	6,802.00	6,800.64	6,800.64

=====  
 Completed: 09/22/2009 02:36:00 AM

**EXHIBIT 1**

**EXISTING CONDITIONS  
DRAINAGE BASIN MAP**

**EXHIBIT 2**

**POST DEVELOPMENT  
DRAINAGE BASIN MAP**

---



# APPENDIX F

## Utility Information

ORDINANCE NO. 1879

AN ORDINANCE GRANTING TO CITIZENS UTILITIES COMPANY, A DELAWARE CORPORATION, ITS LEGAL REPRESENTATIVES, SUCCESSORS, LESSEES AND ASSIGNS, CERTAIN POWERS, LICENSES, RIGHTS-OF-WAY, PRIVILEGES AND FRANCHISE TO CONSTRUCT, OPERATE AND MAINTAIN IN THE CITY OF FLAGSTAFF, STATE OF ARIZONA, AS NOW OR HEREAFTER CONSTITUTED, WORKS, SYSTEMS AND PLANTS FOR THE HANDLING, PRODUCTION, MANUFACTURING, TRANSPORTING, STORING, SALE AND DISTRIBUTION OF GAS INTO, OUT OF, AND THROUGH SAID MUNICIPALITY, AND FOR THE DISTRIBUTION AND SALE OF SUCH GAS TO SAID MUNICIPALITY, ITS INHABITANTS AND OTHERS, INCLUDING CUSTOMERS INSIDE, BEYOND, AND OUTSIDE OF THE LIMITS OF SAID MUNICIPALITY; AND TO USE THE STREETS, AVENUES, EASEMENTS, RIGHTS-OF-WAY, ALLEYS, HIGHWAYS, SIDEWALKS, BRIDGES AND OTHER STRUCTURES AND PLACES AND PUBLIC GROUNDS IN SAID MUNICIPALITY FOR A PERIOD OF TWENTY-FIVE (25) YEARS; AND PRESCRIBING IN CONNECTION THEREWITH CERTAIN RIGHTS, DUTIES, TERMS AND CONDITIONS HEREIN MENTIONED; AND PROVIDING FOR THE PAYMENT TO SAID MUNICIPALITY OF A PERCENTAGE OF CERTAIN REVENUES OF GRANTEE FROM ITS OPERATIONS THEREIN; AND DECLARING AN EMERGENCY.

BE IT ORDAINED BY THE COUNCIL OF THE CITY OF FLAGSTAFF AS FOLLOWS:

SECTION 1: That the City of Flagstaff, a municipal corporation in Coconino County, Arizona, herein called the "Municipality," hereby grants to, and vests in, Citizens Utilities Company, a Delaware corporation, duly authorized to transact within this State a public service business as a gas utility, herein called the "Company," a franchise with the right to operate a gas plant, system, pipelines and works in the Municipality, as now or hereafter constituted, and the authority, license, power and privilege to maintain, construct, build, equip, conduct or otherwise establish and operate in said Municipality, works or systems and plants to manufacture, use, sell, store, distribute, convey or otherwise establish, conduct, serve, supply or furnish the inhabitants of said Municipality and others, and to the Municipality whenever it may desire to contract therefor, gas for light, fuel, power, heat and any and all other useful purposes, and the Company hereby is granted passage, right-of-way and its right to occupy and use in any lawful way during the life of this franchise, every and any and all streets, avenues, alleys, highways, sidewalks, bridges and other

structures of said Municipality, both above and beneath the surface of the same, as said streets, avenues, easements, rights-of-way, alleys, highways, sidewalks, bridges and other structures now exist or may be hereafter extended, for every and any such service, use, effect and lawful purpose as herein mentioned. The Municipality shall not be liable to the Company should the Company construct facilities pursuant to this franchise in any area over which the Municipality has erroneously exercised jurisdiction, except that the Municipality shall reimburse the Company for all fees paid to the Municipality attributable to the sale of gas within the said area.

SECTION 2: The Company is hereby authorized, licensed and empowered to do any and all things necessary and proper to be done and performed in executing the powers and utilizing the privileges herein mentioned and granted by this franchise, provided the same do not unreasonably conflict with water or other pipes, sewers or other pre-existing underground installations, and that all work done in said streets, avenues, easements, rights-of-way, alleys, highways, sidewalks, and bridges of said Municipality by the Company shall be done with the utmost diligence and the least inconvenience to the public or individuals, and the Company shall, within a reasonable time, restore such streets, avenues, easements, rights-of-way, alleys, highways, sidewalks, and bridges excavated by it to their original condition as nearly as practicable, subject to the reasonable approval of the Municipality. The Company will make every effort to coordinate all work with the Municipality. The Company shall remove or relocate its lines and facilities as and when required by the Municipality; such removal or relocation shall be made as follows:

- A. The entire cost of relocation shall be borne by the Municipality if the Company is required by the Municipality to relocate facilities which are located in private easements or rights-of-way obtained by the Company prior to the dedication of the public street, alley or easement from which the facilities must be relocated. These prior rights of the Company would also be unaffected by any subsequent relocation.
- B. Except as covered in Paragraph A above and Paragraph G below, the Company shall bear the entire cost of relocating facilities located on public rights-of-way, the relocation of which is necessary for the Municipality's carrying out a function in the interest of the public health, safety or welfare. The Company's right to maintain its lines and facilities is subject to the paramount right of the Municipality to use its streets for all governmental purposes. Governmental purposes include, but are not limited to, the following functions of the Municipality:
  1. Any and all improvements to Municipality streets, alleys and avenues;

