CHAPTER 5: ALTERNATIVES ANALYSIS

Introduction

This chapter of the Airport Master Plan discusses airport development alternatives considered in the planning process for the Sioux Falls Regional Airport (FSD). Alternatives evaluated for this study are based comparing existing conditions with facility requirements determined from the activity forecast reviewed in detail in the previous chapters. Alternatives found to be reasonable to accommodate the short and long-term needs are identified. Potential impacts of each alternative considered are discussed and used to help the airport select a preferred alternative(s). Alternatives outlined are split into functional facility areas:

- <u>Airfield</u>
- Passenger Terminal
- <u>Air Cargo</u>
- General Aviation
- Landside
- Support Facilities & Other

A <u>Preferred Development Strategy</u> based on the preferred alternatives is identified at the conclusion of the alternatives analysis. This preliminary plan provides a guideline for implementation based on identified needs and priorities. The plan to implement the preferred alternative is reviewed in more detail in **Chapter 6: Implementation Plan**.

Evaluation Process

The overall guiding principle is to provide an airport facility that adequately serves the community needs and is flexible to industry changes. Alternatives must meet FAA design criteria and be implementable with the existing infrastructure and environment. A wide range of alternatives were evaluated to determine the best solution for the airport to meet anticipated needs identified by Planning Activity Level (PAL), which were described in Chapter 4.

The alternative evaluation process includes identifying, evaluating and finally selecting. Alternatives were first identified that meet the facility need and objective(s). "No-action" or "do-nothing" alternatives were considered as well. Next, alternatives were evaluated for their ability to realistically meet the objective along with impacts. Criteria used to evaluate alternatives include operational performance, best planning tenets, environmental and fiscal factors. No weighting factors were used for evaluation as they could have skewed the results. Finally, an alternative was selected that best met the needs of the airport based on the benefits and impacts. The preferred alternative(s) are shaded in green in this report. All costs are planning-level non-engineering estimates in 2014 dollars. Alternatives from one facility area may also have an impact on another facility area so these factors were also considered when compiling one preferred airport development alternative.

The alternatives were reviewed and refined through meetings with airport management and airport focus groups. The preferred alternatives were presented to the general public for review and comment at a public open house held on January 22, 2015. The preferred alternative(s) were presented to the Airport Authority in March 2015 for approval.

Development Considerations

Each functional area of the airport has specific needs and constraints that affect the formulation of realistic, implementable development alternatives. These are discussed in detail within this Chapter; an overarching consideration at FSD is the airport's role within the regional aviation system.

Sioux Falls Regional Airport has growing aviation needs across all operational areas; commercial passenger, air cargo, corporate and small general aviation. Many of these functional areas are in need of additional capacity to accommodate the projected need through the planning period. These expanded areas require additional space in areas that are constrained by airport property and other functional areas.

FSD is unique in that it is the main airport accommodating all types of regional aeronautical needs. A balanced aviation system ideally provides a system of airports serving a large population area that each focus on accommodating one or more functional areas. For a community the size of Sioux Falls, a primary commercial service airport may serve the commercial, cargo and corporate aviation needs while one or more reliever airports would serve smaller general aviation activity. There are currently limited growth opportunities at the smaller general aviation airports in proximity to Sioux Falls. Planning studies were completed in 2007 but efforts to consolidate airports into one regional airport in Lincoln County were unsuccessful.

The highest and best use of FSD is to accommodate commercial aviation activities including passenger, air cargo and corporate business aviation activity. Alternatives evaluation considered development at FSD to fully meet these needs. Although important to the overall area aviation system, the needs of general aviation activities are secondary at FSD and should be accommodated by alternative airports. Development alternatives at FSD should plan for this type of development where possible as to not sacrifice expandability of commercial aviation needs. It is recommended that the FAA continue to evaluate the potential to accommodate small general aviation activity at an alternative airport within the regional aviation system.

Airfield Development Alternatives

The Airfield Development Alternatives reviewed the following infrastructure elements:

- <u>Runway</u>
- Taxiway System
- <u>Airport Traffic Control Tower</u>

Requirements Summary

The airfield is a vital to the airport's core infrastructure to accommodate aircraft operations. The following section summarizes key airfield facility requirement findings:

- The Boeing 767-300ER aircraft type (ARC D-IV, TDG-5) is expected to remain the critical design aircraft through PAL 4.
- No runway extension or configuration modifications to air carrier runway ends are needed to meet length and capacity needs based on forecasted operations.
- Runway hourly capacity enhancements such as holding bays and/or bypass taxiways may be necessary by PAL 3 and should be planned to enhance aircraft sequencing.
- Enhancements to Runway 3-21 and 15-33 approach procedures to increase airport operational utility in instrument meteorological conditions should be evaluated considering the surrounding built and natural environment.
- Runway 9-27 is not required for wind coverage and should be considered for decommissioning.
- Targeted runway improvements including blast pads and paved shoulders are needed to meet current design standards for both air carrier runways.

Runways

An evaluation of development alternatives to accommodate the airfield facility requirements for each of the FSD runways is described in the following sections.

RUNWAY 3-21

Configuration

The primary air carrier runway, Runway 3-21, is of sufficient length, width and strength to accommodate regular use of the design aircraft. An 8,999 foot runway length will accommodate the intended use of the design aircraft, a Boeing 767-300F with ARC D-IV standards without major restrictions. The runway ends are constrained by natural and man-made environmental features. The airport views the potential impacts of a runway extension to outweigh the potential benefits, thus it will not be evaluated at this time. No change in runway length, width or strength is recommended thus no alternatives were evaluated.

Constructing 25-foot wide paved shoulders along the sides of the runway and upgrading blast pads for the current runway configuration is a targeted improvement to meet FAA design standards. The nobuild alternative would not allow the runway to meet minimum FAA design standards for the critical design aircraft and is not recommended. Another targeted improvement to upgrade the Runway 21 visual guidance slope indicator (VGSI) to a Precision Approach Path Indicator (PAPI) should also be incorporated.

Table 5-1 – Targeted Runway 3-21 Recommendations

Runway	Improvement
3-21	25' Paved Runway Shoulder
3, 21	200' x 200' Paved Blast Pad
21	Upgrade VGSI to PAPI

Source: KLJ Analysis

Approaches

Recommended improvements include upgrading the approach to a Category II ILS to achieve lower weather minima which increases airport utility. The options include upgrading the Runway 3 or 21 ends, or do nothing. It is assumed that one runway end can be upgraded due to available funding and justification. If no action is taken then aircraft would not be able to land at FSD 0.7 percent of the time, or about 61 hours per year. Flights would be cancelled or have to divert to alternative airports resulting in additional operator costs. The number of qualifying instrument approaches could justify a Category II ILS approach near PAL 3.

Alternative 1: Upgrade Runway 3 End

Runway 3 is the runway end that is able to accommodate the greatest percentage of arrivals during instrument meteorological conditions based on wind conditions. The runway can accommodate more than 65 percent of arrivals with a maximum crosswind component of 20 knots. Upgrading Runway 3 from a Category I ILS (2400 RVR) to a Category II ILS approach would require the following facility improvements:

- Upgrade Approach Lighting System to ALSF-2 located within airport property near golf course. Light stations are located every 100 feet along centerline.
- Install touchdown zone lighting.
- Install additional midfield RVR equipment 400 feet from runway centerline.
- Locate rollout RVR equipment 400 feet from runway centerline.
- Ideally, acquire control over approximately 11 acres of land for approach lighting system over city golf course property. Proposed land exchange rights should be sufficient for the footprint of the lighting system.

The estimated infrastructure (non-land) cost to upgrade the Runway 3 end is \$5.3 million.

Figure 5-1 – Upgrade Runway 3 End Exhibit



Source: KLJ Analysis, Google Earth

Alternative 2: Upgrade Runway 21 End

Runway 21 accommodates the lowest percentage of arrivals during instrument meteorological conditions based on wind conditions. The runway can accommodate less than 40 percent of arrivals with a maximum crosswind component of 20 knots. Upgrading Runway 21 from a Category I ILS (1800 RVR) to a Category II ILS approach would require the following facility improvements:

- Upgrade Approach Lighting System to ALSF-2 located within airport and city owned property. Light stations are located every 100 feet thus may require one to be placed in the Big Sioux River.
- Install additional midfield RVR equipment 400 feet from runway centerline.
- Locate Runway 21 glideslope antenna and RVR equipment 400 feet from runway centerline.
- Ideally, secure control over approximately 9 acres of land for approach lighting system over city property. The existing approach lighting system is located on this same land and the footprint is similar to the existing system.

The estimated infrastructure (non-land) cost to upgrade the Runway 21 end is \$4.8 million.

Figure 5-2 – Upgrade Runway 21 End Exhibit



Source: KLJ Analysis, Google Earth

Preferred Alternative

The preferred alternative is to plan to upgrade the Runway 3 end for Category II ILS approach because of its ability to maximize wind coverage with acceptable impacts. To provide a flexible plan however, the Airport Layout Plan will show both ends to be capable of accommodating Category II ILS approaches with minimums as low as 1200 RVR within the intent that one runway end would be upgraded.

Table 5-2 – Runway 3-21 Approach Alternative Evaluation

Alternative	Actions Strengths		Actions Strengths		Weaknesses	Relative Ranking
No Build	No Action	• Minimizes cost	 Instrument approach capacity constraints remain 	3		
1	Upgrade Runway 3 to CAT II ILS (1200 RVR)	 Better utilization with wind coverage Lower visibility minimums remain on opposite runway end (Runway 21: 1800 RVR) 	 Requires additional in- pavement lighting Lighting upgrades located adjacent to golf course Higher estimated project cost (\$5.3 million) 	1		
2	Upgrade Runway 21 to CAT II ILS (1200 RVR)	 Utilizes existing in-pavement navigational aids Lower estimated project cost (\$4.8 million) 	 Less wind coverage Requires relocation of additional navigational aids Higher visibility minimums on opposite runway end (Runway 3: 2400 RVR) Approach lighting system upgrades over Big Sioux River will require additional environmental review 	2		

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

Exhibit 5-1: Airfield (Runway) Development on Page 5-18 graphically depicts the preferred alternative.

Land Use

FAA land use standards should be met for all runways. Once a proposed land exchange is completed¹, the airport will have obtained a full land use and/or airspace easement within and adjacent to the inner Runway 3 precision approach. This will meet design standards for adequate control within the FAA's Runway Protection Zone (RPZ). A land use and/or airspace easement will also be acquired for portions of the Runway 21 RPZ and adjacent property.

To meet FAA design standards, the Airport should control property over approximately 7 acres of land within the Runway 21 RPZ, on the east side of Minnesota Avenue. Existing structures including the United States Postal Service facility can remain, consistent with FAA's RPZ policy. It should be noted however a displaced threshold of 450 feet resulting in a reduced Runway 21 landing distance available of 8,549 feet would remove the approach RPZ from this land use.

A no action alternative may put the airport at risk for additional development in this area incompatible to airports. The preferred alternative to control land use in the local area from new incompatible land uses is to enact a comprehensive, multi-jurisdictional airport overlay zoning ordinance or purchase an avigation land use easement restricting further incompatible development.



Figure 5-3 – Runway 21 Land Use Exhibit

Source: KLJ Analysis, Google Earth

¹ Proposed land exchange between the Sioux Falls Regional Airport Authority and the City of Sioux Falls (2013). Exchange would transfer 64.7 acres of property to City, 4.2 acres to Airport, RPZ & Approach Zone Avigation Easements to Runway 3/21 to Airport, Access Easement to City.



Source: KLJ Analysis, Google Earth

Airspace

Airspace should be maintained to be compatible with <u>FAA Advisory Circular 150/5300-13A</u> airport design standards and free of new obstructions. Obstructions are in process of removal within the Runway 3 inner FAR Part 77 approach and transitional surfaces. New airspace easements will be acquired to control new airspace obstructions. The minimum FAA 34:1 approach surface is now clear as of October 2014. The newly realigned private airport perimeter road will be the controlling object clearing a 34:1 slope.

Obstructions to the Runway 21 approach surface should undergo an FAA aeronautical study with an airspace easement acquired in land use control areas. Trees currently penetrate the minimum 34:1 approach surface, providing a clear 26:1 approach surface. Obstructions deemed a hazard to air navigation should be lowered, lighted or removed. A mobile object on the BNSF railroad tracks and transmission towers penetrate the Part 77 50:1 approach surface, and provides a clear 36:1 approach. A FAA study will be requested in the Airport Layout Plan to determine further action with any obstructions.

An one-engine inoperative surface should be considered for evaluating new airspace obstructions as not to create new air carrier aircraft operational restrictions. Utilizing previous FAA national policy, the one-engine departure surface allows for a clear 50:1 surface for Runway 3 departures outside of the inner approach objects. The critical objects are power poles. Runway 21 departures are provided a clear 45:1 departure surface. The critical objects are trees.

An FAA proposed policy may allow FSD to develop its own one-engine inoperative surface for FAA review and approval. The Airport should coordinate with critical operators and incorporate a standard into the existing zoning ordinance. Roadway development at intersection of Minnesota Avenue and 60th Street West and the D&I railroad should be monitored in the Runway 3 departure zone. A 60th Street bridge and light poles providing grade separation over the D&I railroad would likely clear a 50:1 clear surface, less than the previous FAA standard of 62.5:1. An at-grade railroad crossing would likely not cause any new impacts. No roadway option has been selected by the City of Sioux Falls at this time. No action to prevent new obstructions could jeopardize the utilization and investment in Runway 3-21. Further evaluation is required by the Airport and FAA to determine impacts and design standards prior to roadway project design.

The preferred alternative to control airspace in the local area from new incompatible land uses is to enact a comprehensive, multi-jurisdictional airport overlay zoning ordinance which protects critical airspace surfaces.

RUNWAY 15-33

Configuration

Runway 15-33 is considered the secondary air carrier runway at FSD with a length of 8,000 feet. The runway does see use from critical Design Group IV aircraft for air cargo and very common use from Design Group III aircraft from the passenger airlines. Overall, Runway 15-33 has about 1.7 percent better all-weather wind coverage than Runway 3-21 with a maximum crosswind component of 20 knots. The existing runway length, width and strength is capable of accommodating the critical aircraft during most operations. A runway extension or development to enhance this runway to the primary air carrier runway is limited by natural and man-made environmental constraints. A review of design standards to this secondary runway was completed.

There were two configuration alternatives for Runway 15-33 evaluated. Design Group IV aircraft include the Airbus A300-600F, Boeing 767-300F and Boeing 757 aircraft regularly operated by cargo aircraft. Design Group III aircraft include most mainline air carrier aircraft including the Airbus A-320 and MD-80 series aircraft.

Alternative 1: Maintain Design Group IV Standards

To maintain Runway 15-33 to Design Group IV standards a 25-foot wide paved shoulder is required. This runway would continue to be available to the overall FSD critical design aircraft.

Alternative 2: Design Group III Standards (>150,000 lbs.)

Downgrading Runway 15-33 to Design Group III standards would limit operations in larger aircraft that may need the runway during strong crosswind conditions. Paved shoulders are recommended but not required for a Design Group III runway.

Alternative 3: Design Group III Standards (<150,000 lbs.)

If the maximum certificated takeoff weight of Design Group III aircraft is limited to 150,000 pounds with approach visibility minimums as low as ³/₄ mile, then the runway width standard is 100 feet, recommended paved shoulder width is 20 feet and runway blast pad width is 140 feet. Aircraft would be limited to 150,000 pounds which would further reduce the utility of the runway. Operations would generally be limited to 70-90 seat regional jet aircraft. Design standards do not appreciable reduce and operational limitations increase.

Preferred Alternative

Because of the enhanced wind coverage with prevailing northwest winds, Runway 15-33 is recommended to remain as a Design Group IV runway with the existing runway length, width and pavement strength. This will provide continued operational and safety benefits.

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Minimizes cost	• Runway would not meet all FAA standards for critical aircraft	2
1	Maintain Design Group IV Standards	 Accommodates overall design aircraft Maximizes airport utilization during prevailing winds 	• Requires additional investment and maintenance costs	1
2	Design Group III Standards (>150,000 lbs.)	-Reduces ongoing airport maintenance cost	• Reduces airport utility by limiting aircraft weight	3
3	Design Group III Standards (<u><</u> 150,000 lbs.)	• Reduces ongoing airport maintenance cost	 Minimizes airport utility of all alternatives by limiting aircraft weight Requires edge lighting relocation 	4

Table 5-3 – Runway 15-33 Design Standard Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

Constructing 25-foot wide paved shoulders along the sides of the runway and upgrading the Runway 33 blast pad for the current runway configuration is a targeted improvement to meet FAA design standards for ARC D-IV aircraft. The no-build alternative would not allow the runway to meet minimum FAA design standards for the critical design aircraft and is not recommended.

Table 5-4 – Targeted Runway 15-33 Recommendations

Runway	Improvement
15-33	25' Paved Runway Shoulder
33	200' x 200' Paved Blast Pad
33	Object Free Area Mitigation
	(see below)

Source: KLJ Analysis

Exhibit 5-1: Airfield (Runway) Development on Page 5-18 graphically depicts the preferred alternative.

Runway 33 Object Free Area

The Runway Object Free Area (ROFA) to Runway 33 end contains the airport perimeter fence and roadway (Minnesota Avenue) that are normally incompatible land uses. These objects limit the compliant OFA to about 750 feet beyond the Runway 33 end where 1,000 feet is required. Two options were evaluated to mitigate incompatibilities without modifying the runway end location. Options to modify the runway would reduce runway length, have sizeable runway utility and/or environmental impacts thus were not considered.

Alternative 1: Request FAA Modification of Standards

The airport perimeter fence was recently relocated as part of an FAA-funded project to the edge of the Minnesota Avenue right-of-way. It cannot be located further away from the runway end without roadway realignment. This alternative maintains the compliant OFA distance to 700 feet beyond Runway 15 departure end. A portion of the fence and Minnesota Avenue still run through the OFA. This alternative allows the airport to make improvements to best mitigate considering existing constraints and not affecting Runway 15-33 operations. No other build alternative exists without major reconfiguration. This would provide an acceptable level of safety as this condition has been in use without an accident or incident since 2003 when Runway 15-33 was extended. A FAA Modification of Standards would be submitted to FAA for review and approval.

