

CHAPTER 2 ALTERNATIVES

The alternatives development and screening process included four steps (**Figure 2-1**). Each step of the process involved analysis, recommendations, and validation from a multidisciplinary study team composed of environmental, engineering, and traffic professionals. UDOT designed each alternative to an extent that allowed for a conceptual assessment of operational performance and impacts.

Chapter 2 documents the process and results for:

- *Alternatives identification,*
- *Preliminary alternatives screening,*
- *Purpose and need screening,*
- *Alternatives comparison, and*
- *Identification of the preferred alternative.*

Figure 2-1: Alternatives Development and Screening Process



2.1 STEP 1: IDENTIFY ALTERNATIVES

Following development of the purpose and need, the study team developed nine build alternatives. In developing the alternatives, the following sources of information were considered:

- The Wasatch Front Regional Council (WFRC)'s *Regional Transportation Plan, 2007-2030* (2030 RTP) (WFRC 2007);
- The Kearns Township General Plan (Kearns 2009); and
- Public comments gathered from the Kearns Township Community Council and a public open house. (Chapter 4 discusses the scoping process.)

2.1.1 No Build Alternative

The No Build Alternative was considered to provide a baseline for evaluating future (year 2040) traffic conditions and for comparing impacts with the other alternatives. Under the No Build Alternative, 5400 South would continue to operate as a five-lane roadway (two travel lanes in each direction with a center turn lane) from 4015 West to 4800 West, and a seven-lane roadway (three travel lanes in each direction

with a center turn lane) from Bangerter Highway to 4015 West (**Figure 1-2** of Chapter 1). It is assumed that improvements planned in the 2030 RTP, other than widening 5400 South, would be implemented. These improvements include widening of 4700 South, 3500 South, 7800 South, State Route [SR]-111, and construction of the Mountain View Corridor (**Figure 1-4** of Chapter 1).¹

Under the No Build Alternative, the intersections at 4015 West and 5400 South, 4220 West and 5400 South, and 4800 West and 5400 South will operate at Level of Service (LOS) E or worse in year 2040 (**Figure 1-6** of Chapter 1). The intersection of 4015 West and 5400 South will act as a bottleneck, allowing only 75 percent of westbound traffic through the intersection. Chapter 1 provides more details regarding the year 2040 No Build traffic conditions.

2.1.2 Build Alternatives

Nine build alternatives were developed that represent a range of roadway improvement options.

- **Alternative 1:** Widen 4700 South to seven lanes (about 135 feet wide) between Bangerter Highway and 4800 West.
- **Alternative 2:** Intersection improvements at 4015 West and 4800 West with associated widening of 5400 South to seven lanes between 4015 West and 4220 West, then transitioning back to the existing roadway cross section from 4220 West to 4800 West.
- **Alternative 3:** Intersection improvements at 4015 West and 4800 West with associated widening of 5400 South to seven lanes between 4015 West and 4220 West. Additional widening of 5400 South between 4220 West and 4800 West to improve shoulders and sidewalks along the corridor.
- **Alternative 4:** Widen 5400 South to seven lanes (about 135 feet wide) on the north side and provide intersection capacity improvements at 4015 West and 4800 West.
- **Alternative 5:** Widen 5400 South to seven lanes (about 135 feet wide) on the south side and provide intersection capacity improvements at 4015 West and 4800 West.
- **Alternative 6:** Widen 5400 South to seven lanes (about 135 feet wide) on the south side from 4015 West to approximately 4620 West and on the north side from 4620 West to 4800 West. Alternative 6 would also provide intersection capacity improvements at 4015 West and 4800 West.
- **Alternative 7:** Widen 5400 South to a standard five-lane cross section (four travel lanes and turn lane that cannot be used as a travel lane) with shoulders and sidewalks (about 110 feet wide) and operate the roadway with Flex Lanes.
- **Alternative 8:** Widen 5400 South to a six-lane cross section (about 120 feet wide with five travel lanes and turn lane that cannot be used as a travel lane) and operate the roadway with Flex Lanes.
- **Alternative 9:** Widen 5400 South to a seven-lane cross section (about 135 feet wide with six travel lanes and a turn lane that cannot be used as a travel lane) and operate the roadway with Flex Lanes.