2. Establishing and maintaining sanitary sewers, storm drains, and related facilities;
  3. Establishing and maintaining municipal parks, parkings, parkways, pedestrian malls, or grass, shrubs, trees and other vegetation for the purposes of landscaping any street or public property. The Municipality will consult with the Company on the placement of landscaping in the public rights-of-way where there are existing Company facilities;
  4. Providing fire protection, which will be limited to construction of fire protection facilities and City installed water lines for fire protection purposes;
  5. Collection and disposal of garbage, which will be limited to the construction of collection and disposal facilities and will not apply to placement of dumpsters.
  6. Construction, maintenance and repair of all governmental buildings and facilities.
- C. The installation of pipe and other facilities to serve domestic water shall be considered both governmental and proprietary and, therefore, the actual cost of relocation shall be shared by the Company paying fifty percent (50%) and the Municipality paying fifty percent (50%).
- D. The Company shall bear the entire cost of relocation of existing facilities, irrespective of the function served, where the Municipality's facilities, or other facilities occupying a right-of-way under authority of a Municipality permit or license, are already located in the public right-of-way and the conflict between the Company's potential facilities and existing facilities can only be resolved expeditiously, as determined by the Director of Public Works, by the movement of the existing Municipality's or permittee's facilities.
- E. If the Municipality participates in the cost of relocation of the Company's facilities for any reason, the cost of relocation to the Municipality shall not include any betterment to the Company's facilities as they existed prior to relocation.
- F. The Municipality will not exercise its right to require utility facilities to be relocated in an unreasonable or arbitrary manner. The Company and the Municipality may agree to cooperate on the location and relocation of other facilities in the public right-of-way. The Company shall save the Municipality, its officers and agents, harmless from any and all liabilities proximately caused by the Company's negligence in the erection, construction, installation or operation hereunder of the Company's facilities. The Company shall obtain all necessary permits (without cost to the Company

pursuant to Section 6 hereof) for work in the public rights-of-way. All work in the public rights-of-way will be in compliance with applicable Municipal Codes, standards and regulations as they exist at that time. The Company will obtain, and pay for, all required building permits and buy-in fees for non-gas distribution facilities such as offices, garages, repair shops and like facilities. The Municipality will provide its normal inspection services for these construction projects. The Municipality will not, nor will it be required by the Company to, inspect, monitor or approve construction of any gas distribution facility.

- G. In the event that the Company relocates any of its facilities at the request of the Municipality for a "governmental purpose," as that phrase is defined in Section 2 B hereof, and the Municipality fails to either (1) exercise the function which constitutes such "governmental purpose" or (2) complete the improvement which constitutes such "governmental purpose" within three (3) years of completion of the relocation of the Company's facilities to accommodate such "governmental purpose," the Municipality shall reimburse the Company the entire and actual cost of such relocation within ninety (90) calendar days of such billing.

SECTION 3: The Municipality shall in no way be liable to or responsible for any accident or damage that may occur in the construction, operation or maintenance by the Company of its lines and appurtenances hereunder, and the acceptance of this grant shall be deemed an agreement on the part of the Company to indemnify said Municipality and hold it harmless from and against any and all claims, costs losses or expenses which may accrue to said Municipality as a result of the Company's activities as enumerated in Section 1.

The Company shall maintain throughout the term of this franchise, liability insurance, a program of self-retention or general assets to adequately insure and/or protect the legal liability of the Company with respect to the installation, operation and maintenance of the gas distribution facility, together with all the necessary and desirable appurtenances authorized herein to occupy the public right-of-way. Such insurance, self-retention or general asset program will provide protection for bodily injury and property damage, including contractual liability and legal liability for damages arising from explosion, collapse and underground incidents.

The Company shall file with the Municipality documentation of such liability insurance, self-retention or general asset program within sixty (60) days following the effective date of this franchise, and thereafter upon request of Municipality.

SECTION 4: The rates and charges to be charged by the Company for furnishing gas service hereunder and the rules and regulations to be

made and enforced by the Company for the conduct of its business shall be those from time to time on file and effective with the Arizona Corporation Commission applicable to such service.

SECTION 5: The Company shall have the right and privilege of assigning this franchise and all rights and privileges granted herein, and whenever the word "Company" appears herein, it shall be construed as applying to its successors, lessees, and assigns.

SECTION 6: The Company, its successors, lessees, and assigns, for and in consideration of the granting of this franchise and as rental for the occupation and use or easement over, upon and beneath the streets, avenues, easements, rights-of-way, highways, alleys, sidewalks, and bridges in said Municipality, shall pay to the Municipality, commencing with the first full billing period after the effective date of this franchise and continuing each year during all the time this provision shall remain in force and effect, a total aggregate sum of two percent (2%) of the gross receipts of the Company, its successors, lessees and assigns, during such year, for gas sold within the corporate limits of the Municipality, subject to the limitations hereinafter stated; such gross receipts to consist of the total amount collected from users and consumers on account of gas sold and consumed within the corporate limits of the Municipality under the Company's rates in existence at the time, excepting therefrom, however, the gross receipts for gas sold to industrial consumers under special contract, and the gross receipts for gas sold to the Municipality for its own use. Notwithstanding the provisions of this Section, should the Company enter into any franchise with any entity of this State which provides for a higher percentage of Company gross receipts payment than two percent (2%) the Municipality shall automatically receive the same higher percentage rate payment. The Company shall make such payments semi-annually on or before the last day of January and July in each such year while this provision shall remain in full force and effect. If the Company fails to deposit said fees with the Municipality's finance department by the twentieth (20th) day of the month immediately succeeding the date the fee became due and payable, the Company shall be assessed (i) a ten percent (10%) late fee, and (ii) interest at the rate of twelve percent (12%) per annum on any unpaid balance (exclusive of late fees), said interest being calculated from the first day the payment became due. For the purpose of determining such revenue, the books of the Company shall at all times be subject to inspection by duly authorized municipal officials. Said payments shall be in lieu of any and all other franchise, license, privilege, instrument, occupation, excise or revenue taxes and all other exactions or charges (except general ad valorem property taxes, special assessments for local improvements, and except municipal privilege, sales or use taxes authorized by law and collected by the Company from users and consumers of gas within the corporate limits of the Municipality) upon the business, revenue, property, gas lines, installations, gas systems, conduits, storage tanks, pipes, fixtures or other appurtenances