Alternative 2: Implement Declared Distances

Declared distances are operational restrictions used to mitigate incompatibilities to airspace and/or land use. Operational restrictions would allow for a full ROFA. The Accelerate Stop Distance Available (ASDA) and Landing Distance Available (LDA) for Runway 15 would be reduced from 8,000 feet to 7,700 feet. These declared distances would be published in aeronautical documents for pilots.



Figure 5-5 – Runway 33 OFA Exhibit

Source: KLJ Analysis, Google Earth

Preferred Alternative

The preferred alternative is Alternative 1 to submit a Modification of Standards form to FAA for review and approval. Alternative 2 (Implement Declared Distances) would be implemented only if Alternative 1 is found not to be acceptable.

Alternative	Actions Strengths		Actions Strengths		Weaknesses	Relative Ranking
No Build	No Action	No Action• No change to condition that has existed safely for years • Does not require infrastructure changes• Does not address design 		3		
1	Request FAA Modification of Standards (MOS)	 Acknowledges deficiency but notes existing level of safety Does not require infrastructure changes 	 Does not fix design standard deficiency Subject to FAA review and approval 	1		
2	2 Implement Declared Distances Out infrastructure		 Reduces Runway 15 takeoff and landing distances available to 7,700 feet Reduces runway utility for commercial and large corporate jets May lead to operational confusion 	2		

Table 5-5 – Runway 15-33 OFA Mitigation Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

Exhibit 5-1: Airfield (Runway) Development on Page 5-18 graphically depicts the preferred alternative.

Approaches & Airspace

Investments made to Runway 21 as the primary instrument runway to FSD have made Runway 15-33 the secondary instrument runway. Enhancing the Runway 15-33 approaches were reviewed. Each runway end is currently designed for non-precision instrument approaches with visibility minimums no lower than 1 mile. Enhanced approaches are recommended to be evaluated to maximize the airport's utility in instrument meteorological conditions. Runway 15-33 sees 4.62 percent more observations with acceptable wind coverage for typical small corporate aircraft (ARC B-II) than Runway 3-21 during visibility less than 1 mile. Runway 15 currently has higher approach cloud ceiling minimums than Runway 33 most likely as a result of higher prevailing obstacles. It is recommended the FAA flight procedures office be contacted to conduct a more detailed feasibility study to review the possibility of establishing an approach with visibility minimums lower than 1 mile.

Alternative 1: Maintain Existing Runway 15-33 Approaches (1 mile Visibility)

Maintaining Runway 15-33 approaches would not require changes to the Runway Protection Zone (RPZ). There are approximately 10 acres of land within the Runway 33 RPZ that are not currently under airport land use control. Land uses include roadways, power structures and a small portion of a commercial building. The airport should plan to acquire a land use and airspace easement to control new land uses. To remove these land uses from the RPZ a runway shift of more than 1,400 feet would be required.

The FAR Part 77 airspace surfaces remain the same with a 500-foot wide primary surface and 34:1 approach slopes. There are trees are airspace obstructions to the Runway 33 Part 77 34:1 approach surface which limit the approach to a 26:1 clearance. A pole and trees penetrate the Runway 15 Part 77 34:1 approach surface. The Runway 15 approach provides a clear 29:1 approach. All Part 77 obstructions should be evaluated for airspace impacts by FAA in the Airport Layout Plan, where their recommended disposition will be identified (i.e. marking, lighting, lower/removal).

A 20:1 clear FAA approach surface required at a minimum to preserve the instrument approaches. The east edge of a lighted water tank may be a 20:1 penetration² within the Runway 33 FAA approach and should be removed or obstruction marked to allow for the lowest possible approach visibility minimums. Trees are a few feet below the 20:1 FAA approach surface to Runway 33 and provide a clear 21:1 slope. An FAA airspace determination would identify the recommended disposition of objects. No action may prevent any upgraded approach from being implemented on Runway 33.

Alternative 2: Upgrade Runway 33 Approach (³/₄ mile Visibility)

An approach with visibility minimums no lower than $\frac{3}{4}$ mile requires a larger approach FAA RPZ. The inner RPZ width increases from 500-feet to 1,000-feet wide, and the outer width increases from 1,010-feet to 1,510-feet wide. The airport should plan to acquire a land use and airspace easement to control new land uses. This would also trigger an FAA RPZ alternatives analysis and require FAA approval. Portions of commercial and water department structures would be encompassed by the expanded RPZ, including the water tank. An additional 9 acres of property, roadways and a railroad would be introduced into the expanded RPZ. To remove these land uses from the RPZ a runway shift of nearly 1,500 feet would be required.

An approach to either Runway 15 or 33 end with $\frac{3}{4}$ mile visibility also requires an expanded FAR Part 77 primary surface width from 500-feet to 1,000-feet wide. Minnesota Avenue may become a new FAR Part 77 approach surface penetration, but the FAA 20:1 approach surface would be clear. This

² Approach end of runways expected to support instrument night operations serving greater than approach Category B aircraft from Row 5, Table 3-2 in FAA AC 150/5300-13A *Airport Design*

alternative has the potential to affect development in the terminal area. Tail heights may penetrate the Part 77 transitional airspace surface if terminal concourse development options proceed to the southwest. New airspace obstructions may be encountered, however critical FAA approach surface airspace surfaces do not change standards. Part 77 obstructions would needed to be evaluated by FAA.

Based on current cloud ceiling minima for a non-precision approach with vertical guidance, a basic approach lighting system is required to lower visibility minimums from 1 mile to $\frac{34}{4}$ mile. The required system is a 1,500-foot long Omnidirectional Approach Lighting System (ODALS). The last light may have to be located off-airport property within the Minnesota Avenue median/right-of-way.

Alternative 3: Upgrade Runway 15 Approach (³/₄ mile Visibility)

An approach with visibility minimums no lower than ³/₄ mile requires a larger approach FAA RPZ. All of these expanded areas fall within existing airport property. An upgraded approach requires an expanded FAR Part 77 primary surface width which has the potential to affect the configuration of gate development in the terminal area. New airspace obstructions may be encountered, however FAA approach surface airspace surfaces do not change standards. This alternative would trigger an FAA RPZ alternatives analysis and required FAA approval, although no new incompatible land uses would be introduced.

Based on current cloud ceiling minima for a non-precision approach with vertical guidance, a full approach lighting system is required to lower visibility minimums from 1 mile to $\frac{34}{4}$ mile. The required system is a 2,400-foot long Medium Intensity Approach Lighting System with Runway Alignment Lights (MALSR) which remains within airport property.

Alternative 4: Upgrade Runway 33 Approach (Lower Than ³/₄ mile Visibility)

This configuration was shown on previous FSD airport planning documents along with the use of declared distances to clear airspace. Lowering instrument approach minimums requires a 2,500 foot long RPZ land use protection area and a MALSR. Additionally, Minnesota Avenue and other prevailing objects do not clear the FAA 34:1 airspace surface required for a ½ mile approach, thus the landing threshold must be shifted to clear airspace. Any runway shift would reduce the utility of the runway. The water tank may have to removed and/or relocated to achieve compatible land use and airspace clearance depending on the runway shift length. An RPZ alternatives analysis would be triggered and would introduce new land uses unless the runway is shifted significantly.

Alternative 5: Upgrade Runway 15 Approach (Lower Than ³/₄ mile Visibility)

Lowering instrument approach minimums to less than ³/₄ mile triggers additional changes to airport design standards. Terrain approximately 3,100 feet from the Runway 15 end would penetrate the FAR Part 77 50:1 airspace surface. The critical 34:1 FAA approach surface would have existing power line penetrations that may require lowering and/or removal. No incompatible land uses would be introduced. A 2,400-foot long MALSR and precision runway markings would also be required.





Source: KLJ Analysis, Google Earth

Preferred Alternative

The goal is to enhance the utility of Runway 15-33 while balancing built and natural environmental impacts. Approaches to Runway 15 and 33 are recommended to be upgraded to accommodate visibility minimums as low as ³/₄ mile as it provides a runway utility enhancement with an acceptable level of impact. An approach to Runway 15 will have fewer off-airport impacts than Runway 33, however Runway 33 maximizes all-weather runway utility and may be able to achieve lower minimums than Runway 15.

Exhibit 5-1: Airfield (Runway) Development on Page 5-18 graphically depicts the preferred alternative.

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Minimizes cost	 Does not enhance runway utility Does not prevent new incompatibilities 	3
1	Maintain Runway 15-33 Approaches (1 mile)	 Actions taken to provide adequate land use control No RPZ alternative analysis required 	• Does not enhance runway utility	2
2	Upgrade Runway 33 Approach (3/4 mile)	 Enhances runway utility Approach aligned with prevailing wind Requires ODALS with smaller footprint than MALSR 	 Introduces new structures into RPZ Wider Primary Surface Additional land use control areas introduced Requires Approach Lighting System (ODALS) ODALS light located off- airport property near Minnesota Avenue 	1A
3	Upgrade Runway 15 Approach (3/4 mile)	 Enhances runway utility Does not introduce new land uses into RPZ RPZ within airport property MALSR located within airport property but crosses Big Sioux River 	 Wider Primary Surface Requires longer Approach Lighting System (MALSR) MALSR crosses Big Sioux River Higher minimums likely due to terrain 	1B
4	Upgrade Runway 33 Approach (Lower than ¾ mile)	 Maximizes runway utility Approach aligned with prevailing wind 	 Introduces several new structures into RPZ MALSR located off-airport Airspace and land use mitigation may require runway shift reducing utility Wider Primary Surface POFZ limits holding bay size 	5
5	Upgrade Runway 15 Approach (Lower than 3/4 mile)	 Maximizes runway utility RPZ within airport property 	 Terrain and power line airspace obstructions Approach not aligned with prevailing wind Wider Primary Surface 	4

Table 5-6 – Runway 15-33 Approach Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

RUNWAY 9-27

Runway 9-27 provides critical access to the airport for aircraft during strong westerly wind conditions. Maintaining this runway and providing safe operating environment is an important objective for the airport. Additional research shows the pavement was designed and constructed in 1976 for heavy aircraft. The runway, however, is not needed to achieve 95 percent wind coverage thus the runway may not be eligible for FAA funding. Several alternatives were considered for the future disposition of this runway.

Alternative 1 (No Action)

The existing runway is published as to accommodate aircraft with a maximum gross weight of 30,000 pounds. This runway is only occasionally used by large aircraft greater than 12,500 pounds. This alternative would keep the existing published design standards for ARC B-II, large aircraft.

Alternative 2 (Publish Runway 9-27 for Small Aircraft Exclusively)

Based on the available runway length of 3,151 feet, this runway has a length that primarily serves small aircraft. New FAA design criteria has modified the size of the RPZ for runways served by small aircraft exclusively. Modifying this runway to a published pavement strength of 12,500 pounds would re-classify this runway for small aircraft exclusively. This would reduce land use restrictions that provides additional opportunity for automobile parking in the terminal area. Larger aircraft could operate on this runway but should be pre-approved by airport management, with annual operations under substantial use thresholds.

Alternative 3 (Eliminate Runway 9-27 Overlapping RSAs, Small Aircraft Exclusively)

FAA airport design standards recommend, if possible, to eliminate overlapping Runway Safety Areas (RSAs) as work would affect both runways. The Runway 9 end overlaps the Runway 3-21 RSA, and the Runway 27 end overlaps the Runway 15-33 RSA.

Non-overlapping safety areas would require a significant runway shift (leading to intersecting runways), or a reduction in runway length to approximately 2,475 feet. This length is impracticable for small aircraft operations as the recommended length is more than even the current length. Significant investment in a runway is not required for wind coverage is not considered prudent use of the airport's funds.

Alternative 4 (Close Runway 9-27)

Closure of Runway 9-27 is not recommended at this time as the runway is still utilized by air ambulance operators and during strong westerly wind conditions. At such time the runway requires significant pavement rehabilitation and FAA does not participate in a rehabilitation project, then runway closure could then be considered. Closure of this runway was identified as a future consideration in a July 3, 2014 FAA inspection letter to FSD airport management.

Figure 5-8 – Runway 9-27 Alternatives Exhibit



Source: KLJ Analysis, Google Earth

Preferred Alternative

The preferred runway alternative is to modify the design standards for small aircraft exclusively and publish the runway at 12,500 pounds pavement strength into the future. This will better reflect regular operations and eliminate previous land use restrictions. Runway 9-27 closure, however, may have to be considered in the long-term or ultimate scenario. This is a change from the previously approved ALP. There is however a need to modify the taxiway geometry serving Runway 9-27 to enhance safety. This will be evaluated in the Taxiway System section.

Exhibit 5-1: Airfield (Runway) Development on Page 5-18 graphically depicts the preferred alternative.

Alternative	Actions Strengths		Actions Strengths		Actions	Weaknesses	Relative Ranking
1/No Build	No Action	 Does not require changes to runway ends Runway continues to be utilized during strong westerly wind conditions 	 Remains designed for large aircraft requiring larger RPZ Runway not needed to meet wind coverage which may limit future FAA funding 	2			
2	Publish Runway 9-27 for Small Aircraft Exclusively	 Does not require changes to runway ends Reduces size of RPZ Provides additional opportunity for auto parking near Runway 9 approach Runway continues to be utilized during strong westerly wind conditions 	 Occasional operations in large aircraft would require prior approval Runway not needed to meet wind coverage which may limit future FAA funding 	1			
3	Eliminate Runway 9- 27 Overlapping RSAs, Small Aircraft Exclusively	 Corrects overlapping RSAs Reduces size of RPZ 	 Runway not needed to meet wind coverage which may limit future FAA funding Runway length reduced to 2,475 feet, reducing utility New FAA survey required 	3			
4	Close Runway 9-27	 Reduces airport maintenance and financial burden of this pavement Additional landside development space for automobile parking 	• Eliminates airfield utility gained from third runway for small aircraft	4			

Table 5-7 – Runway 9-27 Design Standard Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

Another targeted long-term need for Runway 9-27 would be the installation of PAPI lights. This would be beneficial for those operating from this shorter runway. However, because this runway is used occasionally and the potential of long-term closure, the improvement is considered optional at the discretion of airport management.

Preferred Runway Development

Exhibit 5-1: Airfield (Runway) Development on the following page outlines the preferred runway development alternative.



Leg	end
•	Precision Approach Path Indicator (PAPI)
•	Future ALSF-2 Lighting
	Future MALSR Lighting
•	Future ODALS Lighting
	 Existing Airport Property
	 Future Airport Property
	Runway 33 Object Free Area (ROFA)
	Existing Runway Protection Zone
	Future Blast Pad Upgrade
	Future Cat. II Glide Slope Critical Area
	Future Cat. II Localizer Critical Area
	Future Land Exchange Easements
	Future Runway Protection Zone Easement
	Future Runway Protection Zone(Approach)
	Future Runway/Taxiway Shoulder
	Future Touchdown Zone Lighting

Runway Design Improvements

- **1.** Submit FAA Modification to Design Standards for Runway 15/33 Object Free Area penetrations.
- 2. Modify Runway 9/27 to Small Aircraft Exclusively Standards
- 3. Upgrade Paved Runway Blast Pads
- 4. Construct Paved Runway Shoulder (25 feet)
- 5. Install Runway 3 Touchdown Zone Lights
- Upgrade Runway 21 and/or Runway 3 approaches to Category II Instrument Landing System (1/4 mile visibility)
- **7.** Upgrade Runway 15 and/or 33 approaches to 3/4 mile visibility
- 8. Decommission Runway 9/27 and Convert to Taxiway (Long-Term/Ultimate)



*Intended for Planning Purposes Only

PRELIMINARY



Taxiway System

An evaluation of development alternatives for the FSD taxiway system is described below.

FIVE CORNERS INTERSECTION

There is a need to mitigate the intersection where Taxiway A, B and E meet at what is locally known at the "five-corners" intersection. This intersection is identified as a "hot spot" by FAA in aeronautical publications because its configuration may lead to pilot confusion. The taxiway intersection geometry should be corrected. Alternatives to modify its configuration include the following:

Alternative 1: Connection with Taxiway B

The existing Taxiway E alignment to the apron would be removed and relocated with a right-angle connection with Taxiway B to the west. This would create a T-intersection located approximately 400 feet north of the Taxiway A and B intersection. The taxiway curve near the apron would be result in about a 30 degree curve. Taxiway B is the parallel taxiway for Runway 3-21, the runway with instrument approaches providing maximum utility.

Alternative 2: Connection with Taxiway A

The existing Taxiway E alignment to the apron would be removed and relocated with a single rightangle connection with Taxiway A to the south. This would create a T-intersection located approximately 300 feet north of the Taxiway A and B intersection. The taxiway curve near the apron would be result in about a 25 degree curve. Taxiway A is the parallel taxiway for Runway 15-33, the runway best aligned into the prevailing wind.

Alternative 3: Remove Taxiway E

Removal of Taxiway E would require traffic to be funneled through Taxiway F and D to the east general aviation apron. This configuration would require larger aircraft to maneuver around parked aircraft for entry and exit operations, but also open up additional aircraft parking space within the apron. The pavement strength of Taxiway F and D would have to be upgraded in the future.



Figure 5-9 – Five Corners Intersection Alternatives Exhibit

Source: KLJ Analysis, Google Earth

Preferred Alternative

The preferred alternative is Alternative 3 to remove Taxiway E, however the final configuration should be compatible with future commercial and general aviation apron expansion needs. A solution will be incorporated into the east general aviation development concepts evaluated in the General Aviation Development Alternatives section.

Exhibit 5-2: Airfield (Taxiway) Development on Page 5-30 graphically depicts the preferred alternative.