¹ Year 2040 socio-economic conditions prepared by WFRC were used in the WFRC regional transportation model to predict future traffic conditions. Planned transportation projects from the 2030 RTP were assumed since a plan for year 2040 transportation improvements has not yet been adopted by WFRC.

2.2 STEP 2: PRELIMINARY SCREENING

Preliminary screening was a qualitative step using professional judgment and knowledge of traffic operations in the study area and surrounding region. During this step, the study team determined if the nine alternatives could provide sufficient capacity on 5400 South to meet 2040 traffic demand.

2.2.1 Preliminary Screening Results

Operational performance for Alternative 1, 7, 8, and 9 was derived from the 2040 No Build conditions, and alternative specific modeling was unnecessary. A description of how operational conditions were derived for these alternatives is as follows.

- **Alternative 1:** As discussed in Chapter 1, 2040 No Build traffic conditions assumed 4700 South was already widened to seven lanes as defined in the 2030 RTP. Even with the widening of 4700 South, 5400 South would not operate at an acceptable LOS, as shown in **Figure 1-6** of Chapter 1. Therefore, this alternative was eliminated from consideration.
- **Alternative 7:** The five-lane Flex Lane configuration includes three lanes operating in the peak direction and one lane operating in the non-peak direction, with a center turn lane. As shown in **Figure 1-6** of Chapter 1, under the 2040 No Build conditions the non-peak directional traffic (eastbound) during the PM peak period would operate at LOS E or F. Alternative 7 would reduce capacity in the non-peak direction, and would operate worse than the No Build condition in the non-peak direction. Therefore, this alternative was eliminated from consideration.
- **Alternative 8:** The six-lane Flex Lane configuration includes three lanes operating in the peak direction and two lanes operating in the non-peak direction, with a center turn lane. As shown in **Figure 1-6** of Chapter 1, under the 2040 No Build conditions the non-peak directional traffic (eastbound) during the PM peak period would operate at LOS E or F. Alternative 8 would not increase capacity in the non-peak direction and would operate the same as the No Build condition in the non-peak direction. Therefore, this alternative was eliminated from consideration.
- **Alternative 9:** Seven-lane Flex Lanes (4 travel lanes in the peak direction and 2 travel lanes in the non-peak direction) was eliminated from consideration because the Flex Lanes would provide too much capacity in the peak direction and not enough capacity in the non-peak direction. Additionally, Flex Lanes would increase project costs and add complexity to roadway operations. Alternative 9 would have the same right-of-way requirements as any of the seven-lane alternatives.

2.3 STEP 3: PURPOSE AND NEED SCREENING

Each of the remaining five alternatives was screened to determine if the specific alternative would meet the design year 2040 traffic needs on 5400 South. This step was a quantitative step, using traffic modeling results to support decisions to eliminate or carry forward alternatives.

During this step, the study team applied the screening criteria defined below. If the alternative served the traffic needs defined in the criteria, it was advanced to the next step. An alternative was considered for further analysis only if the alternative met both of the screening criteria.