of the Company and all other property or equipment of the Company, or any part thereof, relating to the sale and distribution of natural gas in said Municipality during the term of this franchise; provided that, anything to the contrary herein notwithstanding, said payment shall continue only so long as said Company is not prohibited from making the same by any lawful authority having jurisdiction in the premises, and so long as the municipality does not charge, levy or collect, or attempt to charge, levy or collect other franchise, license, privilege, occupation, excise or revenue taxes or other exactions or charges hereinabove mentioned, and if any lawful authority having jurisdiction in the premises hereafter prohibits said payment, or the Municipality does levy, charge or collect or attempt to levy, charge or collect such other franchise, license, privilege, occupation, excise or revenue taxes, or other exactions or charges, the obligation to make such payments hereinabove provided for shall forthwith cease.

SECTION 7: This franchise shall be accepted by the Company in writing, which acceptance shall be filed with the Municipality within sixty (60) days after the passage of this Ordinance, and when so accepted, this Ordinance shall be a contract duly executed by and between the Municipality and the Company.

SECTION 8: If any section, paragraph, subdivision, clause, phrase or provision hereof shall be adjudged invalid or unconstitutional, the same shall not affect the validity hereof as a whole, or any part or provision other than the part so decided to be invalid or unconstitutional, except that if Section 6 be adjudged invalid or unconstitutional, in whole or part, this Franchise shall, at the Municipality's option immediately terminate and be of no further force or effect.

SECTION 9: This franchise shall continue in full force and effect for a period of twenty-five (25) years from the date of passage of this Ordinance.

SECTION 10: All plant, system, pipelines, works, and all other physical property installed by the Company in accordance with the terms of this franchise shall be and remain the property of the Company, and upon expiration of this franchise or any extension or renewal thereof, the Company is hereby granted the right to enter upon the streets, avenues, easements, rights-of-way, alleys, highways, sidewalks, bridges and other structures of said Municipality for the purpose of removing any and all such plant, system, pipelines, works and other property of the Company, at any time within six months after termination of this franchise or any such extension or renewal thereof. Upon removal of Company property, the Company shall repair the property of the Municipality per the requirements of Section 2.

SECTION 11: The immediate operation of this Ordinance is necessary for the preservation of the public peace, health and safety of the City of Flagstaff, Arizona, and an emergency is hereby declared to exist and this Ordinance shall be in full force and effect from and after its adoption by the City Council of the City of Flagstaff and its approval by the Mayor thereof.

PASSED AND ADOPTED by the Council and approved by the Mayor of the City of Flagstaff, this 3rd day of October, 1995.

*E. Swan*  
\_\_\_\_\_  
MAYOR

ATTEST:

*Linda Butler*  
\_\_\_\_\_  
CITY CLERK

APPROVED AS TO FORM:

*Joseph L. Bertall*  
\_\_\_\_\_  
CITY ATTORNEY

**CERTIFICATION**

I, LINDA BUTLER, City Clerk of the City of Flagstaff, Arizona, do hereby certify that the attached is a full, true, and correct copy of Ordinance No. 1879, adopted by the Flagstaff City Council at their Meeting held October 3, 1995.

IN WITNESS WHEREOF, I have hereunto set my hand and impressed the official Seal of the City of Flagstaff, this 25th day of October, 1995.