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Direct taxiway access to central apron remains	• Does not correct taxiway "hot spot"	4
1	Connection with Taxiway B	 Corrects "hot spot" Direct taxiway access to central apron remains 	 Requires new taxiway alignment Limits future apron expansion opportunities 	3
2	Connection with Taxiway A	 Corrects "hot spot" Direct taxiway access to central apron remains Aligned with most common general aviation runway 	 Requires new taxiway alignment Limits future apron expansion opportunities 	2
3	Remove Taxiway E	 Corrects "hot spot" Allows for additional aircraft parking space Creates opportunities for future apron expansion 	 Removes direct taxiway requiring modified aircraft maneuvering pattern Taxiway E and F upgrade is required 	1

Table 5-8 – "Five Corners" Intersection Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

CAPACITY ENHANCEMENTS

Runway Exits

High speed exit taxiways are typically located between 5,000 and 5,500 feet from the runway end to facilitate quick turnoff of large aircraft from the runway to enhance airfield capacity. Right-angled taxiways provide turnoff locations at other ideal exit locations for landing operations. High speed and right-angled taxiway exits were reviewed. Each proposed taxiway location was analyzed for a no build or build scenario. Approximate locations of exit taxiways for each large aircraft runway were determined based on the existing runway and taxiway system configuration.

- <u>Runway 3</u> This runway is a primary landing runway for air carrier aircraft at FSD due to prevailing winds. A high-speed exit could be constructed 6,500 feet from the landing threshold where a gap of 3,700 feet exists between right-angled Taxiway M and A4. This location would be idea for heavy aircraft destined for the air cargo apron. A reverse turn would be needed for aircraft destined for the passenger terminal complex. Alternatively a right-angled taxiway could be implemented if other air cargo or general aviation taxiways result in direct access to the runway. The Build alternative to construct a high-speed taxiway in the long-term is recommended.
- <u>Runway 21</u> An ideal location for a high-speed exit within existing exit taxiways is 5,200 feet from the landing threshold. The location is just after the right-angled turnoff Taxiway M within a gap of 1,800 feet between the next runway exit at Taxiway B2. Runway 9 is an acute angle and not recommended for turnoffs. The anticipated reconfiguration of Taxiway B2 to a 90 degree taxiway leaves a reduction in capacity, but can be mitigated by expanding the exit

taxiway radius according to input received from the South Dakota Air National Guard. If Taxiway B2 is realigned to a right angle, a long-term high-speed taxiway exit 5,200 feet from the landing threshold is recommended. A high-speed turnoff would allow for access to the existing or future cross-field taxiway, eliminating the need for back-taxiing from Taxiway B2 and reduce overall taxiing times to the passenger terminal for larger aircraft.

- <u>Runway 15</u> The possible high-speed exit can be located 5,700 feet from the landing threshold between Taxiway M and an obtuse-angled Taxiway A2. Taxiway M is located 5,100 feet from the threshold at an ideal location. There is a 1,700 foot gap between these exit taxiways. This high-speed exit however may result in direct access from the expanded passenger terminal apron which is discouraged. A right-angled taxiway could be placed about 6,000 feet from the landing threshold in a location with short taxiing times to the terminal. Additionally, Taxiway A2 is also recommended to be modified to a right-angled exit further enhancing capacity. As a result of proximity to Taxiway M and obtuse alignment of existing Taxiway A2, the Build option to construct a right-angled modified Taxiway A2 exit taxiway is recommended.
- <u>Runway 33</u> This is another common landing runway for air carrier aircraft due to prevailing winds. The ideal high-speed turnoff location would be 5,500 feet from landing threshold just after crossing Runway 3-21. The next right-angled exit taxiway is located 6,600 feet from the landing threshold. The gap between parallel taxiway B and Taxiway A3 is 2,400 feet. A new taxiway would conflict with Taxiway L and lead to direct access. As a result of the location of existing turnoff taxiways, an additional exit taxiway beyond Runway 3-21 intersection but before the extended intersection with Taxiway L is recommended.

No other runway exit taxiways are recommended for FSD.



Source: KLJ Analysis, Google Earth

Table 5-9 - 1	Taraeted	Runwav Exit	Taxiwav I	Recommendations
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Runway	Improvement	Distance from Runway End (approx.)
3	Acute Angle/High-Speed Exit	6,500 feet
21	Acute Angle/High-Speed Exit	5,200 feet
15	Right-Angle Exit (A2)	6,200 feet

Source: KLJ Analysis

Exhibit 5-2: Airfield (Taxiway) Development on Page 5-30 graphically depicts the preferred alternative.

Holding Bays & Bypass Taxiways

Holding bays and bypass taxiways for each runway end were reviewed together for feasibility. These components provide additional departure capacity and flexibility allowing aircraft to hold outside of the active departure queue. A holding bay for each runway is generally preferred over a bypass taxiway to maximize utilization of existing pavements, provide holding areas outside of the immediate runway environment and to provide full runway length for departures. Each holding bay and bypass taxiway proposed were analyzed for a no build or build scenario for each runway end.

- <u>Runway 3</u> This is a common primary departure runway for air carrier aircraft at FSD due to prevailing winds. There is no holding bay or bypass taxiway currently installed. A holding bay or bypass taxiway would be beneficial to provide departure flexibility. Construction may require the perimeter road to be realigned. **Constructing a holding bay capable of accommodating two ADG-IV aircraft is recommended.**
- <u>Runway 21</u> This runway end is commonly used by air cargo aircraft during calm or southerly wind conditions due to the runway end's proximity to the air cargo apron. A holding bay is currently in use at this runway end but is not designed for ADG-IV aircraft. Taxiway B4 is considered a bypass taxiway located 1,000 feet beyond the Runway 21 threshold and provides additional departure capacity. An expansion of the existing holding bay to the northeast could accommodate up to two ADG-IV aircraft but would impact the air cargo apron, fence and access road. Alternatively, expansion of the existing bay to accommodate one ADG-IV aircraft and/or a bypass taxiway is recommended to minimize impacts to the air cargo apron.
- <u>Runway 15</u> This runway is used for departures but only during strong easterly wind conditions that prevent the use of Runway 21. A holding bay is currently in use at this runway end but is not designed for ADG-IV aircraft. An expansion to the north would provide capacity for up to two ADG-IV aircraft. A much smaller expansion would accommodate one ADG-IV aircraft. An expansion of the holding bay for two ADG-IV aircraft is the recommended alternative.
- <u>Runway 33</u> This is another common primary departure runway at FSD due to prevailing winds and proximity to the passenger terminal. There is currently a holding bay located on the west side of the runway end for SDANG use. A holding bay or bypass taxiway would be beneficial to provide departure flexibility. There is sufficient space to provide a holding bay capable of simultaneously accommodating two ADG-IV aircraft provided the existing airport perimeter fence is relocated and Runway 33 is limited to ³/₄ mile instrument approach visibility. A portion of the holding bay is located within the Runway 27 RPZ. Designing the holding bay to extend further to the south would locate the parked aircraft outside of the Runway 27 RPZ. The holding bay build alternative for two ADG-IV aircraft is recommended in the mid-term. If holding bay development prevents future passenger terminal parking expansion then a bypass taxiway is recommended at a minimum to enhance capacity.



Source: KLJ Analysis, Google Earth

Table 5-10 – Targeted Holding Bay & Bypass Taxiway Recommendations

Runway	Improvement
3	Holding Bay for two ADG-IV Aircraft
21	Holding Bay for one ADG-IV aircraft
21	Bypass Taxiway
15	Holding Bay for multiple ADG-IV Aircraft
33	Holding Bay for multiple ADG-IV aircraft and/or Bypass Taxiway

Source: KLJ Analysis

Exhibit 5-2: Airfield (Taxiway) Development on Page 5-30 graphically depicts the preferred alternative.

RUNWAY 9-27 INTERSECTIONS

The intersection of Runway 9-27 and its access taxiways with both Runway 15-33 and Runway 3-21 results in geometry that may be confusing to pilots. The Runway 9 access taxiway and Taxiway B2 at Runway 3-21 share the same pavement which could cause aircraft to inadvertently taxi onto a runway or taxiway. Additionally the Runway 27 access taxiway, Taxiway C2 and Taxiway A2 share one intersection with Runway 15-33 creating multiple entry/exit points. Taxiways A2, B2 and C2 in the proximity of Runway 9-27 currently do not meet FAA exit taxiway angular standards. Runway 9-27 may be decommissioned in the long-term which presents an opportunity to correct the intersection geometry.

An alternative eliminated from consideration to provide access to the runway ends is a full parallel taxiway. This was evaluated in the 2006 master plan to divert traffic away from Taxiway C that is now exclusively used for military traffic. Development of a taxiway in this area would create conflicts with



other taxiway and runway intersections, and is also not needed if Runway 9-27 is decommissioned. This alternative is dismissed from consideration.

Background

During the Master Plan process, it was identified that Taxiway B2 was is need of reconstruction in the short-term. This required taxiway alternatives to be re-evaluated and re-sequenced. The existing B2 alignment does not meet FAA standards. It was recommended the taxiway be realigned as a targeted improvement to a right-angle exit taxiway from Runway 21, meeting FAA standards. This exit taxiway would serve Runway 21 landing operations from SDANG and heavy commercial aircraft. A larger exit taxiway radius pavement was required from SDANG to facilitate higher speed military aircraft runway exits to maintain Runway 3-21 landing and takeoff capacity.

Runway 9-27 was also identified by the FAA and the airport to be considered for future closure once its pavement is in need of reconstruction, which may occur in the long-term planning horizon. This allows for new Taxiway B2 to serve as an exit taxiway in lieu of a connection to Runway 9-27, which currently does not meet FAA exit taxiway angle standards. Due to these new considerations the alternatives presented below have revised from the original master planning analysis.

Taxiway C2 is primarily used by SDANG for Runway 15 landing operations, but also is used to provide access to the holding bay currently used by military and occasional civil aircraft.

No Build

Operations on Runway 9-27 require Runway 15-33 and Runway 3-21 to be clear of traffic. No independent operations are allowed with the current configuration. Independent operations would require the runway ends to be modified which is not recommended by the Airport. A No Build scenario would continue to provide access from each runway to Runway 9-27 and not resolve any taxiway geometry issues.

Alternative 1

This alternative removes the pavement connecting the Runway 9 end to Runway 3-21 in lieu of the new Taxiway B2 alignment. An optional high-speed taxiway between Taxiway B2 and M can then be developed for capacity. This alternative features removal of Taxiway C2 to remove the complex geometry near the Runway 27 end. A holding bay to Runway 33 would need to be constructed for civil aircraft to eliminate the need to cross Runway 15-33. Taxiway A2 would be realigned to provide a right-angled taxiway to meet FAA standards for Runway 15 landing operations. Its alignment would be compatible with traffic from Runway 9-27 crossing Runway 15-33, similar to the configuration as Taxiway M crosses Runway 15-33. The estimated cost to implement this alternative is \$7.2 million, which includes the reconstruction of Runway 9-27 for conversion into a taxiway. The targeted improvement of constructing a Runway 33 holding bay costs an estimated additional \$3.0 million.

Alternative 2

This alternative was developed to provide an ideal alignment for the long-term cross-field taxiway. Proposed action also includes removing direct, non-standard connection to the Runway 9 end and realigns Taxiway B2 to a right angled taxiway. When Runway 9-27 is converted into a taxiway, it would be realigned to provide a right-angle crossing with Runway 15-33 and connect with Taxiway A. This would occur north of the arrestor bed to prevent an angled holding point other than 90 degrees at approximately 6,200 feet from the landing threshold. Taxiway C2 would remain in its current configuration for SDANG use. Taxiway A2 would be removed and relocated with new cross-field taxiway alignment once the holding bay is constructed as it would have no practical use. The estimated cost to implement this alternative is \$6.6 million, which includes the reconstruction of Runway 9-27 for conversion into a taxiway. The cost is lower because total taxiway length is less than Alternative 1.



Source: KLJ Analysis, Google Earth

Preferred Alternative

Alternative 2 is recommended as it best addresses capacity, safety and financial considerations. The taxiway design corrects civil taxiway alignments to FAA design standards. The cost to implement Alternative 2 is less than Alternative 1 assuming reconstruction of Runway 9-27 is needed to convert that pavement into a taxiway. Construction of a Runway 33 holding bay is assumed to be a targeted improvement and not directly driven by these alternatives. The realignment of Taxiway B2 is recommended in the short-term, with the conversion of Runway 9-27 to a cross-field taxiway to occur in the long-term. This would trigger the removal of Runway 9 pavement connection, Runway 9-27 reconstruction to a taxiway, and construction new cross-field taxiway alignment connecting to Taxiway A.

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Minimal cost	• Does not improve/correct intersection geometry	3
1	 Realign Taxiway B2 Remove Runway 9 Connection Convert Runway 9-27 to Cross-Field Taxiway Remove Taxiway C2 Realign Taxiway A2 	 Improves intersection geometry Taxiway A2 realigned for right-angle turnoff use (similar to Taxiway M) Removes need to maintain Taxiway C2 at non-standard angle 	 Taxiway C2 removed which currently provides ideal SDANG access Increased cost over Alternative 2 Requires Holding Bay construction 	2
2	 Realign Taxiway B2 Remove Runway 9 Connection Convert Runway 9-27 to Cross-Field Taxiway Maintain Taxiway C2 Remove Taxiway A2 	 Corrects intersection geometry on civil taxiways Reduced cost over Alternative 1 Creates standard 90 degree angle to cross Runway 15-33 Runway 15-33 turnoff realigned to 90 degrees standard 	 Creates multiple new taxiway alignments Requires reconstruction of current pavements to be cost effective with Alternative 1 Taxiway C2 remains which does not meet FAA standards and has limited civil use 	1

Table 5-11 – Runway 9-27 Intersection Taxiway Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred).

Exhibit 5-2: Airfield (Taxiway) Development on Page 5-30 graphically depicts the preferred alternative.

ULTIMATE TAXIWAY B ALIGNMENT VISION

Taxiway B serves Runway 3-21, but its centerline setback from Runway 3-21 centerline varies from 560 feet to 660 feet from Runway 3 to Runway 21 end, respectively. This results in a taxiway alignment jog that is not truly parallel with the runway. A 400 foot setback from runway to taxiway centerline is required at a minimum for an ARC D-IV runway, however a setback distance of 450 feet is recommended for TDG 4/5 aircraft when a high-speed exit with a reverse turn is constructed. To maintain development flexibility a 450 foot runway to taxiway centerline setback is recommended to be reviewed. A straightened taxiway centerline is recommended for potential operational flexibility and to open up potential development opportunities. Multiple build and a no-build alternative were evaluated.

Alternative 1: Maintain Existing Taxiway B Alignment

The existing alignment allows for adequate taxiway functionality between runway ends that exceeds current airport design standards. The drawback is that is limits development of the east cargo apron to the existing footprint which is undersized for the future needs. A non-parallel alignment also prevents the taxiway from being used as a temporary runway during periods when both runways are inoperative such as during intersection work. This alternative proposes to reconstruct the existing taxiway to its existing alignment when pavement requires reconstruction.

Alternative 2: Reconstruct Taxiway B (450' Setback)

This alternative is to reconstruct Taxiway B to a new 450 foot setback. The realignment would occur over time as existing pavement sections are in need of reconstruction. This alternative opens up development space in the east cargo apron complex. The taxiway would be shifted 210 feet further away from the apron providing additional development space for the parking and maneuvering of aircraft. The facility requirements identified a need for approximately 50 percent more apron space by PAL 4. Other air cargo apron development alternatives will be explored but this taxiway alternative provides a significant development opportunity. Impacts include the additional cost to connect new

pavement in with existing pavements and modify taxiway lights. The 400-foot wide Runway Obstacle Free Zone (ROFZ) must be clear for use as a temporary runway. A water well located west of the SDANG apron would be within the temporary ROFZ. This alternative requires full taxiway realignment.

Constructing a taxiway alignment setback 450 feet from runway centerline limits the airport to an ADG-IV critical design aircraft with high-speed taxiway exits with reverse turns. The next category would be ADG-V that requires a 500 foot runway centerline setback to accommodate approaches with visibility minimums less than ½ mile. Example ADG-V aircraft include the Boeing 777, Boeing MD-11 and Airbus A-340. Based on the planned primary runway length aircraft types are not expected to operate from FSD on a regular basis. Preserving a greater taxiway alignment however is not foreseen as needed into the future.

Alternative 3: Reconstruct North Portion of Taxiway B (560' Setback)

This alternative is to reconstruct all portions except the south quarter of Taxiway B to match the existing 560 foot setback at the south end near Runway 3. The realignment would occur over time as existing pavement sections require reconstruction. The taxiway would be shifted 90 feet further away from the apron providing some additional development space for the parking and maneuvering of cargo aircraft. There would be additional cost to connect new pavement with existing pavements and modify taxiway lights. Another benefit is to utilize about 1,900 feet of parallel Taxiway B already constructed meeting minimum standard. This setback can also provide a temporary 400-foot wide ROFZ from permanent objects for use as a temporary runway.



Figure 5-13 – Ultimate Taxiway B Vision Alternatives Exhibit

Source: KLJ Analysis, Google Earth

Preferred Alternative

The preferred alternative is Alternative 3. The primary benefits are to utilize existing south Taxiway B infrastructure, maximize development space for the east air cargo complex and to provide for the flexibility to use this alignment as a temporary runway during periods of runway intersection construction. In total, this alternative will cost \$14.9 million to realign Taxiway B.

Table 5-12 – Ultimate Taxiway B Vision Alternative EvaluationAlternativeActionsStrengthsWeak

Alternative	Actions	Strengths	Weaknesses	Ranking
1/No Build	No Action	• Minimal cost	 Excessive setback may limit development Alignment prevents use as temporary runway 	3
2	Reconstruct Taxiway (450' Setback)	 Alignment prevents use as temporary runway Maximizes air cargo development opportunities 	 Additional cost to realign taxiway and pavement Requires full taxiway realignment Penetrations to temporary runway OFZ 	2
3	Reconstruct Taxiway (560' Setback)	 Matches existing taxiway setback near Runway 3 end Meets standards for use as temporary runway. 	 Additional cost to realign taxiway and pavement Limits air cargo development opportunities 	1

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

TARGETED IMPROVEMENTS

Targeted improvements are those that are recommended to meet airport design standards and have limited alternatives.