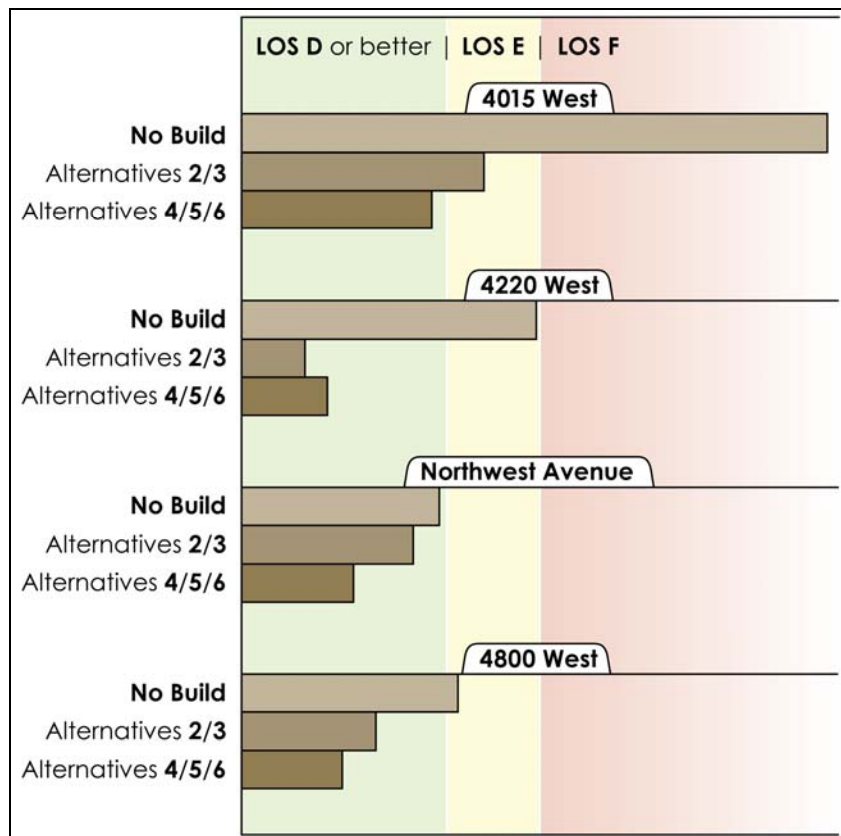
2.3.1 Purpose and Need Screening Criteria

The purpose and need screening criteria were developed to determine if an alternative could improve traffic conditions in support of the proposed project’s primary purpose and need. Screening criteria were defined as follows:

- **Travel Demand:** Would the intersection LOS at all signalized intersections along the corridor operate at LOS D or better?
- **Regional Mobility:** Would the alternative be consistent with the system phasing plan identified in the 2030 RTP and effectively facilitate connections to the rest of the transportation network?

Project-level traffic modeling was conducted for five of the alternatives and the information is documented in the *5400 South – Bangerter Highway to 4800 West Traffic Evaluation & Concept Report* (Avenue Consultants 2011) and summarized in **Figure 2-2**. Alternative 2 and 3 would operate the same and were modeled as one alternative. Alternatives 4, 5, and 6 would operate the same and were modeled as one alternative.

Figure 2-2: Design Year 2040 Level of Service for 5400 South Intersections by Alternative



Source: Avenue Consultants 2011

2.3.2 Purpose and Need Screening Results

Based on the results of the traffic evaluation, it was determined that Alternatives 4, 5, and 6 were the only alternatives that would improve 5400 South operations to LOS D or better at each of the intersections along the corridor. These three alternatives met the traffic demand component of the purpose and need of the proposed project.

It was determined that Alternatives 4, 5, and 6 were the only alternatives that would be consistent with the 2030 RTP system phasing plan and effectively facilitate the connections with the rest of the transportation network by providing the capacity specified in the 2030 RTP. These three alternatives met the regional mobility component of the purpose and need of the proposed project.

Table 2-1 summarizes the purpose and need screening results and justification for screening alternatives.