*Linda Butler*  
\_\_\_\_\_  
CITY CLERK

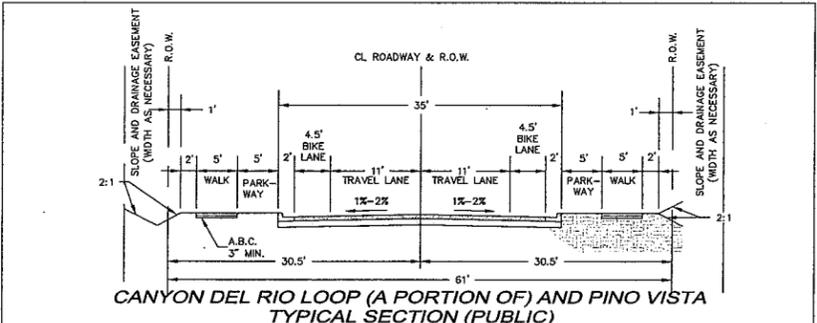
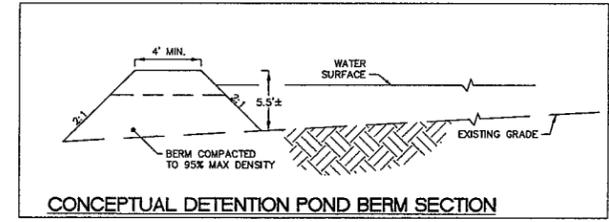
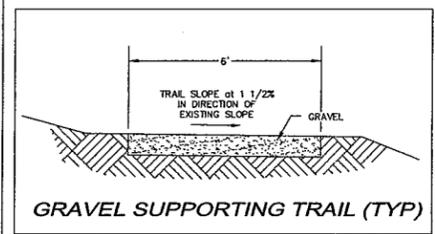
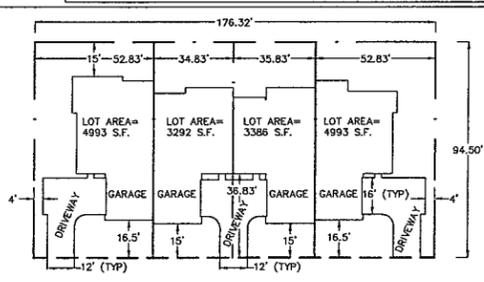
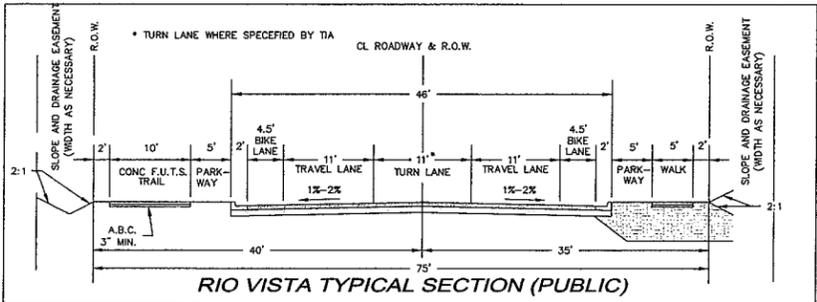
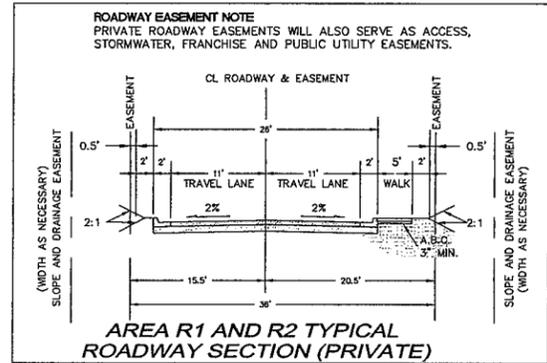
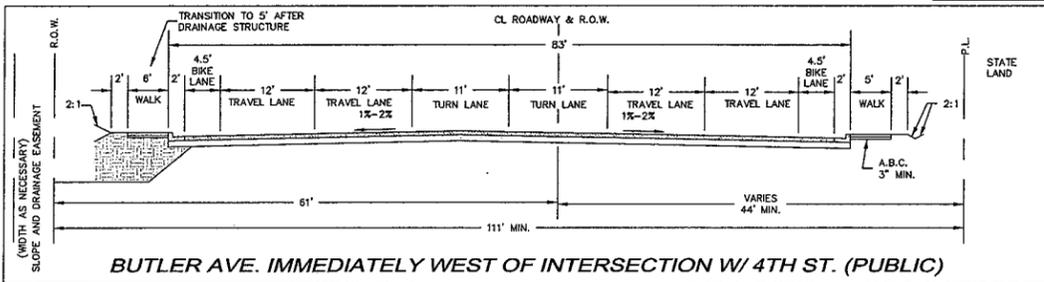
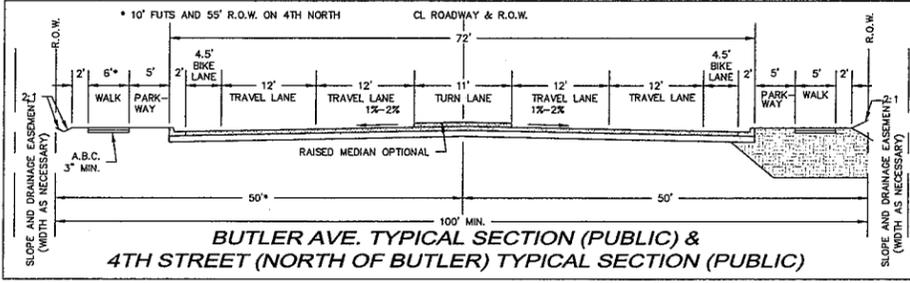
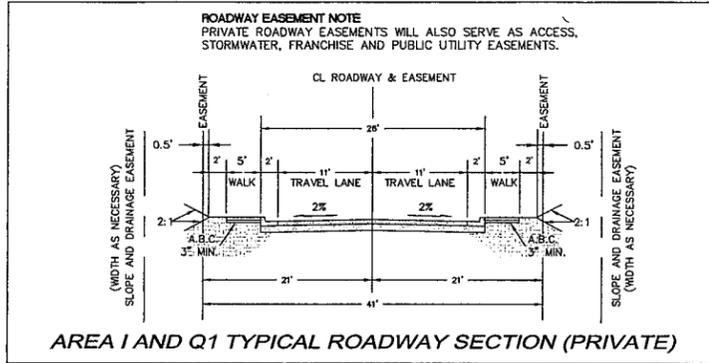
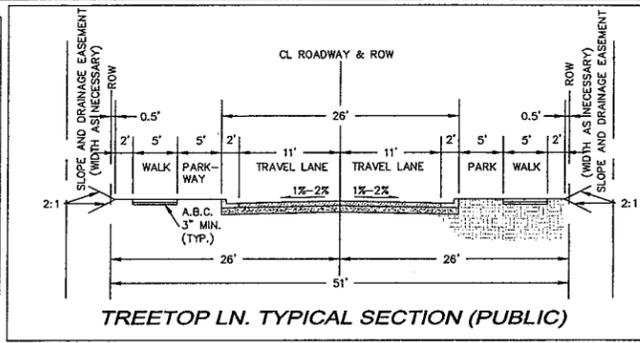
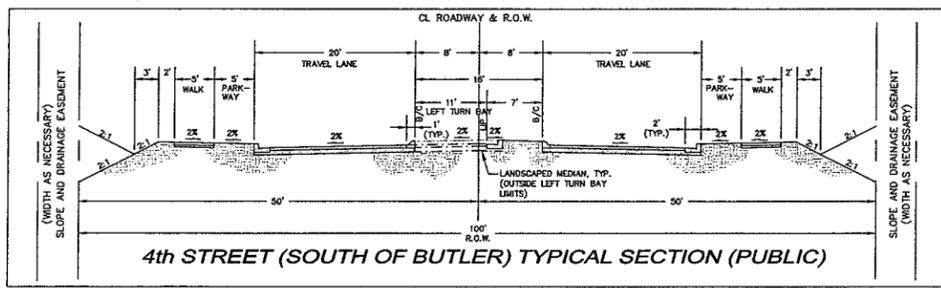
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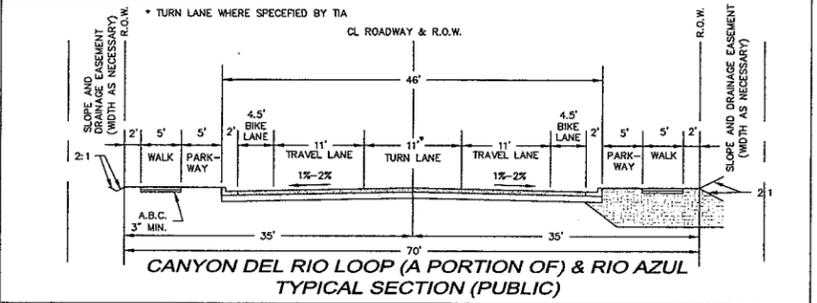
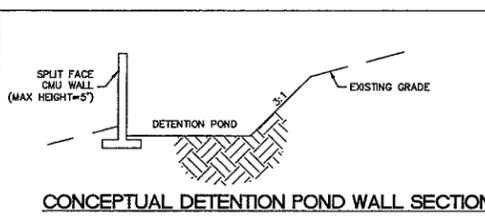
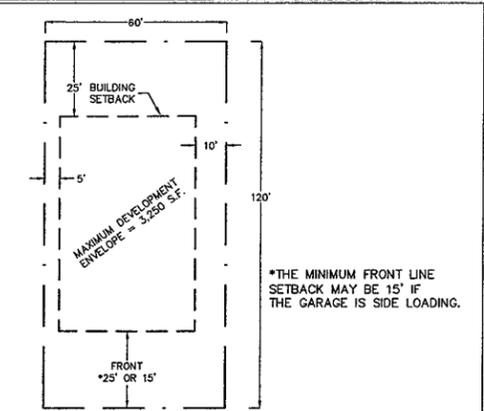
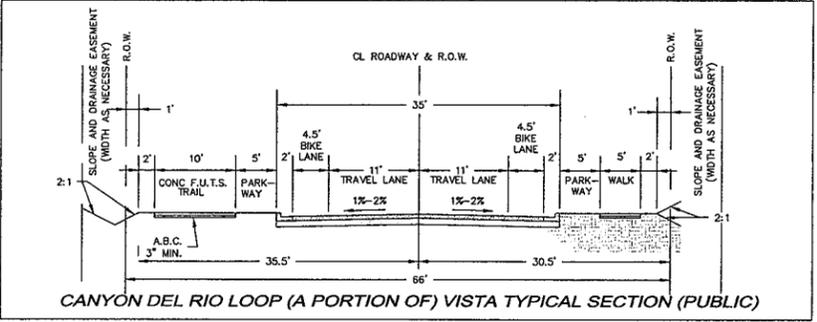
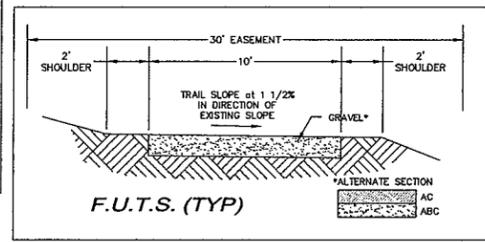
# APPENDIX G