Paved Shoulders

Constructing paved shoulders on taxiways serving ADG-IV aircraft is required, and recommended for pavements serving ADG-III aircraft. The most critical ADG-IV aircraft is classified as a TDG-5. Paved shoulders 25-feet in width should be constructed in locations with regular use by ADG-IV aircraft including Taxiway A, B, M, J, H, G and associated connecting taxiways. Paved shoulders 20-feet in width are recommended to be planned for Taxiway F, E and D, L and K in the future serving ADG-III aircraft with TDG-3.

Correcting Direct Access

Direct access from an apron to a runway should be corrected per FAA airport design standards to reduce the risk of runway incursions. Taxiway K to the west cargo apron and the northernmost access taxiway to the east cargo apron both have direct access to Runway 3-21 and is recommended to be corrected. Correcting this pavement geometry involves removing pavement and constructing an alternative entrance. The revised taxiway geometry for the east cargo apron should be reviewed in concert with aircraft parking stands in the east cargo apron alternatives.

	· · · · · · · · · · · · · · · · · · ·
Taxiway(s)	Improvement
A, B, M, J, H, G	25' Paved Shoulders
F, E, D, L, K	20' Paved Shoulders
K	Remove Direct Access to Runway 3-21
East Cargo Connector	Remove Direct Access to Runway 3-21

Table 5-13 – Targeted Taxiway Recommendations

Source: KLJ Analysis

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Source: KLJ Analysis, Google Earth

Exhibit 5-2: Airfield (Taxiway) Development on Page 5-30 graphically depicts the preferred alternative.

Airport Traffic Control Tower

The FAA is responsible for siting, constructing and maintaining an Airport Traffic Control Tower (ATCT) for an airport. The airport, through this master plan study, is evaluating potential sites at a high-level to protect land use and development so that future ATCT sites remain feasible. The ATCT sites considered feasible in a 2006 site study are considered in this master plan.

The existing ATCT site may or may not be maintained at the current site. Since the last master plan study, the FAA has invested in upgrading equipment at the current ATCT suggesting the current site is considered sufficient. The tower is 50 years old and may need to be replaced within the planning period. Airport development will consider ATCT line-of-sight requirements for the current and potential alternative sites.

EXISTING ATCT

All airport development in this master plan should consider the existing ATCT complex with a controller eye of 1487.7 feet MSL (about 65 feet above ground level) for airfield line of sight considerations. Passenger terminal area complex may lead to localized line of sight penetrations of the airfield with larger Boeing 757 aircraft tails.

ALTERNATIVE 1: EXISTING ATCT COMPLEX

Future development at the current site should be considered. In the future a new ATCT could be developed near the existing ATCT. Other planned airport development is surrounding the existing complex which would lead to a constrained site. Existing facilities could be utilized. A 100 foot high tower may provide a clear line of sight over future terminal development. Ultimate terminal concourse development would require further line of sight evaluation.

ALTERNATIVE 2: WEST GENERAL AVIATION COMPLEX

An alternative site in this area was identified in a 2006 tower siting study. A location to the south of the SDARNG and north of the west general aviation apron is considered suitable for a new ATCT. This site is still considered feasible. Proposed public airport access from the west would provide for similar public access as the existing ATCT. The line of sight to the airfield from a 90 foot high would be clear based on a preliminary evaluation.

ALTERNATIVE 3: REMOTE WEST SITE

An alternative site in this area was identified in a 2006 study but considered unacceptable. The line of site to the airfield appears to be clear, however other site considerations eliminate this site. Most land to the west of Runway 3-21 and 15-33 is leased for SDANG use through 2036. The site is located in the Airport Surveillance Radar (ASR) critical area and may result in interference. This site can also only be accessed through internal controlled access airport roadways. No public access is needed at this time to this portion of the airfield west of Runway 15-33.

Figure 5-15 – Airport Traffic Control Tower





<u>Alternative 1</u> Construct 100' Airport Traffic Control Tower Existing ATCT Complex

Source: KLJ Analysis, Google Earth

Table 5-14 – Airport Traffic Control Tower Alternative Evaluation

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	Existing ATCT To Remain	• Eliminates need to construct new facility	 Aging building and infrastructure Future parked aircraft tail line of sight issues 	3
1	New ATCT in Existing Complex	• Cost effective to utilize existing infrastructure	 Site within constrained area between passenger terminal and general aviation area Requires higher tower to clear most line of sight issues 	2
2	New ATCT in West General Aviation Complex	 Master Plan can accommodate ATCT Site Clear line of sight with 90- foot high ATCT Adequate space to construct ideal facility 	 Additional travel time to reach site from downtown No separate west access at this time 	1
3	New ATCT in a Remove West Site	 Clear line of sight Adequate space to construct new facility 	 No public access Possible interference with ASR antenna 	4

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)

PREFERRED ALTERNATIVE

No single preferred alternative is recommended in this study for an ATCT site because action is initiated by FAA. One feasible option for a clear line of sight is a location in the west general aviation complex, however development within the existing ATCT site may also be possible which would maximize utilization of existing facilities. An alternative site should be a consideration. Further FAA study is required.

Passenger Terminal Development Alternatives

The Passenger Terminal Development Alternatives section reviewed the following infrastructure elements:

- Terminal Building Areas
- Terminal Apron

Requirements Summary

The passenger terminal provides the necessary infrastructure to accommodate commercial passenger operations. The following section summarizes key passenger terminal facility requirement findings:

- Provide additional baggage claim and baggage handling space by PAL 1 to meet current and future needs.
- Increase the total number of gates to nine to meet passenger enplanement and aircraft fleet mix needs, including expanded holdrooms and concourse circulation space by PAL 4.
- Provide up to three Remain Over Night (RON) to meet projected needs.
- Provide up to two aircraft deicing pads to accommodate aircraft as large as ADG-IV with adequate throughput during peak operations.

Terminal Building Areas

CONSIDERATIONS

The passenger terminal complex at FSD serves the air travel needs of the general public utilizing commercial airlines. As a facility that annually processes nearly 1 million inbound and outbound total passengers, accommodating passenger needs is vital to provide adequate level of service for the growing air needs for the Sioux Falls region.

Passenger forecasts and facility requirements identified the need for two additional gates through PAL 4, for a total of nine in the terminal concourse. The average aircraft size is forecast to increase. Gate space needs will evolve to accommodate primarily Design Group III large regional and narrowbody aircraft that generally carry 80 to 177 passengers. One contingency gate to accommodate a Boeing 757 is included in the final total.

The terminal building requires additional concourse length, width and circulation area. Passenger holdrooms should be expanded at individual gate areas to accommodate larger aircraft sizes. The current plans to expand the security screening checkpoint should be incorporated into concepts. Baggage claim, baggage handling, and car rental concession areas require additional space. Long-term Federal Inspection Services (FIS) should also be considered along with accommodating the existing General Aviation Facility (GAF). All other facility areas including ticketing are considered adequate to meet needs through PAL 4.

Alternative concepts need to consider a geometrically constrained terminal complex. The current GAF is located on the south end of the terminal and provides a challenge in expanding the baggage claim and rental car concession area. Automobile parking has been expanded on the east side of the terminal building to meet this growing facility need. Larger aircraft require additional space and need to be accommodated in this constrained environment. This has provided a new consideration in planning for terminal development.

The terminal apron needs to be designed to accommodate the safe movement and circulation of aircraft. Considerations include geometric clearances and jet blast. A dual taxiway entrance at Taxiway A is also recommended to improve aircraft circulation and flow.

Other considerations include an aging terminal building. The structure was built in the 1960's and does not meet the width standard for a dual-loaded concourse. The building will require rehabilitation or even replacement in the future, likely beyond the planning period identified in this master plan study. Terminal development concepts should consider these long-term needs.

This Master Plan calls for the protection of airspace for ³/₄ mile visibility minimums to Runway 15-33. FAR Part 77 transitional airspace begins 500 feet from the runway centerline and extends upward an outward at a 7:1 slope. Future development should keep clear of this surface whenever possible, however airspace penetrations may be acceptable if there are significant benefits. An FAA airspace determination will be requested if objects are proposed to penetrate this future airspace surface.

CONCEPTS

Terminal Concourse

For this review the terminal concourse is considered the sterile space beyond the security checkpoint including gates, holdrooms and concessions. Several initial concepts were evaluated to determine the preferred development direction to accommodate the facility requirements.

Alternative 1 (Rotunda)

Alternative 1 proposes a rotunda at the end of the existing terminal concourse to accommodate two additional gates. A preliminary concept was prepared in the past by the Airport's architect. The plan called for two gates (net gain of one), official holdroom seating for a 180 total passengers and a 10-foot wide corridor. Requirements call for a net gain of two gates and recommended seating for at least 220 passengers. Two additional gates can fit around this rotunda concept, however it does not provide ideal layout for two additional gates with considerations for ideal holdroom size, circulation, restrooms and concessions. This concept is not recommended.

Alternative 2 (Extension)

Alternative 2 proposes a concourse expansion that would provide additional concourse length and space for an additional two gates, holdrooms, concessions and restrooms. This alternative proposes an expansion at a 90-foot width accommodating two additional gates with a total of 14 aircraft parking stands. Aircraft parking areas clear the future FAR Part 77 transitional surface for Runway 15-33 protection, but larger aircraft are limited to parking on the northeast side. The north taxilane can be designed to accommodate aircraft up to a Boeing 757, but may cause jet blast issues. Existing building rehabilitation would need to be staged in a multi-phased project. This alternative is recommended for further consideration.

Alternative 2A (Modified Extension)

Alternative 2A is a derivative of Alternative 2. The concourse expansion bends to become parallel to the runway. This would provide the opportunity to connect into a long-term 18-gate concourse (Alternative 6A) that would clear the future Runway 15-33 airspace surfaces. This expansion would provide space for an additional two gates, holdrooms, concessions and restrooms. A total of 14 aircraft parking stands are provided. This concourse configuration requires additional apron expansion and creates limits the north taxilane to Design Group III aircraft. Larger aircraft (i.e. Boeing 757) would need to park on the west side of the concourse, but become a limited ATCT line of sight issue. This alternative is recommended for further consideration.

Alternative 3 (Second Pier 1)

Alternative 3 focuses development on new concourse pier to create a "Y" configuration. This is consistent with previous planning studies completed at the airport. This concept adds an additional three gates in a new single-loaded concourse approximately 320 feet long. The overall length is needed to preserve the full use of Gate 1. A dual-loaded concourse is not proposed to preserve existing automobile parking lot. Due to the expense of constructing an entire new pier for three additional gates, this alternative is not recommended.

Alternative 3A (Second Pier 1 with Rotunda)

Alternative 3A is the development shown on the previous Airport Master Plan study completed in 2006. A second terminal concourse pier "Y" configuration with an additional seven gates is modeled. This dual-loaded concourse requires apron space on the east side where an automobile parking lot was constructed since the last planning study. Due to the expense of replacing automobile parking and constructing a new pier, this alternative is not recommended.

Alternative 4 (Second Pier 2)

Alternative 4 proposes to modify Alternative 3 to create a single-loaded concourse with a potential direct connection to a future expanded FIS facility on the south end of the terminal building. This "hockey-stick" design allows the concourse to turn parallel with the terminal building creating a possibility for a secure access FIS arrival corridor. This concourse provides an additional three gates. This design impacts a portion of the existing automobile parking. There is still a considerable amount of unusable space between the concourse and the terminal building. This alternative is not recommended for further consideration.

Alternative 5 (Second Pier 3)

Alternative 5 is similar to Alternative 4 to reduce the space between the concourse and terminal building. An additional three gates are proposed over a 300 foot long concourse pier. This design creates an opportunity for expanded baggage handling, baggage claim, airport administration and FIS facilities behind the concourse pier. The connection between the concourse pier and a future expanded FIS facility is shortened and preserved. Net aircraft parking stands increases to 13. This design impacts a portion an additional portion of existing automobile parking over Alternative 4. This alternative is recommended for further consideration.

Alternative 6 ("T" Concourse)

Alternative 6 is a long-term terminal concourse expansion concept. The "T" style concourse would provide expandability for up to 18 gates providing capacity well beyond the PAL 4 needs. This concept would allow for a phased development that would replace the existing terminal concourse. The location of the concourse does not meet FAR Part 77 airspace protection recommendations for Runway 15-33. Minimum taxiway/taxilane separation requirements are met for Taxiway A and a new terminal taxilane. Design Group IV taxilanes are planned. Impacts include removing and relocating automobile parking. As a result of impacts to protecting the future Runway 15-33 airspace this alternative is not recommended in lieu of the feasibility of Alternative 6A.

Alternative 6A (Modified "T" Concourse)

Alternative 6A shifts the long-term terminal concourse complex to the east to clear the potential future FAR Part 77 airspace for Runway 15-33. This alternative further constrains available space and likely requires taxilanes on the east side to be limited to Design Group III aircraft. This alternative is recommended for further consideration. Alternative 2A proposes an expansion compatible with Alternative 6A configuration. Further concourse expansion and replacement would occur when the project is justified as a result of new demand or building condition. The estimated cost of this full-build project in 2014 dollars is \$63.5 million.

Alternative Evaluation

The results of an initial alternative screening are summarized in the table below. After the initial alternative screening, Alternatives 2, 2A, and 5 were further evaluated to arrive at a preferred alternative to meet needs through this master planning period. Ultimate needs were also reviewed.

Figure 5-16 – Terminal Concourse Alternatives



Source: KLJ Analysis, Google Earth

Table 5-15 – Terminal Concourse Alternative Screening

Alternative	Actions	Strengths	Weaknesses	Evaluation
No Build	No Build	• Minimal cost	• Will not meet forecast facility gate needs in PAL 3	Eliminate
1	Rotunda	• Small footprint	 Design does not meet future facility size requirements Not compatible with long- term expandability 	Eliminate
2	Extension	• Configuration matches existing concourse design	 Boeing 757 jet blast considerations on NE side Aircraft parking limitations to clear future Runway 15-33 airspace and ATCT line of sight 	Proceed
2A	Modified Extension	 Aircraft tails clear future Runway 15-33 airspace Improved ultimate terminal compatibility 	 NE taxilane limited to Design Group III aircraft Some ATCT line of sight penetrations with parked critical aircraft 	Proceed
3	Second Pier 1	• Limits construction impact to existing operations	 Larger footprint needed to accommodate 3 gates Increased cost over other alternatives 	Eliminate
3A	Second Pier 1 with Rotunda: Ultimate	• Accommodates ultimate needs	 Requires relocation of automobile parking Limits expandability of terminal building 	Eliminate
4	Second Pier 2	• Connectivity with current FIS location	 Increased footprint needed to accommodate 3 gates Unusable space between concourse and terminal 	Eliminate

Table continues on the following page

Alternative	Actions	Strengths	Weaknesses	Evaluation
5	Second Pier 3	 Connectivity with current FIS location Smaller unusable space between concourse and terminal 	 Increased footprint needed to accommodate 3 gates Smaller footprint than Alt. 3 Requires relocation of some automobile parking 	Proceed
6	"T" Concourse: Ultimate	 Provides a usable plan to rehabilitate terminal concourse Meets ultimate airport vision 	• Row of parked aircraft may not clear future Runway 15-33 airspace	Eliminate
6A	Modified "T" Concourse: Ultimate	 Clears future Runway 15-33 airspace Provides a usable plan to rehabilitate terminal concourse Meets ultimate airport vision 	 East taxilane on back side of concourse limited to Design Group III aircraft Some existing ATCT line of sight penetrations 	Proceed

Source: KLJ Analysis

Next, the remaining concourse alternatives were further evaluated against each other. An important consideration for the airport is a preferred alternative that provides FSD with a terminal concourse concept that is expandable to meet future needs but also considers other potential impacts. The following exhibit summarizes the alternatives considered for further evaluation.

Table 5-16 – Terminal Concourse Alternative Analysis

Metric	Alt. 2	Alt. 2A	Alt. 5
Expansion Size (est.)	15,300 SF	15,800 SF	22,600 SF
Expansion Style	Extension	Modified Extension	Second Concourse Pier 1
Total Gates	9 (+2)	9 (+2)	10 (+3)
Total Parking Stands	14 (+2)	14 (+2)	13 (+1)
Apron Expansion Size	17,100 SY	18,700 SY	27,600 SY
Existing Auto Parking Impacts	No	No	70,000 SF (est. 215 stalls)
Ability to Meet Future Runway 15-33 Airspace	Results In Aircraft Parking Restrictions	Yes; Aircraft Parking limited to Boeing 757	Yes; No Restrictions
Control Tower Line of Sight Requirements Met	Yes	No; Boeing 757 Aircraft Tails Penetrate	Yes
New Terminal Taxilane Limitations	Limited to select Design Group III airplanes on NE side	Limited to select Design Group III airplanes on NE side	None
Federal Inspection Services (FIS)	No; Separate Project	No; Separate Project	Optional; Connection to Expanded GAF/FIS
Constructability	Impacts to Gate 7, Aircraft Maneuvering	Phased Impacts to Gates 6 and 7, Aircraft Maneuvering	Impacts to Gate 1
Ultimate Concourse Plan	Phased Rehab/Replacement	Phased Rehab/Replacement	Phased Rehab/Replacement
Ultimate Expansion Plan	Alt. 5 Expansion or New Concourse (Alt. 6); Limits Ultimate Parallel Terminal Taxilane	Alt. 5 Expansion or New Concourse (Alt. 6A)	Alt. 2 Expansion
Estimated Cost	\$8.4 million	\$8.8 million	\$12.6 million
Relative Ranking	2	1	3

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred)
A preliminary screening was completed to evaluate the ATCT line-of-sight for Alternative 2A development. As shown in the following exhibit, only aircraft tails of the critical aircraft (Boeing 757) would block the direct line-of-sight (LOS) from controllers to Taxiway A. A modified parking layout could be considered during the design phase to minimize impacts. The impact is considered to be acceptable.