Table 2-1: Purpose and Need Screening Results Summary

Alternatives Considered	Would the alternative serve traffic demand?	Would the alternative improve regional mobility?	Why Eliminated/ Advanced?	Alternative Advanced?
Alternative 2	No. The intersection of 4015 West and 5400 South would operate at LOS E.	No. The 2030 RTP anticipates widening 5400 South to seven lanes. Providing additional intersection capacity would improve traffic conditions on 5400 South but not to the extent anticipated in the 2030 RTP.	Traffic modeling suggests the alternative would not effectively reduce congestion on 5400 South.	No
Alternative 3	No. The intersection of 4015 West and 5400 South would operate at LOS E.	No. The 2030 RTP anticipates widening 5400 South to seven lanes. Providing additional intersection capacity would improve traffic conditions on 5400 South but not to the extent anticipated in the 2030 RTP.	Traffic modeling suggests the alternative would not effectively reduce congestion on 5400 South.	No
Alternative 4	Yes. 5400 South would operate at LOS D or better.	Yes. Improvements to 5400 South are consistent with the phasing in the 2030 RTP and tie into the regional transportation network.	The alternative would effectively reduce congestion on 5400 South and would improve regional mobility.	Yes
Alternative 5	Yes. 5400 South would operate at LOS D or better.	Yes. Improvements to 5400 South are consistent with the phasing in the 2030 RTP and tie into the regional transportation network.	The alternative would effectively reduce congestion on 5400 South and would improve regional mobility.	Yes
Alternative 6	Yes. 5400 South would operate at LOS D or better.	Yes. Improvements to 5400 South are consistent with the phasing in the 2030 RTP and tie into the regional transportation network.	The alternative would effectively reduce congestion on 5400 South and would improve regional mobility.	Yes

Notes: Shaded cells represent alternatives that were advanced to the next level of screening.

2.4 STEP 4: COMPARATIVE EVALUATION

Following the purpose and need screening process, engineering and environmental considerations defined below were evaluated for each alternative. Alternatives were not eliminated based on poor performance related to any single engineering or environmental issue. Rather the performance of the alternative as a whole was evaluated.

2.4.1 Comparative Evaluation Considerations

2.4.1.1 Engineering Considerations

Engineering considerations are important to maintain operational performance, to maintain Utah Department of Transportation (UDOT) and American Association of State Highway and Transportation Officials (AASHTO) design standards, and to present a constructible improvement. Conceptual designs and engineering judgment were used to evaluate the engineering aspects of the alternatives, with the following topics considered.

- **Design Standards:** Compliance with UDOT and AASHTO standards (e.g., design speed, lane width, shoulder width, grade, cross slope).
- **Roadway Classification:** Removal of accesses to better comply with roadway classification standards. (5400 South is classified as a Category 3 roadway. Standards for this type of facility include no un-signalized intersections, no un-signalized accesses, and half-mile spacing between intersections. The roadway currently does not meet these standards, so proposed project elements that better meet the Category 3 definition were viewed as improvements.)
- **Utility Impacts:** Conflicts with utilities identified on as-built drawings obtained from utility owners.
- **Cost of Construction:** Preliminary engineering cost estimates were used to compare the order of magnitude cost differences between alternatives.

2.4.1.2 Environmental Considerations

Environmental considerations were based on potential impacts the alternative could have on the built environment, and based on public comments indicating important community concerns.

- **Relocations:** The number and type of relocations that would occur in the study area and the resulting effect on the community.
- **Historic Resources:** The number of historic buildings constructed within the historic time period that would be impacted by the project.
- **Community Facilities:** The number of community facilities such as churches, the fire station, and the police station impacted by the project.
- **Economics:** Impacts to the Kearns Township tax base resulting from relocations.

2.4.2 Comparative Evaluation Results

2.4.2.1 Engineering Consideration Results

From an engineering standpoint, Alternative 6 performed the best (**Table 2-2**). Alternative 6 had the lowest cost, eliminated the most accesses along the corridor, had fewer utility impacts, and would comply with UDOT and AASHTO standards. The other two alternatives (Alternative 4 and 5) did not perform as well from the standpoint of cost or elimination of accesses.