## Butler Avenue Plans and Estimate

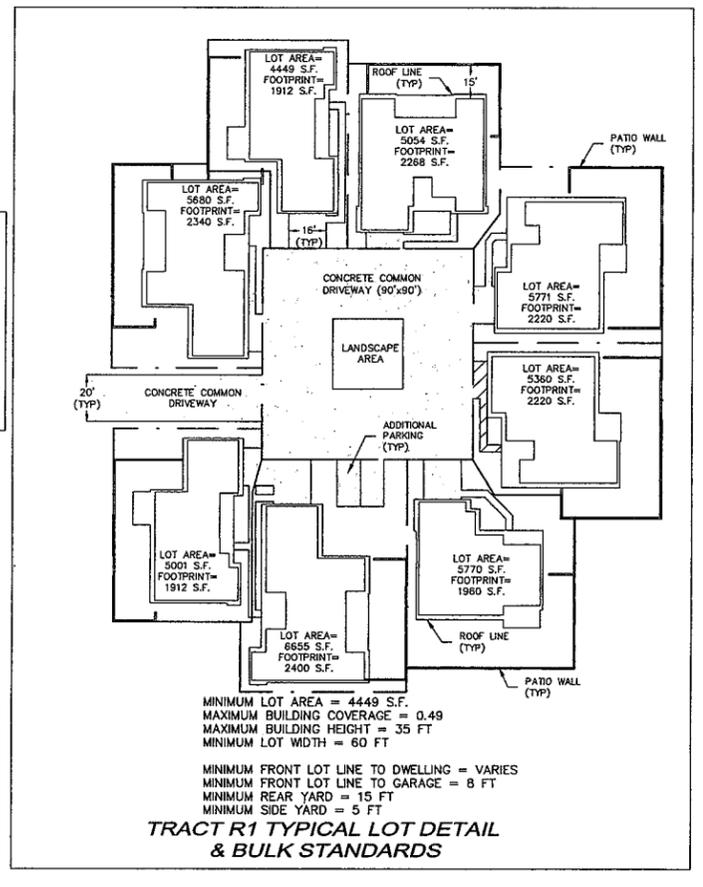
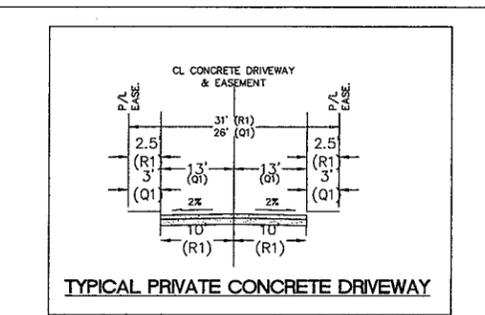