Source: KLJ Analysis, Google Earth

Preferred Alternative

A plan that accommodates the airport's development vision is a cornerstone of this Airport Master Plan. FSD airport administration wish to preserve the ultimate terminal airport development vision for a "T" concourse design. Alternative 2A is recommended as the preferred alternative because it provides FSD with the ability to accommodate additional passengers and larger aircraft forecast through PAL 4, but also protect for needs beyond this planning period. Airspace, parking and aircraft maneuvering limitations from the preferred alternative are considered acceptable because forecast facility needs are met. Alternative 2A would be constructed to be compatible with Alternative 6A as the ultimate concourse expansion plan.

Exhibit 5-3: Terminal Concourse and Building Preferred Layout on Page 5-39 graphically depicts the preferred alternative.

Terminal Building

The terminal building is considered to be the functional areas in the non-secure area including ticketing and baggage claim. The terminal building options evaluated were driven by the terminal concourse alternatives.

Considerations

Terminal building needs include expanded baggage claim, baggage handling and car rental concessions. The passenger ticketing lobby and baggage processing facilities are projected to meet demand for the planning period thus no improvements are recommended.

The current U.S. Customs and Border Protection (CBP) facilities are located on the south end of the terminal building and limits expansion of baggage claim facilities. Relocating the facility would be desirable to open up expandable space. Because of ongoing investments made by the airport to

improve the existing facility to General Aviation Facility (GAF) standards, relocating the CBP was considered not to be a financially feasible the short-term.

Rental car facilities are constrained by their location adjacent to a public corridor. When CBP facilities are in-use, this area can become very congested with on 14 feet of width for both queuing car rental customers and passengers in the corridor to exit the terminal.

Concept Evaluation

Concepts were reviewed to provide the airport with a general direction for development. A full analysis was not considered to be necessary as alternatives were limited as a result of CBP improvements and the preferred concourse alternative.

Options to upgrade the existing GAF to an FIS for larger aircraft processing were considered, but dismissed as a result of eliminating the south concourse expansion alternative. This would provide an opportunity for a connection to a new concourse pier or even a dedicated FIS international arrivals gate. Expanding the current CBP facility limits taxilane object free area for the ultimate "T" concourse concept identified in Alternative 6A. A long-term FIS facility could be accommodated in the ultimate terminal building.

Concepts to expand the baggage handling and claim area to the west were explored to meet short-term needs. This would increase the depth without significant impacts to the CBP facility. Three concepts with the same expansion footprint were drafted for Airport consideration. Each short-term baggage claim concept with general use building expansion has an estimated cost of \$4.0 million.









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*Intended for Planning Purposes Only

PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field Terminal Concourse and Building Preferred Layout Exhibit 5-3



Figure 5-18 – Terminal Building Expansion

Source: KLJ Analysis, Google Earth





Source: KLJ Analysis, Google Earth

All concepts considered providing up to four domestic-use baggage claim devices in the long-term by replacing the CBP facility beyond this planning period. No preferred concept was identified for this Master Plan as all options required the same space footprint. A final alternative will be developed during the project design. Alternative 3 however would meet the airport's desire to have a separate baggage claim device for each flight during peak period and was considered an added benefit.

The car rental concessions are located in a congested area. Expanding the front wall of the terminal building to match the east side is recommended to maximize space. This would provide remodel/expansion opportunities to expand the restrooms, conference room, baggage claim/office space, seating area and rental car concession space. An additional 4 feet of corridor space could be created in front of the rental car counters during secure CBP operations. This development is recommended to provide better space utilization but limits expandability and passenger flow.

In the long-term, reducing congestion and providing expansion opportunities for ground transportation concessions were considered in evaluating alternatives. A new ground transportation center connected to the south side of the terminal building would provide a sufficiently sized area to accommodate

relocated car rental and other related concessionaries. This would ease congestion experienced with a narrow corridor especially when the CBP secure area is in-use. The existing GAF would remain. Alternatively, a rental car center connected to a parking structure would also fulfill the same purpose.

Other targeted terminal building improvements include providing non-secure concession area expansion to the west. This will provide flexibility to accommodate additional concession space as demand warrants. An additional improvement is to accommodate a secure FIS arrival corridor exit lane to the non-secure area to complement a future FIS facility in the terminal concourse configuration.

Concept	Actions	Strengths	Weaknesses
No Build	No Build	• Minimal cost	 Does not meet current baggage claim demands
1	 Expand Back Wall by 55 feet for Baggage Handling Construct 3 "T" shape flat plate devices (+/- 150 LF each) One of three devices can be partitioned for CBP use 	 Increases passenger circulation space Improves baggage handling flow Area for expanded baggage claim offices Maximizes baggage claim device frontage 	• Does not provide a claim device for each peak flight
2	 Expand Back Wall by 55 feet for Baggage Handling Construct 3 domestic-use sloped plate devices (+/- 140 LF each) One of three devices can be partitioned for CBP use Relocate Baggage Offices 	 Increases passenger circulation space Improves baggage handling flow Device can accommodate larger bags 	 Sloped plate device will likely result in higher cost Does not provide a claim device for each peak flight Requires relocation of baggage claim offices to new expansion area
3	 Expand Back Wall by 55 feet for Baggage Handling Construct 3 domestic-use circular flat plate devices (140 LF each) Construct one dedicated CBP device (75 LF) Relocate Baggage Offices 	 Increases passenger circulation space Improves baggage handling flow Accommodates fourth baggage claim device 	 Construction of fourth device for CBP device will result in additional cost Requires relocation of baggage claim offices to new expansion area

Table 5-17 – Baggage Claim/Handling Expansion Concepts

Source: KLJ Analysis

Preferred Concepts

All concepts should preserve the expandability of the ultimate terminal concourse vision. Baggage claim expansion concept 3 is recommended because it would preserve investments in the CBP facility and provide dedicated space for peak arrival flight times in the short-term. A terminal building remodel/expansion in the short or mid-term would provide additional usable space. Long-term concept to expand the terminal building to the south for car rental concessions is recommended to ease congestions and provide expansion opportunities. Ultimate expansion of the non-secure concession area and providing a dedicated FIS exit are also recommended for planning purposes.

Exhibit 5-4A: Terminal Building Preferred Interior Development - Upper Level on Page 5-42 graphically depicts the preferred alternative.

Exhibit 5-4B: Terminal Building Preferred Interior Development - Lower Level on Page 5-43 graphically depicts the preferred alternative.

Exhibit 5-5: Ultimate Terminal Vision on Page 5-44 graphically depicts the preferred alternative beyond this airport master planning period.







PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field Terminal Concourse and Building Preferred Interior Development - Upper Level Exhibit 5-4A







PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field Terminal Concourse and Building Preferred Interior Development - Lower Level Exhibit 5-4B



Legend
Gate
× – × Proposed Fence
imes — $ imes$ Existing Fence
Ultimate TOFA
— Ultimate Taxilane/Taxiway Centerline
Building/Road Removal
Existing Hotel
Existing Road
Existing Terminal Building/Concourse
Future Parking Structure Option
Future Taxiway
Ultimate Airport Terminal/Concourse Vision (Alt. 6A)
Future De-Ice/Overnight Parking Expansion
Future Apron Expansion Edge
Pavement/Building Removal
Future Airport Concourse Vision (Alt. 2A)
Ultimate Apron
Ultimate Passenger Loading Bridge
Access Road and Parking Lot
Proposed Loading/Unloading Facility
Proposed Road
Relocated Building

TOFA = Taxiway Object Free Area FIS = Federal Inspection Services



PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field Ultimate Terminal Vision Exhibit 5-5

Terminal Apron

CONSIDERATIONS

The terminal apron needs to be sized to accommodate the maneuvering of the design aircraft for each concourse gate. Facility requirements identified the need for at least two de-icing pads and five additional Remain-Over-Night (RON) parking stands for a total of 17 parking stands. The preferred terminal concourse alternative provides a total of 14 aircraft parking stands. A remote RON parking apron should accommodate at least three aircraft parking positions.

FSD desires to minimize the development of new pavement whenever possible. Combining the de-icing and RON pavement should also be considered. A limitation to meeting full facility requirements is available space and future concourse expansion.

CONCEPTS

Overall

Facility concepts within or near the passenger terminal area were evaluated. A separate centralized airfield or runway end aircraft de-icing facility was conceptually considered. This type of facility is considered ideal by some operators. There is not sufficient facility space to accommodate such a development at FSD, including locating at key departure holding bays without affecting other airport functional areas.

Alternative 1 (North)

Alternative 1 proposes to develop a complex to the north of the terminal building dedicated to de-icing and RON facilities. The concept is compatible with Alternative 2A concourse development. A 400' x 200' de-ice complex allows for in/out access to Taxiway A for one Design Group III and one Design Group IV aircraft simultaneously, or three CRJ-700 aircraft. Two RON hard stands are located immediately to the southeast of the Airport Traffic Control Tower. Aircraft must be towed in/out to prevent jet blast impacts, and be located outside of the east general aviation taxilane OFA. The concept requires the relocation of Taxiway D. RON parking cannot be accommodated because of aircraft tail penetrations to the future Runway 15-33 airspace. This alternative is compatible with future and ultimate development plans. This alternative has an estimated cost of \$5.0 million.

Aircraft tails and de-icing plumes may obstruct the ATCT line-of-sight to movement areas on Runway 15-33 and/or Taxiway A. De-icing operations would be relocated from existing operations that are along a direct line of sight to Runway 33 end.

Alternative 2 (South)

Alternative 2 proposes to develop a complex to the south of the terminal building for de-icing and RON facilities. This option would provide a 400' x 200' space for de-icing outside of taxiway/taxilane object free areas. RON parking cannot be accommodated because of aircraft tail penetrations to the future Runway 15-33 airspace. This facility design requires less pavement than Alternative 1 and makes use of open space with the development of concourse Alternative 2A to the north. This alternative is expandable to the south but may impact the City water well, which would cost approximately an additional \$4 million to relocate. Development of an ultimate "T" configuration would also impact the long-term viability of this configuration. This alternative has an estimated cost of \$5.2 million.

Aircraft tails and de-icing plumes may obstruct the ATCT line-of-sight to movement areas on Runway 15-33 and/or Taxiway A. De-icing operations would be located near a direct line-of-sight to the Runway 33 end.



Figure 5-20 – RON/De-Icing Alternatives



Alternative 3 (Combined)

This option utilizes available space to the north and south of the terminal. Alternative 1 would be developed to the north providing two de-ice aprons and two dedicated RON hard stands. To provide additional RON capacity, a secondary RON apron could be developed south of the terminal concourse and west of the automobile parking area. This area would be constructed as demand warrants to accommodate up to three Design Group IV aircraft. This pavement area is needed for the ultimate terminal concourse configuration, so the investment would be utilized in any ultimate "T" terminal development. Parked aircraft in the south RON apron can be configured to avoid any ATCT line-of-sight restrictions to active movement areas. This alternative has an estimated cost of \$7.5 million.





Source: KLJ Analysis, Google Earth

Alternative	Actions*	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Minimal investment	 RON at capacity around existing terminal Future capacity needs not met 	4
1	 Construct 22,000 SY North De-Ice Apron (2 aircraft) Construct 11,600 SY North RON Apron (2-3 aircraft) 	 Compatible with ultimate concourse vision Maximizes space to north 	 Requires relocation of Taxiway D Results in limited ATCT line-of sight issue De-icing area cannot be used for RON to meet future airspace 	2
2	• Construct 27,500 SY South De-Ice Apron (2 aircraft)	• Located away from ATCT in less constrained area	 Results in ATCT line-of sight issue Requires additional pavement Not compatible with ultimate concourse vision City water well is a constrains De-icing area cannot be used for RON to meet future airspace 	3
3	• Construct Alternative 1 • Construct 18,500 SY South RON Apron (3-4 aircraft)	 Provides additional capacity flexibility South RON apron not an ATCT line-of-sight or airspace issue 	• Development constrained by water well and automobile parking	1

Table 5-18 – De-Icing Facility/RON Apron Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred). *Actions assume separate construction of pavement required for terminal concourse Alternative 2A.

Preferred Alternative

The preferred alternative is Alternative 3. This alternatives best utilizes available space and meets facility requirements. The concept provides a combined de-ice/RON facility to the north of the terminal, with the flexibility to develop additional RON parking to the south.

Exhibit 5-6: De-Ice and Remain Overnight Apron Preferred Development on Page 5-49 graphically depicts the preferred alternative.



Legend	
Gate	
× – × Proposed Fence	
$\times - \times$ Existing Fence	
\times - \times Future Fence Reloc	ation
Future Fence Remo	oval
Future TOFA	
Future Taxiway Strip	De
Future Taxiway Imp	rovement
Access Road and P	arking Lot
Proposed Loading/U	Jnloading Facility
Proposed Road	
Relocated Building	
Building/Road Rem	oval
Existing Hotel	
Existing Road	
Existing Terminal B	uilding
Future Passenger L	oading Bridge
Short-Term Termina	I Building Expansion
Ultimate Airport Cor	acourse Vision (Alt. 6A)
Ultimate Terminal B	uilding Expansion
Future Aircraft De-lo	cing/Overnight Parking Expansion
Future Concourse A	pron Expansion
Future De-Ice/Over	night Parking Taxiway/Taxilane





PRELIMINARY

Sioux Falls Regional Airport Joe Foss Field De-Ice and Remain Overnight Apron Preferred Development Exhibit 5-6



Air Cargo Development Alternatives

Requirements Summary

The air cargo area at FSD is considered vital airport development infrastructure component typically served at a commercial service facility. As a regional hub for two mainline cargo airlines and various regional feeder carriers, accommodating future growth needs at the airport is important. The following section summarizes key air cargo facility requirement findings:

- Provide an additional 31,000 SF of air cargo processing building space to accommodate growing operations.
- Construct an additional 30,600 SY of air cargo apron to accommodate all existing air cargo traffic and expected future air cargo operations.

The critical design aircraft is a Boeing 767-300F, an Airplane Design Group IV airplane with a Taxiway Design Group 5 standards. Through PAL 4, approximately 63 percent more total air cargo processing and storage building space, 46 percent more apron space, and space for an additional 9 cargo aircraft is required to meet forecast demand. Air cargo activity should also be consolidated onto one apron for security and operational purposes.

Considerations

The primary east air cargo area is constrained by West National Guard drive to the northeast, the east general aviation complex to the south, and Taxiway B to the west. The relocation of Weather Lane and John Orr Drive will provide additional landside development space along the southwest portion of the air cargo apron. This project is scheduled for completion in 2015.

Overall, considerations in developing the alternatives included the general geometric constraints of the site with the proximity of the runway/taxiway complex, need for aircraft maneuvering space, need for future expanded apron space for parked aircraft, and the need to preserve for a future cargo processing infrastructure.

Concepts

Several air cargo development concepts were evaluated to best accommodate the facility requirements considering the existing infrastructure and constrained environment. The existing site was considered adequate to accommodate growth. In all alternatives the existing air cargo activity conducted on the east general aviation apron by Landmark Aviation and the UPS building is moved to the air cargo apron. Large aircraft are also proposed to park with their nose facing the cargo processing buildings to maximize the use of existing apron space.

ALTERNATIVE 1

Alternative 1 maximizes existing space with a linear apron expansion to the northeast and southwest. New air cargo building space is provided to the southwest of the existing complex. This expansion would trigger the need to relocate an airfield access gate to the area between the current Sanford and UPS hangars. This alternative provides an ADG-IV taxiway with additional pavement, along with the removal and relocation of the northeast direct access taxiway. Large aircraft configured "nose-in" to the air cargo building and smaller feeder aircraft positioned along the edges of the apron. The proposed configuration provides for 30 aircraft with the forecast fleet mix, meeting the PAL 3 but not the PAL 4 forecast need for 32 aircraft in PAL 4. Apron and building space meet forecast PAL 4 needs. This alternative has an estimated cost of \$13.5 million which includes a 40,000 SF air cargo building.



Source: KLJ Analysis, Google Earth

ALTERNATIVE 2

Alternative 2 also provides for an apron expansion to the southwest and northeast similar to Alternative 1. Taxiway G is removed to accommodate additional small feeder aircraft parking. The northeast apron expansion wraps around the existing air cargo building to reduce the expansion footprint into a previously excavated area. The proposed configuration provides for 36 aircraft with the forecast fleet mix. This configuration meets all PAL 4 facility requirements. This alternative has an estimated cost of \$13.3 million including a 40,000 SF air cargo building.





Source: KLJ Analysis, Google Earth

ALTERNATIVE 3

Based on the previous two alternatives, Alternative 3 provides an option for the apron expansion to wrap around the two air cargo buildings to maximize aircraft parking space. The southeast apron wraps around a new air cargo building requiring the relocation of John Orr drive to an east-west alignment. The southeast apron expansion also has a tighter aircraft parking configuration to park more aircraft. The proposed configuration provides for 39 aircraft with the forecast fleet mix. This configuration meets all PAL 4 facility requirements. This alternative has an estimated cost of \$14.2 million including a 40,000 SF air cargo building.





Source: KLJ Analysis, Google Earth

Table 5-19 – Air Cargo Alternatives

Metric	Alt. 1	Alt. 2	Alt. 3
Building Expansion Area	+104,000 SF	+83,000 SF	+66,000 SF
Apron Expansion	+36,000 SY	+37,800 SY	+46,500 SY
Total Aircraft Parking	30	36	39
Design Group I/II	22	29	32
Design Group III	3	2	2
Design Group IV	5	5	5

Source: KLJ Analysis. Note: Red indicates an individual element that does not meet forecasted PAL 4 requirements.