Table 2-2: Alternatives Comparison: Engineering Considerations

Alternatives Considered	Design Standards	Roadway Classification	Utility Impacts	Cost of Construction
Alternative 4	Complies with standards.	Eliminates 49 accesses along the corridor, improving consistency with Category 3 classification.	Highest. Impacts to an electrical transmission line.	Highest (baseline + \$7 million)
Alternative 5	Complies with standards.	Eliminates 47 accesses along the corridor, improving consistency with Category 3 classification.	Lowest. Avoids electrical transmission line.	Moderate (baseline + \$4 million)
Alternative 6	Complies with standards.	Eliminates 61 accesses along the corridor, improving consistency with Category 3 classification.	Moderate. Impacts part of the electrical transmission line.	Lowest (baseline cost)

Design Standards

All three alternatives could be designed in accordance with UDOT and AASHTO standards.

Roadway Classification

Alternative 6 would eliminate the most accesses along 5400 South. Elimination of accesses was viewed positively since the new roadway would more closely meet the standards for a Category 3 roadway by improving safety and reducing congestion.

Utility Impacts

There are a number of utilities located within the study area, including electrical (transmission and distribution lines), sewer, water, and gas. The most significant utility impact was relocation of the electrical transmission line. Relocation of the transmission line poles would impact the proposed project’s schedule and cost as well as affect adjacent land owners. Alternative 5 would have the lowest utility impact since it would not impact the transmission lines.

Construction Cost

Preliminary engineering cost estimates were used to compare the order of magnitude cost differences between alternatives. The lowest cost alternative was considered the “baseline cost.” The actual construction cost may vary from the preliminary cost, but the preliminary estimates provided a basis for comparing alternatives. Alternative 6 was less expensive than the other alternatives due to lower right-of-way costs and moderate utility costs.

2.4.2.2 Environmental Consideration Results

Alternative 5 performed the best from an environmental standpoint since there were fewer residential relocations, fewer historic resource impacts, and only one displacement of a community facility (Table 2-3).

Table 2-3: Alternatives Comparison: Environmental Considerations¹

Alternatives Considered	Relocations	Historic Resources	Community Facilities	Economics
Alternative 4	14 Businesses 31 Residences 4 Community Facilities	31 Buildings	Displaces four important community facilities that serve the community.	Displaces 16 businesses.
Alternative 5	14 Businesses 32 Residences 1 Community Facility	32 Buildings	Displaces one community facility that serves the community.	Displaces 16 businesses.
Alternative 6	7 Businesses 54 Residences	54 Buildings	No community facilities would be displaced.	Displaces 9 businesses.

¹ Table results are based on the preliminary design of alternatives. Impacts were identified for comparative purposes. As the design of the preferred alternative has progressed some of the impacts have changed. The actual impacts of the preferred alternative are documented in Chapter 3.

Relocations

Alternative 4 would result in the relocation of properties on the north side of 5400 South. Alternative 5 would result in the relocation of properties on the south side of 5400 South. Alternative 6 would result in relocations on a portion of the north and south sides. Alternative 6 would affect more residences than the other alternatives, but it would affect fewer businesses and avoid major community facilities.

Historic Resources

All of the residences along 5400 South are within the historic time period. Therefore, for purposes of alternatives analysis, all of the residences were considered to be potentially eligible for the National Register of Historic Places. While all of the alternatives would affect historic resources, Alternative 6 would impact substantially more historic resources than Alternative 4 or 5.

Community Facilities

There are five major community facilities along 5400 South in the study area, including three churches that act as important meeting places for the broader community and centrally located police and fire stations that serve the Kearns Township. Alternative 6 was the only alternative that avoided all of these major community facilities

Economics

Kearns Township has a relatively small tax base with a total of 9,800 households and 139 acres of commercial area. Property values in Kearns Township are lower on average than the rest of Salt Lake County. Consequently, tax revenues are lower, but the demand for the provision of services is the same as

in other areas where property values are higher. Further, there are only a few commercially-dedicated areas in Kearns Township, and businesses are the largest contributors to the tax base since they typically provide more tax revenue than they require in Salt Lake County-provided services. Therefore, business relocations could potentially have a larger impact on the Kearns Township tax base than relocation of residential properties. In all, Alternative 6 had the fewest number of business relocations.