MINIMUM LOT AREA = 4993 S.F.  
MAXIMUM BUILDING COVERAGE = 0.51  
MAXIMUM BUILDING HEIGHT = 35 FT  
MINIMUM LOT WIDTH = 34.83 FT  
MINIMUM FRONT LOT LINE TO DWELLING = 36.83 FT  
MINIMUM FRONT LOT LINE TO GARAGE = 15 FT  
MINIMUM REAR YARD = 15 FT  
MINIMUM SIDE YARD = 4 FT



MINIMUM LOT AREA = 7,000 S.F.  
MAXIMUM BUILDING COVERAGE = 0.35  
MAXIMUM DEVELOPMENT ENVELOPE = 3,250 S.F.  
MAXIMUM BUILDING HEIGHT = 35 FT  
MINIMUM FRONT LOT LINE TO SETBACK = 25 FT OR 15 FT  
MINIMUM REAR YARD = 25 FT  
MINIMUM SIDE YARD = 5 FT OR 10 FT

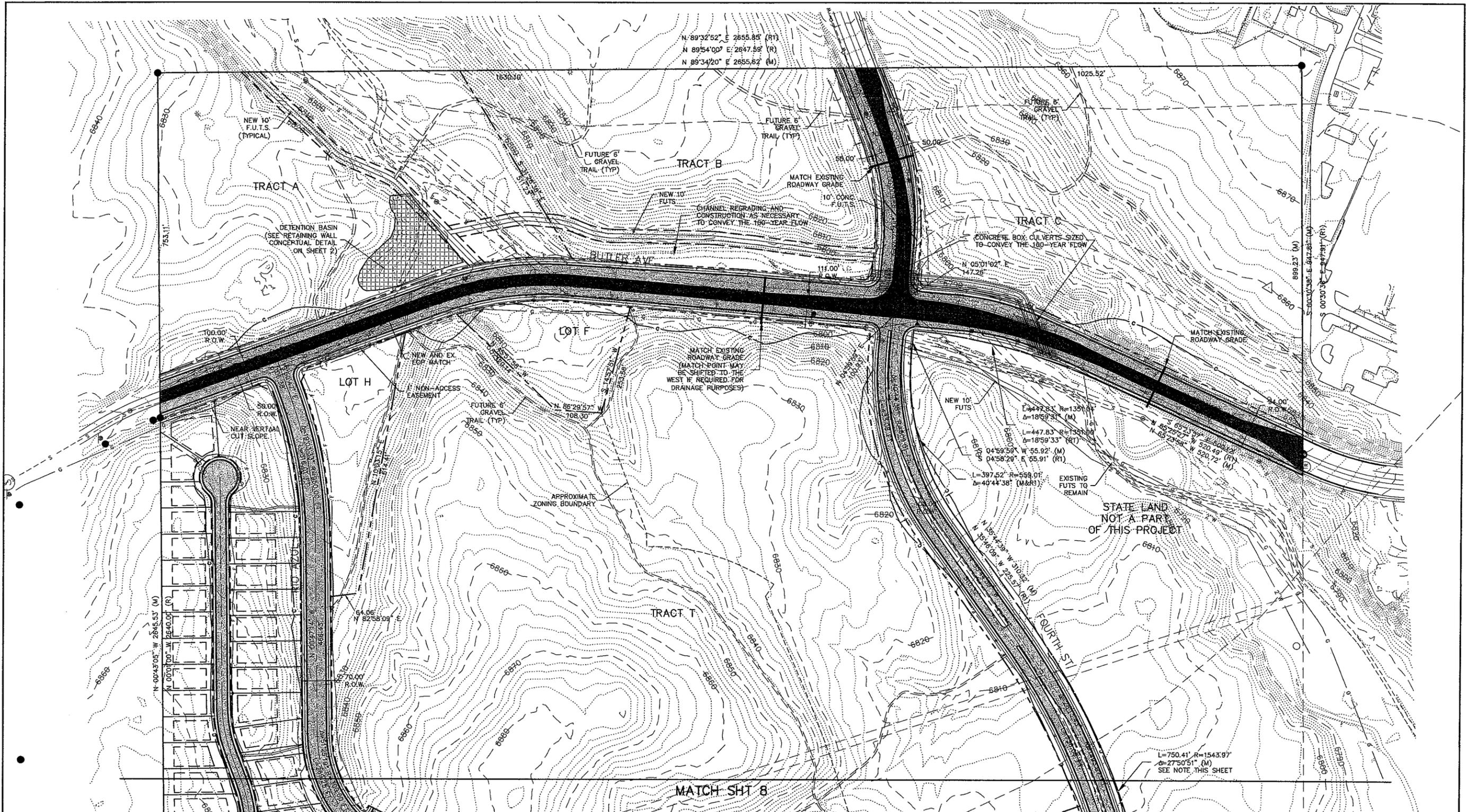


MINIMUM LOT AREA = 4449 S.F.  
MAXIMUM BUILDING COVERAGE = 0.49  
MAXIMUM BUILDING HEIGHT = 35 FT  
MINIMUM LOT WIDTH = 60 FT  
MINIMUM FRONT LOT LINE TO DWELLING = VARIES  
MINIMUM FRONT LOT LINE TO GARAGE = 8 FT  
MINIMUM REAR YARD = 15 FT  
MINIMUM SIDE YARD = 5 FT



FOR AGENCY REVIEW  
NOT FOR BIDDING OR CONSTRUCTION

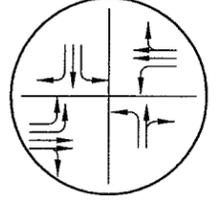
Table with project information including Job No. (02223), Date (12/19/03), Scale (N/A), Drawn (ECB), Design (MAB), and Checked (FBP). Includes company name SHEPHERD - WESNITZER, INC. and project title TENTATIVE PLAT FOR CANYON DEL RIO UNIT 1 TYPICAL ROADWAY SECTIONS AND TYPICAL LOT DETAILS. Includes a revision table and sheet number 2 of 21.