Table 5-20 – Air Cargo Alternative Evaluation

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Minimal investment	 Does not provide expandable space to meet cargo needs Existing configuration limits aircraft maneuverability 	4
1	Linear Expansion	 Maximizes use of existing apron space Least costly alternative 	 Does not meet PAL 4 aircraft parking needs Requires building removal 	3
2	Linear Expansion w/ Maximized North Expansion	 Maximizes use of existing apron space Meets PAL 4 needs Creates new capacity by removing Taxiway G 	• Requires relocation of CBP building with south expansion	1
3	Linear Expansion w/ Maximized North & South Expansion	 Maximizes use of available development space Meets PAL 4 needs Creates new capacity by removing Taxiway G 	 Requires relocation of facilities and new roadway with additional south expansion Most costly alternative 	2

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred).

PREFERRED ALTERNATIVE

The preferred alternative is Alternative 2 because of its ability to meet PAL 4 facility requirements and best utilize available space with acceptable impacts. It provides adequate airside and landside development space without further impacting other key airport development areas.

Exhibit 5-7: Air Cargo Preferred Development on Page 5-54 graphically depicts the preferred alternative.









PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field Air Cargo Preferred Development Exhibit 5-7

General Aviation Development Alternatives

Requirements Summary

FSD is forecast to see growth in general aviation (GA) operations and based aircraft, particularly with activities tied to business turboprop and turbojet aircraft. Corporate GA is a growing sector of the activity at FSD. It is concluded that the highest and best use of the GA facilities is to accommodate corporate aircraft needs. FSD is the primary airport for this type of activity. Other types of GA activity should be accommodated whenever possible, however these facilities for small aircraft are able to be accommodated alternatively at other airports within the regional aviation system.

The following section summarizes key general aviation facility requirement findings:

- Provide an additional 30 percent of aircraft storage space to meet project demand.
- Provide an additional 23 units or 66,000 SF of aircraft storage building space for corporate and conventional hangar sizes.
- Provide an additional 11 T-hangar units for small aircraft totaling 13,000 SF of space.
- Provide flexible development plans to accommodate growth in east and west development areas.
- Expand overall GA apron space after PAL 2, with an additional 18,700 SY or 27 percent projected by PAL 4 for local and transient aircraft.
- Upgrade the east GA apron to accommodate Airplane Design Group III and 90,000 lb. aircraft to meet growing corporate demands.

Considerations

GA activity at FSD is split between an original east and a new west GA development area. There are now two Fixed Base Operators (FBOs) at FSD. Both the east and west areas accommodate corporate aircraft. The east area has constraints within the hangar area limiting operations to select Design Group II aircraft. A jet-park complex in the southeast corner of the east GA area is planned. The east apron is limited to Design Group II aircraft and 60,000 lbs. aircraft. The new west area is designed to accommodate up to Design Group III airplanes.

An important consideration in developing alternatives is reviewing options to concentrate certain types or groups of traffic into specific areas of the airfield, but also allowing for more flexible development areas. This will allow the airport to be managed and operated more effectively.

Development constraints include numerous water well main lines run under the east GA development area. Placing new buildings over these lines is prohibited. Ideally the water lines should be located in open space for access. East GA development is limited by Minnesota Avenue to the east, a growing air cargo area to the north and a growing passenger terminal apron complex to the south. The west GA development area sector is constrained by the airfield and the Runway 15 holding bay. Existing development including the airfield maintenance complex and SDARNG facility also provide constraints.

Concepts

GA development concepts were split between east and west development areas. A cumulative evaluation was completed to review the best set of combined alternatives to suit the airport.

EAST GENERAL AVIATION

The east GA area is split between two main development sub-sectors; the north and south area split by West Hanger Street. Both the north and south areas are currently limited to 55-foot wingspan aircraft

as a result of Taxiway Object Free Area (OFA) limitations. Common aircraft include smaller Beechcraft King Air turboprop and Cessna Citation business jet aircraft.

Proposed hangar development to the east of the Sanford Hangar (22) in the south half is accounted for in these alternatives.

Hangar Alternative 1

Alternative 1 accommodates a mix of small aircraft and corporate development.

This option replaces two old T-hangar buildings (T3, T4) in the southwest corner with corporate hangar development up to 80' x 120' in size consistent with the demand. Direct and indirect landside access would be provided. Another corporate hangar complex on the east side is proposed to maximize the use of space. The current wingspan restriction on the south side is removed by shifting the south taxiway to accommodate a full Design Group II OFA for aircraft wingspans up to 79 feet. Smaller planned hangars allow existing corporate structures to remain.

A planned southeast corporate complex for three 80' x 100' hangars with landside access would be preserved. The remnant parcel at the corner of Minnesota Avenue and West Hanger Street dedicated for non-aeronautical development such as a gas station/retail store. The airport has expressed a desire to have corporate hangars located within sight lines to the passenger terminal entrance road.

The north side access would remain limited to 55-foot wingspan aircraft. Hangar T1 would be replaced with a 12-unit facility, and a new 8-unit T-hangar is proposed to the east. A Design Group I taxilane would provide access to a corporate hangar area to accommodate at least six 60' x 60' hangars. A second row could be developed however the city's well main would pass under the apron pavement serving each hangar. The water well could also be relocated behind the hangar lots. Lots 29 and 30 would continue to be planned for corporate hangars.

The net effect is the loss of 4,800 SF of T-Hangar space (8 units) with up to an additional 139,200 SF of corporate hangar space. This alternative has an estimated infrastructure cost of \$1.5 million.



Figure 5-25 – East General Aviation Alternative 1

Source: KLJ Analysis, Google Earth

Hangar Alternative 2

Alternative 2 provides for additional larger corporate hangar development.

This option also proposes taxiway shift to accommodate full Design Group II access on the south side. Three T-hangar buildings (T3, T4, T5) and an existing corporate hangar are to be removed or relocated for a reconfigured corporate hangar development to accommodate up to six corporate hangars up to 80' x 120' in size. Landside access would be provided to each hangar. Similar to Alternative 1, a southeast corporate hangar complex with a shifted taxiway on the east side is proposed to maximize the use of space. Non-aeronautical development is proposed in areas not suitable for aeronautical use.

The north side access is proposed to be expanded to remove the existing OFA limitation. The current Sanford hangar would be removed the taxiway shifted north to provide a 104' OFA to accommodate aircraft up to 72.4' in wingspan. Hangar T1 would be the controlling structure. This removes restrictions to provide for additional corporate hangar development.

The north development area would feature a 12-unit T-hangar replacement for hangar T1, three new 60' x 60' hangars with Design Group I taxilane access, and a new corporate hangar area accommodating up to four 80' x 100' hangars with an upgraded taxiway and dedicated landside access. The city water well main would have to be relocated under new proposed buildings under hangar access pavement. Lots 29 and 30 would continue to be planned for corporate hangars.

The net effect is the loss of 30,800 SF of T-Hangar space (30 units) with up to an additional 136,200 SF of corporate hangar space and the loss of 12,200 of conventional hangar space from the removal/relocation of the Sanford Hangar. This alternative has an estimated infrastructure cost of \$2.1 million.





Source: KLJ Analysis, Google Earth

Hangar Alternative 3

Alternative 3 accommodates small aircraft with T-hangars, combined with some corporate hangar development.

The south access taxiway is proposed to shift to accommodate full Design Group II access on the south side to serve a future corporate hangar area on the east side. Other development areas focus on smaller aircraft. Two T-hangar buildings (T3, T4) are proposed to be replaced with the area expanded to accommodate a total of four buildings with 32 units for Design Group I aircraft. This configuration makes the highest and best use of existing investments. An additional two small conventional hangars would be provided to the north of hangar 16. Landside access would also be provided. The corporate area with a shifted taxiway and space for non-aeronautical development is provided for in the plan on the east side.

The north side access is proposed to remain limiting wingspans to 55 feet. Hangar T1 would be replaced in the future by a 12-unit structure. A new Design Group I T-hangar development area is proposed to the east of Hangar T1. In total, the north area will accommodate accommodating 48 new or replaced T-hangar units. The city well line would run under public apron pavement. Lots 29 and 30 would continue to be planned for corporate hangars.

The net effect is the gain of 78,400 SF of T-Hangar space (60 units) with up to an additional 42,200 SF of corporate hangar space. This alternative has an estimated infrastructure cost of \$1.2 million.



Figure 5-27 – East General Aviation Alternative 3

Source: KLJ Analysis, Google Earth

Apron Alternative

Due to limited expansion opportunities, one primary apron alternative was proposed to accommodate the east apron for additional aircraft parking demand and Design Group III aircraft. For purposes of this plan, the hangars located along the apron are not proposed to change configuration.

The only viable apron expansion area is to the west. Proposed expanded air cargo and passenger terminal apron facilities to the north and south, respectively, provide growth constraints in the east general aviation area. A proposed apron expansion to the west was explored.

The apron expansion necessitated the removal of Taxiway E to maximize available aircraft parking space for Design Group III maneuvering. Taxiway D would be reconfigured for direct ingress and egress, driven by the preferred passenger terminal complex development. It would also match up with a future Design Group II taxiway shift to serve the south hangar area. Ultimate development for Design Group III into the hangar area is also considered. This configuration eliminates the taxiway "hot spot". Removing Taxiway E and the existing city well also provides additional apron parking area along the existing apron.

The apron expansion provides for Design Group III taxiway and taxilane setbacks for maneuvering. Accommodations were made for the helipad. The apron edge must be setback at least 208 feet from the helipad final approach and takeoff area (FATO) for provide for a clear 8:1 approach. For planning purposes the tail height of a common Design Group III aircraft, a Gulfstream G650 was assumed at 26 feet. Aircraft parking areas will remain outside of the Helipad Protection Zone (HPZ).

The total proposed expansion provides approximately an additional 40 percent of aircraft parking space outside of OFA limits over the current value. Total east apron area proposed is 77,500 square yards. The pavement strength would also need to be upgraded to accommodate up to 90,000 pounds with occasional use of aircraft greater than this weight. Expansion area would provide for overnight parking.

This alternative has an estimated cost of \$7.3 million for apron reconstruction and \$2.7 million for expansion.





Source: KLJ Analysis, Google Earth

WEST GENERAL AVIATION

The west GA area was constructed in 2010 is utilized as a corporate aircraft area providing large convention hangar space for aircraft as large as Design Group III.

Base Alternative 1

Alternative 1 is the base alternative for future west GA improvements. Because this area was designed for Design Group III aircraft future development has focused on accommodating the largest aircraft. Proposed development includes a conventional hangar expansion area to the northwest. Up to six 120' x 120' hangars are shown on the proposed plan with landside access. A Design Group III taxiway would be constructed to provide airside access. The apron size provides 7,400 square yards of expansion space for push-in/pull-out aircraft parking along the southeast edge of the apron for up to Design Group III aircraft. This intent is that this area is used for overnight parking. This alternative has an estimated infrastructure cost of \$1.7 million.



Source: KLJ Analysis, Google Earth

Hangar Alternative 1A

Alternative 1A provides for an option to expand conventional hangar development to the east of the Maverick FBO complex off of Taxiway L. These three 120' x 120' hangars feature dedicated landside and airside access. A connection to redeveloped west cargo area is also proposed with the replacement of the alert hangars with corporate facilities. A total of 6,400 square feet (SF) of new corporate hangar space and 129,600 SF of conventional hangar space is provided in Alternative 1A. This alternative has an additional estimated infrastructure cost of \$1.4 million.

This development concept leaves approximately 2.8 acres of space for a future ATCT site, as this area was identified as a potential feasible development area.



Figure 5-30 – West General Aviation Alternative 1A

Source: KLJ Analysis, Google Earth

Hangar Alternative 1B

Alternative 1B provides an option to construct a Design Group I small aircraft development area to the east of the Maverick FBO complex off of Taxiway L. Phase I development includes two 10-unit T-hangars and four 50' x 50' corporate hangars. This development concept also leaves approximately 2.8 acres of space for a future ATCT site. Landside access is provided to the taxilane from the northeast. A redeveloped west cargo area is also proposed with corporate hangars. This alternative has the potential to add four additional 60' x 60' corporate hangars for 55' wingspan aircraft if an ATCT is constructed and Alternative 1C is not constructed. A total of 25,000 SF of T-hangar space, 30,800 SF of corporate hangar space is provided. This alternative has an additional estimated infrastructure cost of \$1.0 million.





Source: KLJ Analysis, Google Earth

Hangar Alternative 1C

Alternative 1C builds upon Alternative 1B. It provides additional Design Group I small aircraft development space in lieu of protecting for a future ATCT site and larger hangars for 55' wingspan aircraft. Additional 50' x 50' conventional hangars and two additional 10-unit T-hangar buildings are planned in this option. A total of 50,000 SF of T-hangar space, 26,400 SF of corporate hangar space (20,000 SF for Design Group I aircraft), and 129,600 SF of conventional hangar space is provided. Landside access is provided to taxilanes from the northeast and southwest areas. A redeveloped west cargo area is also proposed for corporate hangars. This alternative has an additional estimated infrastructure cost of \$1.6 million.





TOTAL EVALUATION

In reviewing each alternative for the GA hangar areas, specific elements can be selected from each alternative to combine into a preferred alternative to carry forward. The preferred alternatives should meet the overall GA hangar and apron facility needs through PAL 4 for the forecasted fleet mix. A review of the alternatives in the following table including a comparison to the PAL 4 facility requirements.

Metric	East GA Alt. 1	East GA Alt. 2	East GA Alt. 3	West GA Alt. 1A	West GA Alt. 1B	West GA Alt. 1C
T-Hangar Units	-8	-30	+60	0	+20	+40
T-Hangar (SF)	-4,800	-30,800	+78,400	0	+25,000	+50,000
Corporate (SF)	+139,200	+136,200	+42,200	+6,400	+30,800	+26,400
Conventional (SF)	0	-12,200	0	+129,600	+129,600	+129,600
Apron (SY)	+17,100	+17,100	+17,100	+7,400	+7,400	+7,400

Table 5-21 – General Aviation Alternative Comparison to Facility Requirements

Source: KLJ Analysis. Note: Red indicates an individual element that does not meet forecasted PAL 4 requirements.

FSD would like to develop both the east and west areas to maximize development opportunities, therefore a preferred east and west alternative was selected. The combination of the two alternatives should be compared to the overall FSD facility requirements. The following alternative combinations were generally able to meet or exceed hangar facility requirements:

- East GA Alt. 1 and West GA Alt. 1C
- East GA Alt. 2 and West GA Alt. 1C (short by 1 T-hangar unit)
- East GA Alt. 3 and West GA Alt. 1A, 1B and 1C

The following table evaluates the strengths and weaknesses of each general aviation alternative.

Alternative	Actions	Strengths	Weaknesses
East GA Alt. 1	Develop for a mix of Corporate and small aircraft	 Accommodates Design Group Il corporate use on south side Dedicated area for smaller GA aircraft on north side 	• North hangar layout requires relocation of water well main line
East GA Alt. 2	Develop for primarily Corporate aircraft	 Dedicated landside access for south corporate development Maximizes GA corporate development to fit majority of needs 	 Expanded north access taxilane OFA requires impacts to Sanford Hangar North hangar layout requires relocation of water well main line Sacrifices small GA aircraft hangar development area
East GA Alt. 3	Develop for primarily small aircraft	 Maximizes small aircraft development Utilizes existing taxilanes in south area for T-hangars 	 Mix of corporate and small GA development in south area Sacrifices corporate aircraft hangar development
West GA Alt. 1A	Develop for large corporate aircraft	 Maximizes development for Design Group III aircraft -Protects for future ATCT 	• No development for small aircraft needs
West GA Alt. 1B	Develop for future ATCT, large corporate, small aircraft	 Protects for future ATCT Provides expansion to meet small aircraft needs Flexible to provide hangars for some Design Group II aircraft (no Alt. 1C option) 	• Sacrifices opportunity for additional corporate hangar development complex
West GA Alt. 1C	Develop for large corporate and additional small aircraft	 Flexible development when coupled with Alt. 1B Maximizes small aircraft development without major redevelopment 	 Sacrifices ATCT site for small GA aircraft hangar development Sacrifices opportunity for additional corporate hangar development complex

Table 5-22 – General Aviation Alternative Evaluation

Source: KLJ Analysis

The recommended East GA option is to develop the south portion of the East GA area for large conventional hangars for Design Group II aircraft as identified in Alternative 2. This will provide favorable views from the terminal area and also continue with existing corporate hangar development patterns. The north portion is recommended to follow Alternative 1 be dedicated for Design Group I and smaller Design Group II aircraft as a result of existing taxiway entrance constraints. This alternative has an estimated infrastructure cost of \$1.6 million.

The west GA preferred alternative is 1B to provide the conventional hangar space needed and flexibility of additional Design Group I hangar development. If no ATCT site is needed, then Alternative 1C development can proceed. This preferred development allows for the flexibility to development hangars for both small and large aircraft on the east and west portions of the airport. Total estimated non-building infrastructure cost is \$3.3 million.

1	1	
1	1	

Table 5-23 – General Aviation Preferred Alternative

Metric	East GA Alt. 2 (South)	East GA Alt. 1 (North)	West GA Alt. 1C	TOTAL
T-Hangar Units	-30	+12	+40	+22
T-Hangar (SF)	-33,900	+16,900	+50,000	+16,000
Corporate (SF)	+74,200	+54,400	+26,400	+155,000
Conventional (SF)	0	0	+129,600	+129,600
Apron (SY)	+17	,100	+7,400	+24,500

Source: KLJ Analysis. Note: Red indicates an individual element that does not meet forecasted PAL 4 facility requirements.

Exhibit 5-8: East General Aviation Preferred Development on Page 5-65 graphically depicts the preferred alternative.

Exhibit 5-9: West General Aviation Preferred Development on Page 5-66 graphically depicts the preferred alternative.