2.5 PREFERRED ALTERNATIVE

Of the three remaining alternatives (Alternative 4, 5, and 6), the study team determined that Alternative 6 performed the best from an engineering standpoint, and Alternative 5 performed the best from an environmental standpoint. Ultimately, the study team selected Alternative 6 as the preferred alignment, but modified it by reducing the 135 foot wide cross section to about 100 feet. The reduction in the width of the cross section decreased the number of residential relocations to be more consistent with Alternative 5. This modified version of Alternative 6 was selected as the preferred alternative, and is referred to as the Build Alternative throughout the SES.

The Build Alternative includes widening 5400 South to seven lanes (three travel lanes in each direction, with a center turn lane) with new, wider sidewalks along both sides of 5400 South. Intersection improvements would occur at 4015 West and 5400 South and at 4800 West and 5400 South to increase intersection capacity. Intersection improvements at 4015 West and 5400 South include dual left turns or ThrU-Turns. The ThrU-Turn concept (shown on **Figure 2-3**) would eliminate all left turns at the intersection of 4015 West and 5400 South. Drivers on 5400 South would turn right onto 4015 West, and then make a u-turn at a new signalized intersection on 4015 West. Drivers on 4015 West desiring to make a left turn would continue past 5400 South, then make a u-turn at a new signalized intersection, then make a right turn onto 5400 South. A third u-turn on 5400 South west of 4015 West would provide additional accommodation of westbound to southbound movements and southbound to eastbound movements.

The ThrU-Turn intersection was selected as part of the Build Alternative because it increases intersection efficiency and capacity. The ThrU-Turn intersection provides more green time for the vehicles traveling through the intersection, which decreases congestion, accommodates more vehicles, and reduces overall intersection delays by up to 75 seconds per vehicle. The signals at the u-turn locations are coordinated with the signal at the main intersection, which will function as a system to minimize delays at each intersection.

Additionally the ThrU-Turn reduces potential traffic and safety impacts to the surrounding community by reducing vehicle conflicts and minimizing intersection widths. Concerning motorists, it is reported that 30 percent fewer accidents occur with the implementation of similar intersection solutions, making the ThrU-Turn intersection a safer intersection with fewer vehicle conflicts (FHWA 2009). Concerning pedestrians, minimizing intersection width increases pedestrian safety by reducing the amount of time needed to cross the intersection. Furthermore, vehicles do not turn left through the intersection's crosswalks, providing an even safer experience for pedestrians.

The northern leg of the ThrU-Turn intersection on 4015 West would be located in front of Kearns Junior High School. Although the ThrU-Turn intersection would result in increased traffic volumes near the school, it is anticipated that the intersection would actually increase pedestrian safety at this location

because crosswalks across 4015 West and Sam's Boulevard would be signalized. Students would also have safe and reliable crosswalks with less potential for uncontrolled vehicle conflicts. In combination with crosswalk re-establishment, designated walking routes would be established in coordination with Kearns Junior High School. Additionally, a third leg of the ThrU-Turn intersection has been added on 5400 South to reduce traffic volumes using the northern leg of the ThrU-Turn near the school (see **Figure 2-3**). Overall, it is expected that ThrU-Turn will be a safer intersection for both motorists and pedestrians.

The Build Alternative also includes a new intersection planned at 3900 West and 5400 South to improve accessibility to adjacent land uses. Improvements along the corridor may occur with initial construction or may be phased in at a later date.

The Build Alternative is shown in **Figure 2-3**, and the impacts of the Build Alternative are discussed further in Chapter 3.

Figure 2-3: Proposed Build Alternative