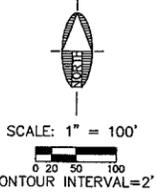
THE PROPOSED 4TH STREET AND BUTLER AVE. INTERSECTION WILL BE RAISED 4.5' TO ACCOMMODATE SIGNALIZED STOP RAMP DESIGN CRITERIA ON 4TH STREET NORTH OF BUTLER. CRITERIA INCLUDES THE FOLLOWING

1. A 35 MPH DESIGN SPEED FOR 4TH.
2. A 45 MPH DESIGN SPEED FOR BUTLER.
3. 3% MAX SLOPE FOR 200' (FROM BUTLER CL) AT THE INTERSECTION ON 4TH.
4. 2% FOR 300' ON BUTLER EACH SIDE OF THE INTERSECTION
5. 6% MAX GRADE ON 4TH AND BUTLER.

THE RAISING OF THE INTERSECTION WILL REQUIRE THAT A PORTION OF EXISTING ASPHALT BE REMOVED ON BOTH 4TH AND BUTLER (SEE PLAN VIEW FOR LOCATION).



**NEW TRAFFIC MOVEMENT PATTERNS AT 4TH AND BUTLER (SIGNALIZED INTERSECTION)**



**FOR AGENCY REVIEW**  
NOT FOR BIDDING OR CONSTRUCTION



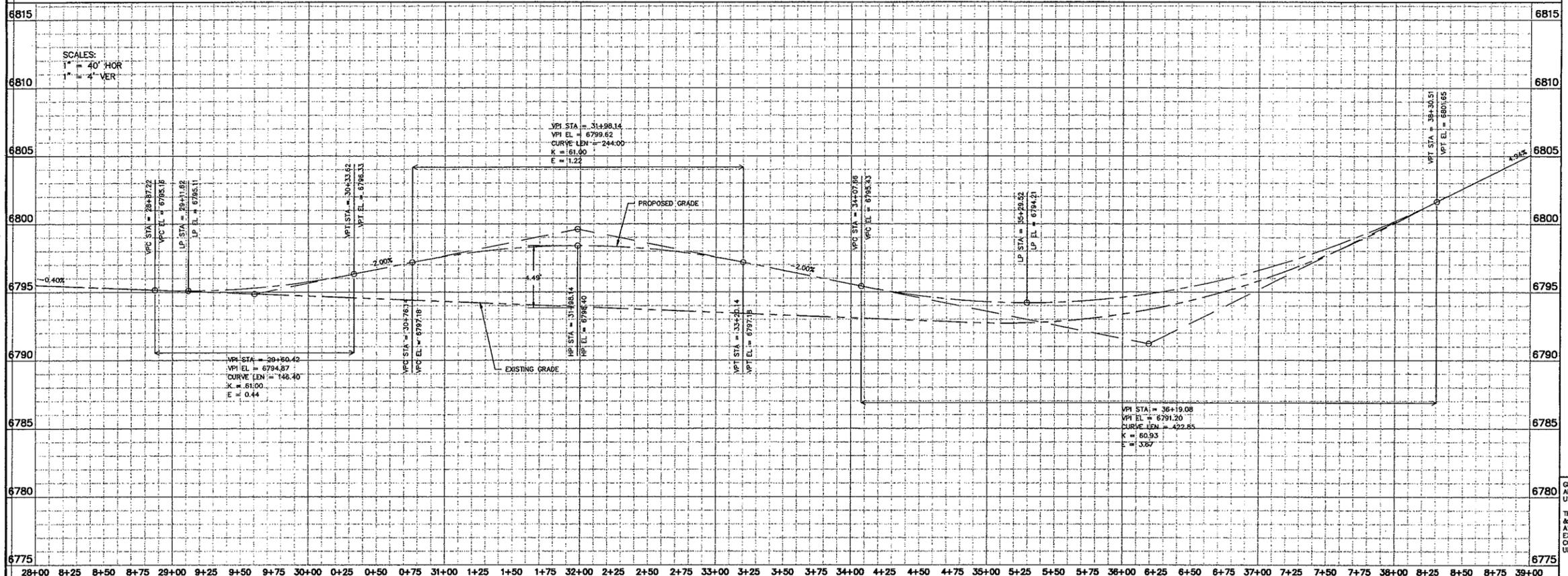
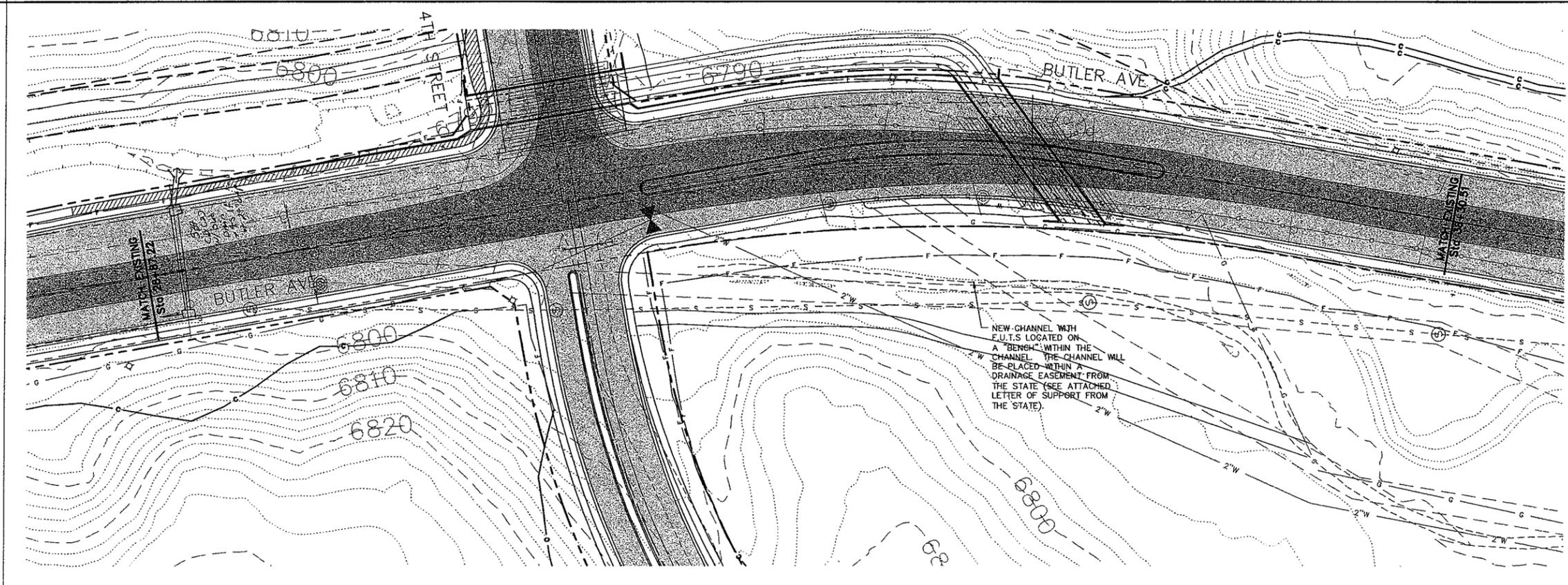
REVISIONS			
NO.	DESCRIPTION	DATE	BY