Legend
Existing Water Well Main
$\times - \times$ Existing Fence
× – × Future Fence
$\times - \times$ Future Fence to be Removed
Water Well Main to be relocated
Future Transient Aircraft Loading/Unloading Zone
Future Taxilane Object Free Area
Future Access Road/Parking Lot
Future Aircraft Parking Area
Future Aircraft Storage Hangar/Building
Future Non-Aeronautical Land Use Area
Future Parking Lot
Future Taxilane/Apron Pavement
Future Building/Pavement Removal



PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field East General Aviation Preferred Development Exhibit 5-8









PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field West General Aviation Preferred Development Exhibit 5-9

Landside Development Alternatives

Requirements Summary

The following section summarizes key landside facility requirement findings:

- No additional significant passenger terminal curbside or access improvements are needed.
- Additional total public automobile parking space is needed now. There is a need for an additional 500 public parking spaces in PAL 1 with nearly 1,600 additional public parking spaces by PAL 4.
- Construct an expanded employee parking area by PAL 2.
- Expand the rental car ready/return parking area in the short-term and expand the rental car storage parking area after PAL 1.
- Construct a 13,300 SF rental car Quick Turn Facility (QTF) to meet the needs through PAL 4.
- Plan and construct a west airport access road to serve west GA and SDARNG areas to improve access.

Terminal Curbside & Access

The passenger terminal curbside area meets the projected facility requirements providing an adequate level of service. An expanded inner curbside area would provide an enhanced service level for passenger drop-off and pick-up. All of the existing terminal frontage is utilized for curbside. A terminal expansion of 80 feet could provide a total curbside length of 660 feet. This would provide an enhanced level of service. Constructing a dual-level roadway is not necessary nor reasonable at this facility. Lengthening the curbside frontage is the best option for enhanced passenger convenience at FSD.

Recent improvements have been made to the terminal roadway including a passenger pickup waiting lot, ticketless parking, "second chance" return-to-terminal roadway and a signalized intersection at the main airport entrance/exit. The existing configuration provides an acceptable level of service for the planning period. Additional parking signage would enhance passenger convenience. As parking is expanded, additional credit card self-service exit points are recommended to improve traffic flow. No configuration changes are recommended to meet PAL 4 needs.

Automobile Parking

CONSIDERATIONS

Parking Needs

FSD has been developing surface parking lots to meet its growing needs to date. The airport will have a need for 1,550 more space by PAL 4. The furthest extent of the south parking lot is at most about 1/4 mile away from the terminal building. Because of this distance, FSD has provided a seasonal shuttle service from December to March from this lot to the terminal. The only opportunity for expandable surface parking space on-airport is to the south but is limited to the west by Runway 15-33 airspace protection for light poles. Surface parking evaluations assume 350 square feet per space which matches the current FSD ratio.

Previous Study Results

A landside access, parking and security study completed for FSD in 2011 recommended the development of a parking structure to the south of the terminal building. This expandable structure not only provides additional covered parking in close proximity to the terminal, but also can incorporate rental car ready/return facilities on the lower level. A parking structure in front of the terminal was also evaluated and will be reviewed for compatibility with this Master Plan.

Available Airport Land for Surface Parking Expansion

A water well owned by the City of Sioux Falls is located on approximately 1.0 acres. While the well is expected to remain in service, approximately 1.0 acres could be utilized for additional surface parking through the acquisition of a land use easement.

The Runway 27 approach also has a bearing on the availability of land for future surface parking. If the runway is classified for small aircraft exclusively, new FAA regulations allows the size of the FAA Runway Protection Zone to be reduced from 13.77 acres to 8.035 acres. A near-term change to the runway classification will allow for additional 2.2 acres of surface parking opportunities.

Future Actions Which Could Impact Airport Land Used for Surface Parking

A holding bay is recommended for Runway 33 to meet aircraft capacity needs. The construction of this facility would likely trigger the need to construct a jet-blast fence if parking were placed nearby. Alternatively, a bypass taxiway could be constructed to acceptably enhance capacity and reduce impacts.

Terminal building and concourse development options would also reduce the number of available spaces so this design must also be considered in meeting overall PAL 4 needs.

CONCEPTS

Both a parking structure and surface parking concepts were evaluated for ability to meet peak parking demands and for impacts upon the airport. The concepts evaluated were limited to maximizing the use of space in the existing on-airport terminal complex. The table at the end of this section provides strengths and weaknesses of each concept. The options assume preferred terminal concourse development as shown in this Alternatives chapter.

Surface Parking

Alternative 1 (1,000' Wide Primary Surface)

Alternative 1 provides utilizes the space south of the existing long-term 765-stall surface economy lot for automobile parking expansion. There is up to 11.9 acres available for additional surface parking space which would accommodate an additional 1,480 spaces. Development maximizes the available space between Minnesota Avenue and the 35-foot vertical building restriction line for Runway 15-33, protecting for a future 1,000-foot wide primary surface. This includes utilizing city well property for parking. The surface parking expansion would require a full-time parking shuttle operation because the southern extent of the lot would be 2,000 feet from the terminal building. A site for a relocated rental car quick turn facility is proposed on the south side of the existing rental car parking lot. Car rental parking expansion would occur to the west of the existing lot.

Development of this alternative would accommodate total parking needs through PAL 3 only. This would require a parking structure, remote parking or off-airport parking to meet PAL 4 and ultimate peak demand. Development of the ultimate terminal concourse would remove about 2.5 acres of surface parking, which would reduce total surface parking capacity to only meet PAL 2 peak demand.

Alternative 2 (500' Wide Primary Surface)

Alternative 2 expands surface parking by an additional 5.1 acres or 630 spaces over Alternative 1 if Runway 15-33 is protected only for a 500' wide primary surface. This moves the 35-foot vertical building restriction line 250 feet closer to Runway 15-33 centerline. This development alternative would potentially restrict the utility of Runway 15-33 and remove the option to improve the approach minimums on Runway 15-33 to ³/₄ mile. Surface parking would be located nearly ¹/₂ mile away from the terminal building and would require an airport shuttle service. A site for a relocated rental car quick turn facility is proposed on the south side of the existing rental car parking lot. By adding this additional parking area the PAL 4 automobile parking needs are met. Development of the ultimate terminal concourse would remove an about 2.5 acres of surface parking, which would also not meet PAL 4 projected peak demand.





Source: KLJ Analysis, Google Earth

Parking Structure

Surface parking within the existing terminal complex does not meet PAL 4 peak demands when considering the preferred airfield configuration. Additionally, the ultimate terminal development vision would further reduce surface parking. As a result, options to construct a parking structure were evaluated. A parking structure also provides benefits including covered parking desired by airport users in close proximity to the terminal, however have high initial and ongoing maintenance sots. Airport management considers a 1,000 stall parking structure to be a minimum size.

Parking Structure Alternative 1 (Terminal Parking Structure)

Alternative 1 reviewed a parking structure located adjacent to the terminal building to the east, above the existing short-term parking lot. The recommended structure is approximately 600' x 163' immediately adjacent to both the ticketing and baggage claim areas further enhancing passenger convenience. The structure is not limited by the future terminal concourse and building expansion, thus provides the airport with future development flexibility. The site would also be compatible with future entrance/exit roadways similar to the 2011 study. Short-term parking would be covered.

Each level of the structure would accommodate approximately 280 parking stalls. A four-level structure would provide an additional 1,120 parking stalls in elevated levels. The lower level would accommodate covered short-term parking or rental car ready-return spaces. Two covered surface connections to the terminal building are recommended. Overall peak automobile parking capacity needs are met with the development of this parking structure combined with surface parking Alternative 1. The need for expanded surface parking is reduced. The structure also would be expandable to provide additional height. A multi-level parking structure however would limit the visibility of the terminal building from Minnesota Avenue.

Alternative 1 has a total estimated cost of \$22.4 million.



Source: KLJ Analysis, Google Earth

Alternative 2 (South Parking Structure)

Alternative 2 re-evaluated a parking structure located to the south of the terminal building from the 2011 parking study. The recommended structure is 380' x 140' located south of the terminal building baggage claim/rental car complex. This structure should be located 100 feet south of a future planned building expansion to meet security setbacks. The structure location needs to be modified to be compatible with the ultimate terminal concourse vision. This restricts the structure size. The site would be compatible with future entrance/exit roadways similar to the 2011 study. The structure provides the option to have covered rental car ready/return parking and provide added convenience for arriving at baggage claim passengers. A covered surface connection to the terminal building is recommended.

Each level of the structure would accommodate approximately 150 parking stalls. A seven-level structure would provide an additional 1,050 parking stalls in elevated levels. The lower level could accommodate rental car ready/return parking needs. Overall peak automobile parking capacity needs are met with the development of this parking structure combined with surface parking Alternative 1. The structure would be minimally expandable. Maximum height is about 130 feet (approximately 8 levels) including any top level lights.

Restrictions may have to be placed on the northwest corner if terminal concourse were constructed due to proximity to aircraft. A jet blast wall may also be needed. The final design of the structure would need to be reviewed for existing surface parking stall impacts.

Alternative 2 has a total estimated cost of \$21.0 million.

Preliminary Economic Evaluation

A preliminary economic evaluation was completed to compare the two options of constructing surface parking alone versus constructing surface parking and a parking structure. Parking structure Alternative 2 was evaluated. The exercise evaluated the initial construction cost and long-term benefit. Variables and assumptions included:

- Construction Need:
 - Total Parking: 2,000 stalls
 - Parking Structure Option: 1,050 parking stalls and 950 surface parking stalls
 - Surface Parking Option: 2,000 surface stalls
- Initial Construction Cost:
 - Parking Structure: \$20,000 per stall
 - Surface Parking: \$2,500 per stall
- Debt Service:



- About 3% interest rate
- Parking Demand:
 - 1,456 average daily parkers in PAL 2 (50% of peak)
 - o 20% of average day parkers utilize parking structure or additional surface parking
 - Values adjusted for surface parking if additional capacity needed
- Parking Revenue:
 - Parking Structure: \$10 per day per occupied stall
 - Surface Parking: \$5 per day per occupied stall
- Surface Parking Shuttle Operation Cost:
 - \circ \$250,000 annually for full-time shuttle service
- No inflation
- No on-going facility maintenance costs

An average daily parking count of 220 cars allows the parking structure/surface parking option to break even over 20 years. An average daily parking count of 359 will allow the parking ramp option to generate additional net income than surface parking alone in 20 years. The comparison of net income per parking stall is shown in the following table. Further study should be completed during the project planning phase.

Figure 5-24 – Automobile Parking Financial Evaluation



Source: KLJ Analysis

It should be noted that it is expected that additional parking customers are willing to pay more to park in a parking structure than a remote parking lot with a shuttle. The parking structure would accommodate both short-term and long-term parkers. A full detailed feasibility analysis should be completed prior to programming the project for funding.

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Minimal capital investment	 Reduces FSD passenger convenience Lost revenue opportunities Increased competition from off-airport parking providers 	4
Surface Parking Alt. 1	Construct 11.9 acres of parking (+/- 1,450 stalls)	 Protects airspace for the enhanced utility of Runway 15-33 Lower initial capital investment than parking structure 	 PAL 4 peak parking needs not met (PAL 3 needs met) May require additional setbacks or jet blast fence for parking near airfield Requires full-time shuttle service or long uncovered walk for passengers 	1
Surface Parking Alt. 2	Construct 15.4 acres of parking (+/- 1,900 stalls)	 PAL 4 peak parking needs met Lower initial capital investment than parking structure 	 Does not protect for preferred Runway 15-33 airspace; limits future runway utility May require additional setbacks or jet blast fence for parking near airfield Limits Runway 33 holding bay development Requires full-time shuttle service or long uncovered walk for passengers 	3
Parking Structure Alt. 1	Construct 4-level 600' x 163' parking structure in front of terminal (+/- 1,120 stalls)	 Additional capacity allows peak PAL 4 parking needs to be met with surface parking Larger parking structure able to be constructed Increased concourse development flexibility Maximizes passenger convenience with shortest walking distances and covered parking Greater net income projected than surface parking alone 	 Highest initial capital investment cost (\$22.4 million) Location reduces visibility of terminal from Minnesota Avenue 	24
Parking Structure Alt. 2	Construct 7-level 380' x 140' parking structure south of terminal (+/- 1,050 stalls)	 Additional capacity allows peak PAL 4 parking needs to be met with surface parking Enhanced passenger convenience with shorter walk distances and covered parking Greater net income projected than surface parking alone Opportunity for rental car parking in lower level, introducing local funding opportunities 	 High initial capital investment cost (\$21.0 million) Reduced footprint as a result of ultimate terminal concourse vision Limited expansion opportunities 	28

Table 5-25 – Automobile Parking Alternative Evaluation

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred).

Preferred Alternative

Surface Parking Alternative 1 is recommended to preserve the future utility of Runway 15-33. In addition to surface parking, a parking structure would enhance passenger convenience, meet peak parking capacity needs and allow for an ongoing enhanced revenue stream. Development of Alternative 2 to the south appears to be the more locally acceptable alternative as a result of its location providing covered rental car ready/return parking and the location not blocking the view of the terminal building. Both parking structure alternatives however will be shown in the Airport Layout Plan for flexibility. A parking study should be completed in the project planning phase to determine the preferred alternative. Both structures provide sufficient capacity and enhance passenger convenience. Surface parking to the south would continue to develop to meet future capacity needs. The development cost of the surface parking is \$2.4 million and Alternative 2 parking structure is \$21.0 million.

Exhibit 5-10: Passenger Terminal Parking Preferred Development on Page 5-74 graphically depicts the preferred alternatives.






*Intended for Planning Purposes Only

PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field Passenger Terminal Parking Preferred Development Exhibit 5-10

Ground Access & Circulation

WEST AIRPORT ACCESS

Roadway Benefits

Public access to the west side of the airfield would provide several benefits to the airport including shorter access times from points north and west, and developing access infrastructure for potential aeronautical and non-aeronautical development. Development within airport property has revenue generation opportunities.

Previous Studies

Conceptual roadway corridors and connections were explored during the completion of the West 60th Street corridor study completed in May 2012. The study proposed capacity and intersection enhancements to West 60th Street. A west airport access road alignment was shown to in general alignment of West 57th Street North.

Future expansion of West 60th Street included two grade separation options; constructing grade separating bridges (Option 1) and constructing at-grade crossings (Option 2) at railroad crossings. Option 1 reduces the number of possible entry points from a west airport access road and West 60th Street. A north-south connection with West 60th Street is recommended along an extended of Bobhalla Drive. Access to West 60th Street is assumed to be located on the western side of airport property at the Bobhalla Drive extension. According to engineering staff at the City of Sioux Falls in March 2015, Option 1 is preferred and no West 60th Street access is possible east of Bobhalla Drive to the railroad crossing.

FAA and Local Considerations

The future access roadway and public roadway right-of-way would run through airport property thus a concurrent use agreement would be required to meet FAA grant assurances. No new roads should be constructed within the Runway 15 RPZ. Protection for instrument approach minimums as low as ³/₄ mile is recommended. Airspace must also be considered including avoiding new development within an assumed Runway 33 One-Engine Inoperative (OEI) surface (62.5:1) whenever possible. This may require the grading of a hill to the northwest of Runway 15 end.

The alignment of the roadway has the potential to shape future aeronautical and non-aeronautical development in the west general aviation area. Areas to the east of the Big Sioux River could connect to the airfield. The area directly to the north of Sanford Sports Complex could be used for compatible non-aeronautical use. All alternatives require a bridge to cross the Big Sioux River with access to West National Guard drive at a "T" intersection. A through street is not recommended because it has the potential to become a shortcut for public vehicles desiring an alternative route to West 60th Street. The roadway alignment should also consider local drainage improvements.

Alternatives

The initial recommended segment access point is at the intersection of a northerly extension of Bobhalla Drive and a West 57th Street extension. This provides connectivity to the West 60th Street corridor. The public right-of-way for Bobhalla Drive would be within airport property and would have to undergo a land release requiring FAA approval.

Alternative 1 (60th Street Study)

Within airport property, roadway alignment Alternative 1 proposes approximately 6,000 linear feet of street along an alignment that crosses the Big Sioux River on the eastern side of airport property terminating at West National Guard Drive with an optional connection with an extended Maverick Place. A conceptual alignment was proposed in in the West 60th Street corridor study. This provides a 29 acre development parcel with airfield access. It is also compatible with proposed SDARNG drainage improvements. The estimated cost of the alternative is \$4.9 million.

Alternative 2 (Modified Alignment)

Alternative 2 proposes approximately 5,500 linear feet of street along an alignment that crosses the Big Sioux River between the railroad and Runway 15-33 terminating at West National Guard Drive with an optional connection with an extended Maverick Place. This alignment provides a more direct route to Bobhalla Drive but divides airport property to the east of Runway 15-33. This alignment provides a 14 acres parcel with aeronautical access and a secondary 10 acre parcel. The estimated cost of the alternative is \$4.7 million.

Preferred Alternative

Alternative 1 alignment is recommended to maximize airport property development opportunities within airport property on the southeast side of the Big Sioux River.

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	No Action	• Minimizes capital investment	 Results in longer access times to the west development area from points north and west Limits development and on-airport revenue generation opportunities 	3
Alternative 1	Ative 1 Construct 1.0 mile road road Ative 1 Construct 1.0 mile road Ative 2 Provides 29 acres parcel with airfield access for development Ative 2 Require large capital investment		 Longer roadway alignment versus Alternative 2 Require large capital investment 	1
Alternative 2 Construct 0.9 mile road		 Provides 14 acres parcel with airfield access, 10 acre parcel for development Shorter roadway alignment 	 Divides development space with possible access to airfield Require large capital investment 	2

Table 5-26 – West Access Road Alternatives

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred).



Figure 5-35 – West Access Road Alternatives



Exhibit 5-11: West Aviation Area Preferred Development on Page 5-78 graphically depicts the preferred alternatives.



Legend				
Existing Airport Easement				
Existing Airport Property				
Future Airport Property				
Existing Airport Perimeter Road				
Future Aircraft Storage Hangar				
Future Apron/Taxiway Pavement				
Future Perimeter Road Removal				
Optional Future Air Traffic Control Tower (ATCT) Site				
Future Road				
Future Taxiway Removal				
Future Runway Protection Zone				
Ultimate Aircraft Storage Hangar				
Ultimate Pavement				

Notes:

- **1.** Future 60th Street roadway expansion planned by City of Sioux Falls
- 2. Roadway connection not possible with 60th Street grade separation design (Option 1) at railroad crossing.
- 3. "T" Intersection design to discourage public use of roadway as shortcut through airport from 60th Street to/from Minnesota Avenue
- 4. Modification to Intersection
- 5. West National Guard Drive to remain
- 6. A perimeter road alignment around Runway 21 would trigger an FAA Runway Protection Zone (RPZ) study of West National Guard Drive
- Future Roadway Extension to Westport Avenue
 Future Bobhalla Drive Extension





*Intended for Planning Purposes Only

PRELIMINARY



Sioux Falls Regional Airport Joe Foss Field West Aviation Area Preferred Development Exhibit 5-11

Support Facilities & Other Development Alternatives

Requirements Summary

The following section summarizes key support and other facility requirement findings:

- Maintain the ARFF facility to comply with Index B requirements through the planning period.
- If desired by the airport, provide at least an additional 9,000 SF of CBP space for a small airport facility to accommodate international charters.
- Provide a location for an ultimate FIS facility.
- Maintain an airfield perimeter fence to FAA and TSA standards for adequate security, access and wildlife control.
- Upgrade the internal access road to minimize crossing airfield areas.
- Identify areas for potential compatible other aeronautical or non-aeronautical development.

Fueling Facilities

The need to accommodate additional fueling storage capacity through PAL 4 can be accommodated through an expansion of existing fueling facilities at the current sites for airport and FBOs. The Airport continues to desire the use of FBO services for small and large fueling; no separate public 24-hour self-serve fuel facility is desired by the airport at this time.

Below ground fueling facilities for a new rental car quick turn facility (QTF) are proposed to be within a 1,000 foot City of Sioux Falls water well buffer guideline. With few alternative QTF sites, airport management would work the city on specific site design standards.

Aircraft Rescue and Fire Fighting (ARFF)

The ARFF station is owned and operated by SDARNG. Their goal is to maintain a state-of-the-art ARFF capabilities. The existing facility meets critical access requirements. FSD is forecast to continue to need to meet Index B requirements. The SDANG facility master plan (September 2014) identifies a shortfall of 4,432 SF for operational and living areas including administration offices, on-site fitness center, equipment storage and apparatus bay. The total need is 6,262 SF throughout the planning period.

There is sufficient space in and around the existing ARFF station to accommodate the projected facility needs. Upgrades are recommended at the existing site. A proposed 4,682 SF ARFF building addition (SDANG Building 16) was requested for funding by SDANG.

Airport Maintenance & Snow Removal

The airport maintenance complex was developed in 2007 to accommodate the current needs and provide expandable space for future needs. The current complex is approximately 4.5 acres accommodating the primary airport maintenance building and an outbuilding relocated to the site. The west general aviation access alternatives propose to preserve an additional 1.5 acres for a total site of 6 acres dedicated to airport maintenance. This 6 acre site, along with expandability on the current site is considered adequate to meet PAL 4 needs.

Customs and Border Protection (CBP)

A CBP General Aviation Facility (GAF) is currently located within the passenger terminal building. Upgrades were approved by FSD in 2014 to allow this facility to meet CBP standards.

Passenger terminal building alternatives considered future CBP facilities. The current GAF facility will remain in its current location. Short-term passenger terminal development will consider the GAF footprint. An upgrade to a small airport facility accommodate international charters requires 9,000 SF of space. This facility is not able to be accommodated in the current site with the ultimate terminal "T" concourse.

An ultimate "T" terminal concourse allows the relocation and development of CBP FIS/GAF facilities to a central location. A combined FIS/GAF facility should also be accommodated in this location for cost and operational efficiency. This will also open up full utilization of the terminal building for ultimate baggage claim expansion. After a review of the airfield, an alternative location for a stand-alone GAF facility could not be identified without significant changes to this Master Plan. It is recommended CBP facility needs be explored in more detail when terminal concourse upgrades are needed.

Security, Access & Wildlife

It is recommended to upgrade and maintain a full airport perimeter security/wildlife fence with controlled access gates. The recommended alignment and access points compatible with each functional facility area will be shown on the Airport Layout Plan. The fence should be consistent with the conclusions of the latest Wildlife Hazard Assessment, including upgrading the fence on the west and north side from 6 feet to 10 feet in height to help prevent deer from entering the airfield.

One targeted improvement is to realign the access point west of the Sanford Hangar to improve access visibility. The redevelopment should be compatible with future east air cargo expansion.

Wildlife mitigation recommendations from the 2014 Wildlife Hazard Assessment that are worth noting in this Master Plan include removing airfield trees, removing large adjacent trees near the golf course and to the northwest of FSD and maintaining a 10-foot perimeter fence.

Other

CONSOLIDATED FACILITIES

Future enhancements to the consolidated facilities complex north of the terminal building include a secure shipping and receiving facility. This would allow on-airport shipments to be cleared through TSA security prior to entering the airside complex. Right now shipments are entering the airport using unscreened vehicles. Product would be transferred from the shipping truck, unloaded, screened, and loaded on a dedicated secure vehicle. This facility would be used for any shipments destined for the secure portion of the terminal complex. Facilities are provided to separate secure and non-secure areas and provide adequate truck parking and maneuvering space. Expansion of this facility in Sioux Falls would require development to the northwest, which would encroach upon the existing Airport Traffic Control Tower complex. A future concept involving the relocation of roadways and parking is identified to meet this need.



Source: KLJ Analysis, Google Earth

INTERNAL PERIMETER ROAD

Considerations

An internal perimeter road provides secure airside access for authorized vehicles and minimize the need to cross active runways and taxiways. A perimeter road provides access between the functional areas of the airport. A secure internal roadway should be explored to enhance safety of vehicles and aircraft on the ground. The current perimeter road is incomplete around the FSD airport.

The challenge at this airport is developing a roadway alignment around existing development constraints. One consideration is developing a roadway alignment that clear the Runway Object Free Area near the Runway 33 and 21 ends. Existing infrastructure prevent developing a new road outside of airport safety zones without other improvements. Also, any new development proposal within the FAA Runway Protection Zone would require an alternatives analysis risk assessment to be completed and approved by FAA. This would trigger a review of options to remove National Guard Drive from the RPZ.

Alternatives

Alternatives to complete the perimeter road were evaluated. One incomplete portion is from the passenger terminal complex to the ARFF station which requires vehicles to cross Runway 33. The other portion is from Taxiway K to the east cargo apron requiring vehicles to cross Runway 21. At this end, roadway options to the north of the railroad were dismissed as not being a cost effective solution.

Passenger Terminal to ARFF Station

One portion where the perimeter road is incomplete is from the passenger terminal complex to the Aircraft Rescue and Fire Fighting (ARFF) station. The perimeter road around the Runway 33 Object Free Area would require a favorable FAA determination as no feasible alternative exists that clears all runway surfaces. Additionally, no roadway is possible around the SDARNG military installation boundary without crossing three active taxiways (C, B/B2, and B). A route through the SDANG installation boundary could be security risk. As a result of the impacts and limited benefit, the airport does not desire to connect this portion of the perimeter road. A No Build alternative is recommended.

Runway 21 Alternative 1 (Convert Public Road to Perimeter Road)

One option the complete an internal perimeter road around Runway 21 is to convert West National Guard Drive to a secure perimeter road. Access to SDARNG and the west general aviation complex will be maintained by developing a new public west access road over the Big Sioux River. Public access would be closed. Utilizing this roadway will also allow fuel trucks to access the Maverick fuel facility on the east side. Controlled access points will be installed on the east and west sides. This will also discourage public use of the RPZ land near the existing recreational trail. The estimated cost of this alternative is \$400,000.

Runway 21 Alternative 2 (Relocate West National Guard Drive)

This alternative would realign West National Guard Drive to allow for a new perimeter roadway to be constructed outside of the Runway 21 Object Free Area. Approximately 1,600 linear feet of West National Guard Drive would be relocated. The existing West National Guard Drive would be converted to the new perimeter road and connected with a new 2,100 linear foot perimeter roadway. A relocated controlled access point would be constructed near the Maverick Fuel Facility. The estimated cost of this alternative is \$1.1 million.

Runway 21 Alternative 3 (Maintain West National Guard Drive)

This alternative would maintain West National Guard Drive and simply realign the intersection to create a more direct access road from Minnesota Avenue. No perimeter road would be developed. This is considered an acceptable solution to the Airport. The estimated cost of this alternative is \$300,000.



Figure 5-37 – Runway 21 End Perimeter Road Alternatives

Source: KLJ Analysis, Google Earth

Runway 21 Alternative 4 (Construct Perimeter Road)

This alternative would construct a perimeter road without modifying the West National Guard Drive alignment. The perimeter road would be approximately 3,000 linear feet in length. To avoid West National Guard Drive, navigational aids and equipment, approximately 220 feet of the roadway would traverse through the Runway 21 Object Free Area, 150 feet from the end of the OFA. This alternative would require approval from the FAA and/or the use of declared distances to restrict usable runway length for safety. The estimated cost of this alternative is \$820,000.

Targeted Improvements

A new perimeter roadway alignment from Maverick Place and North National Guard Place to the northerly portion of the west general aviation hangar expansion area is recommended. This roadway will allow authorized vehicles to bypass the west general aviation apron to exit. A new secure access gate is recommended.

Preferred Alternative

Considering the impacts, benefits and costs, the Airport recommends Alternative 3 to maintain West National Guard Drive as the preferred option. A significant investment is required to maintain east access to the west aviation complex and construct a perimeter road meeting FAA requirements. Maintaining access from Minnesota Avenue to the west complex is critical. The benefit is to divert occasional on-airport traffic around the Runway 21 end in a tower controlled environment. The airport sees the costs outweighing the foreseen benefits.

Alternative	Actions	Strengths	Weaknesses	Relative Ranking
No Build	Do Nothing	• Public access maintained from Minnesota Ave. to west complex	• No perimeter road around Runway 21 developed for added operational benefits	2
Alternative 1	Convert Public Road to Perimeter Road	 Secure perimeter road around Runway 21 Cost effective solution 	• Public access removed from Minnesota Ave., requiring new west access	5
Alternative 2 Relocate West National Guard Drive		 Public access maintained from Minnesota Ave. to west complex Secure perimeter road around Runway 21 	 Requires significant capital investment for new roadways Requires FAA approval 	3
Alternative 3	Maintain West National Guard Drive	 Public access maintained from Minnesota Ave. to west complex Roadway enhancements completed for direct roadway access Does not trigger FAA study 	• No perimeter road around Runway 21 developed for operational benefits	1
Alternative 4 Construct Ne Perimeter Ro		 Public access maintained from Minnesota Ave. to west complex Secure perimeter road around Runway 21 	 Requires large capital investment for new roadway Requires new perimeter road to cross OFA Requires FAA approval 	4

Table 5-27 – Runway 21 Perimeter Road Alternatives

Source: KLJ Analysis. Note: Relative ranking ranges from most preferred to least preferred (1 is most preferred).

Airport Utilities

The location and type of airport utilities for facility development will be considered at the time of facility development. Major considerations include the City water wells and main lines. Development must consider the location of water main lines as no new buildings or structures should be constructed on main lines. This is a consideration for new development particularly in the east general aviation area where approximately 1,000 feet of water well main line should be relocated 80 feet to the west, which costs approximately \$300,000. This would relocate the water line from under future private hangar pavement to more accessible public area.

The location of City water wells also have a bearing on airport development. Future removal or relocation of water wells on the east general aviation apron (#17) and to the south of the passenger

terminal apron (#15) to accommodate future physical airport development is recommended. Other water wells are proposed to remain, although considerations for future fueling facility locations should be made.

Military Facilities

Recommended development of SDANG and SDARNG facilities are driven by their own facility master plan studies. These facilities have a lease with the airport through at least 2036; beyond the planning period for this study.

South Dakota Air National Guard

The installation boundary for the SDANG facility on the south portion of the airport is proposed to be redefined. Taxiway C will become part of the installation boundary for exclusive use only. This boundary change also has the potential to affect future airport perimeter road alignment and security gate locations. Airfield alternatives will work around this proposed military boundary except where otherwise noted.

South Dakota Army National Guard

The boundary for the munitions storage area to the west of Runway 3-21 and 15-33 is not proposed to change. Two plans exist for the north SDANG parcel operated by SDARNG. The SDANG facility master plan proposes to modify boundary of the north parcel to match existing property being used by SDARNG. The SDARNG future development plan proposed an expanded boundary to repurpose of the West Air Cargo Structure for non-aeronautical military use. This is no longer planned thus the SDANG plan is assumed.

There is also a need by SDARNG for a new Readiness Training Institute (RTI). The existing facility does not meet Department of Defense minimum anti-terrorism standards. A new site on airport property compatible with west airport access Alternative 1 is recommended. A lease of fair market value is required.

Aeronautical/Non-Aeronautical Development

There are few areas of the airport that can be considered for new non-aeronautical development after all other functional aeronautical facility needs are identified. Potential development areas include:

- Approximately 1.2 acres of non-aeronautical development at the southwest corner of Minnesota Avenue and Hanger Street
- Land in the east cargo complex, particularly land to the east of John Orr Drive for nonaeronautical development
- Approximately 28 acres to the northwest of the west general aviation area and SDARNG with aeronautical access (concurrent use).
- Approximately 130 acres across from the Big Sioux River diversion channel for non-aeronautical use, particularly north of the Sanford Sports Complex. Development must meet existing and future land use and airspace standards (Runway 15 RPZ, 62.5:1 OIS), and be compatible with the future roadway network alignment.



Source: KLJ Analysis, Google Earth

All non-aeronautical development is required to be shown on the Airport Layout Plan and approved by FAA.

Preferred Development Strategy

Table 5-28 presents a draft phasing plan. This serves as an overall summary of the preferred alternatives for each functional area. This plan is subject to change from refinements in the in **Chapter 6: Implementation Plan** based on Airport Capital Improvement Plan (AICP) financial considerations. The timing of improvements based on Planning Activity Levels should be adjusted accordingly should activity levels change from the approved forecast. The strategy assumes facility maintenance and rehabilitation will be completed as necessary.

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Т	ihle	5-28	– Preterr	ed Devel	lonment	Strateav

	Near-Term 0-5 Years	Future 6-10 Years	Long-Term 11-20 Years	Ultimate 20+ Years
Airfield	PAL 1 • Submit FAA Modification of Design Standards for Runway 15-33 OFA Penetrations • Publish Runway 9-27 for Small Aircraft Exclusively (≤ 12,500 pounds) • Upgrade Runway 3, 21 Blast Pads • Construct Runway 3 Holding Bay • Rehabilitate Taxiway A2 • Remove, Mark or Light Airspace Obstructions • Update Plan for Airport Traffic Control Tower	 PAL Z Remove Taxiway E to Eliminate "Hot Spot" Upgrade Runway 21 VGSI to PAPI Install ALS and upgrade Runway 33 or 15 Approach to ¾ mile Visibility Construct Runway 33 Holding Bay Upgrade Runway 33 Blast Pad Remove East Cargo Taxiway Direct Access Remove Taxiway K Direct Access 	PAL 3 & 4 • Upgrade Runway 3 to Category II ILS (1200 RVR) • Decommission Runway 9- 27, Convert to Realigned Cross-Field Taxiway • Realign Taxiway A2 • Construct Runway 3-21, 15-33 Paved Shoulders • Construct Paved Taxiway Shoulders • Construct Runway 3, 21 High-Speed Exit Taxiways • Construct Runway 15-33 Connecting Taxiway near Taxiway L • Expand Runway 15, 21 Holding Bays, Construct Bypass Taxiway (21)	Beyond PAL 4 • Realign Taxiway B to 560' Setback from Runway 3-21 • Install ALS and Upgrade remaining Runway 33 or 15 Approach to ¾ mile Visibility
Passenger Terminal	 Expand Security Checkpoint Rehabilitate Existing CBP Facilities Construct North De- Icing/Remain-Over-Night Apron (Phase I) 	 Expand and Upgrade Baggage Claim/Handing Facilities Rehabilitate and Expand South Frontage of Terminal Building Construct North De- Icing/Remain-Over-Night Apron (Phase II) 	 Construct Ground Transportation Facility Construct Concourse Expansion to 9 Gates Expand Concession Area Construct South Remain- Over-Night Apron 	 Replace Existing Concourse with New "T" Concourse Construct New CBP Facility with Federal Inspection Services (FIS)
Air Cargo	 Conduct focused Air Cargo Master Plan Study Demolish and/or Relocate On-Site Facilities in Development Area 	 Expand Taxilane and Reconfigure Air Cargo Parking Expand East Air Cargo Apron (South) and Taxiway 	 Construct Air Cargo Building and Access Expand East Air Cargo Apron (North) 	• Expand Air Cargo Building and Access
General Aviation	 Construct East GA Southeast Corporate Hangar Area Realign East GA South Taxilane for ADG-II Aircraft Construct West GA Corporate Taxilane for ADG-III Aircraft 	 Realign and Strengthen Taxiway D, Strengthen Taxiway F Construct East GA Small Hangar Site Taxilane 	 Construct West GA Small Aircraft Hangar Area Construct East GA North Private Hangar Area, Relocate Water Main Redevelop East GA Small Hangar Area for Corporate Use Expand and Strengthen East GA Apron 	 Expand West GA Small Aircraft Hangar Area Expand West GA Apron Develop New Airport for GA Traffic
Landside	• Expand South Term Economy Parking Lot	 Construct Terminal Parking Structure Construct West Access Road 	• Expand South Rental Car, Employee and Economy Parking Lots	• Consider Off-Airport Parking Options
Support & Other	 Expand ARFF Facility (by Others) Upgrade Wildlife Fence Develop multi- jurisdictional airport land use and airspace overlay zoning ordinance Upgrade West National Guard Drive Intersection 	 Update Airport Master Plan Study Construct Rental Car Quick Turn Facility 	 Expand Airport Maintenance Complex Construct Airfield Access Road from Maverick Place to West GA Complex 	• Develop Replacement Airport Traffic Control Tower (by Others)

Source: KLJ Analysis