**SHEPARD - WESNITZER, INC.**  
CIVIL ENGINEERING AND SURVEYING  
110 W. DALE AVE., SUITE 1, FLAGSTAFF, AZ 86001  
(928) 773-0354

JOB NO: 02223  
DATE: 12/18/03  
SCALE: 1"=100'  
DRAWN: ECB  
DESIGN: MJB  
CHECKED: FRP

CACHET HOMES  
FLAGSTAFF AZ  
**TENTATIVE PLAT FOR CANYON DEL RIO UNIT 1**  
SUPPORTING ROADWAY INFRASTRUCTURE NORTH 1/3

SHEET **7**  
OF 21  
TP\_SHT4.dwg



6815  
6810  
6805  
6800  
6795  
6790  
6785  
6780  
6775

28+00 28+25 28+50 28+75 29+00 29+25 29+50 29+75 30+00 30+25 30+50 30+75 31+00 31+25 31+50 31+75 32+00 32+25 32+50 32+75 33+00 33+25 33+50 33+75 34+00 34+25 34+50 34+75 35+00 35+25 35+50 35+75 36+00 36+25 36+50 36+75 37+00 37+25 37+50 37+75 38+00 38+25 38+50 38+75 39+00

SCALES:  
1" = 40' HOR  
1" = 4' VER

PROPOSED GRADE  
EXISTING GRADE

NEW CHANNEL WITH F.U.T.S. LOCATED ON A BENCH WITHIN THE CHANNEL. THE CHANNEL WILL BE PLACED WITHIN A DRAINAGE EASEMENT FROM THE STATE (SEE ATTACHED LETTER OF SUPPORT FROM THE STATE).

BUTLER AVE. PROFILE DESIGN CRITERIA:  
1. Design speed=45 mph  
2. 2% max slope at intersection for 300' (each side of the intersection)  
3. Max roadway slope=6%

GENERAL NOTES:  
ALL STATIONING TO BE SET ALONG THE CENTERLINE OF STREETS, AND WILL BE USED TO DETERMINE THE LOCATION OF FIRE HYDRANTS, CULVERTS, ETC.  
THE INFORMATION ON THESE CONSTRUCTION PLANS CONCERNING THE TYPE, SIZE & LOCATION OF UTILITIES HAS BEEN BASED ON THE BEST INFORMATION AVAILABLE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINATION OF EXACT LOCATION OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO PROTECT ALL EXISTING UTILITIES, IN PLACE, UNLESS OTHERWISE NOTED OR SPECIFIED.

SCALE: 1" = 40'  
0 20 40  
CONTOUR INTERVAL=2'

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File02223

CALL TWO WORKING DAYS BEFORE YOU DIG  
1-800-STAKE-IT

**PRELIMINARY FOR REVIEW ONLY**

REVISIONS			
NO.	DESCRIPTION	DATE	BY

**SHEPARD - WESNITZER, INC.**  
CIVIL ENGINEERING AND SURVEYING  
115 E. GOODWIN STREET, SUITE G, PRESCOTT, AZ 86303  
(928) 541-0443

JOB NO: 02223  
DATE: 9/22/03  
SCALE: AS SHOWN  
DRAWN: MWB  
DESIGN: MWB  
CHECKED: MWB

CACHET HOMES

**BUTLER AVENUE  
PLAN AND PROFILE  
STA 28+00 TO 39+00**

CITY OF FLAGSTAFF  
ARIZONA

SHEET  
**1**  
OF 1