Section 6—Alternatives Analysis

6.1 Introduction

The master plan process inventories existing conditions and environmental considerations (Sections 2 and 3), develops a forecast of anticipated operational activity (Section 4), and identifies the facilities needed to accommodate future demand (Section 5). Next, a series of alternative solutions to satisfy the gap analysis are developed. Finally, the alternatives are evaluated with criteria developed by the Airport.

This section includes proposed development alternatives and evaluates the recommended plan. Alternatives were developed specifically for each major functional area of the Airport: airfield, passenger terminal, ground transportation and roadway access, general aviation, air cargo, and support facilities. The alternatives were evaluated and ranked based on criteria to choose recommended alternatives. The recommended alternatives for each major functional areas will then be combined into a preferred airport-wide development plan, and further evaluated in the implementation and financial sections of the Master Plan, Sections 7 and 8, respectively.

Throughout the alternatives development process, previously established goals for RIAC, phasing considerations related to timing, and affordability will be considered. The result is a list of individual projects within timeframes for implementation. These are presented in the following timeframes:

- Short-term, Planning Activity Level 1 (PAL1)
- Intermediate, Planning Activity Level 2 (PAL2)
- Long-term, Planning Activity Level 3 (PAL3)

Process for Evaluation of Alternatives

The alternatives developed for each functional area went through a comparative analysis process consisting of various criteria, established in coordination with RIAC. The criteria are generally grouped into the following:

- Design Standards (standards, design, and construction)
- Operational (efficiency and traffic flow)
- Environmental (impact and permitting)
- Financial (cost and phasing)
- Feasibility (implementation)

The details of how these factors are specific to each airport functional area is defined within the functional area and the evaluation of their alternatives.

Each criterion is qualitatively analyzed using the following rating system, adjusted, and modified to meet the airport functional area being evaluated. Below is an example:

No or minimal impacts Moderate impacts Significant impacts

Each alternative will be ranked using this evaluation which will result in the recommended alternative. Then, the recommended alternative for each functional area will be combined to create the preferred airport-wide development plan. Detailed cost estimates, phasing, etc. will be available in Section 7, Implementation Plan.

6.2 Airfield Alternatives

The development of airfield alternatives focused on maintaining safety of operations and meeting current airfield design standards, while preserving terminal and cargo/GA expansion opportunities. The following conclusions were reached in the Facility Requirements analysis presented in Section 5:

- No runway extension is needed throughout the planning horizon.
- The orientation of the existing runways provides sufficient wind coverage. Runway 16-34 is considered a crosswind runway for B-II aircraft and smaller.
- The future critical aircraft is anticipated to be a C-V aircraft. Only Runway 5-23, and the taxiways anticipated to be used by C-V aircraft, would be upgraded to meet ADG V standards once regular ADG V aircraft operations materialize (500 or more annual operations).
- Airfield geometry improvements are required to meet FAA design standards and maximize safety.
- Airfield lighting improvements are required to enhance safety.

This section first describes potential mitigation alternatives for each issue, and provides a preliminary qualitative evaluation of each alternative. Next, individual alternatives are be combined to develop the recommended airfield alternative.

Airfield evaluation criteria are as follows:

- Design Standards: compliance with FAA design standards outlined in FAA AC 150/5300-13
- Operational: provides for safe and efficient flow of aircraft traffic
- Environmental: minimize impacts to wetlands and neighboring communities (noise)

- Financial: estimated construction cost of proposed improvements
- Feasibility: implementation challenges (airfield closures during construction, impacts to other existing/planned facilities)

6.2.1 Mitigation of Individual Issues

6.2.1.1 Runway 16-34 Design Code

Figure 6.1 depicts two alternatives for the Runway 16-34 design code; these alternatives are described below.

Alternative 1: Runway 16-34 Remains C-IV

Alternative 1 proposes for Runway 16-34 to remain an ADG IV runway, and would only require a portion of the Runway 16-34 shoulders to be widened from 25 feet to 35 feet.

Alternative 2: Runway 16-34 is Downgraded to B-II

Alternative 2 proposes for Runway 16-34 to be downgraded to a B-II runway. The runway downgrade would require reducing the runway width to 75 feet (from the existing 150 feet), with 10-foot optional runway shoulders. Also, the Taxiway C MOS would be canceled, effectively preventing aircraft larger than B-II from using Taxiway C.

Evaluation of Alternatives

As shown in **Table 6.1,** Alternative 1 comes with minimal cost impacts, as runway shoulders would be required along the full length of Runway 16-34, and regular maintenance on a C-IV runway would be more extensive than on a B-II runway.

Table 6.1 - Runway 16-34 Design Code Alternatives Evaluation

Criteria	Alternative 1	Alternative 2
Design Standards		
Operational		No Aircraft Larger than B-II
Environmental		
Financial	Add shoulders	Remove Pavement; Relocate Signage, Lighting and Markings
Feasibility		Significant Runway Closures
Recommended Alternative	✓	

Sources: WSP USA, July 2019.

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

Alternative 2 would result in moderate to significant operational, cost and implementation impacts. Aircraft larger than B-II would no longer be able to operate on Runway 16-34 and parallel Taxiway C, resulting in less flexibility during certain weather conditions when winds favor the use of Runway 16-34. Additionally, aircraft parking at the north end of the passenger terminal regularly use Runway 34 for arrivals to take advantage of shorter taxi times; this would no longer be possible should Runway 16-34 be downgraded to B-II.

Downgrading the runway would also come at a cost, since a portion of the existing runway pavement would need to be demolished (runway and shoulder pavement), runway/taxiway lighting and signage would need to be relocated, and the runway and connecting taxiway markings would need to be re-striped. Lastly, construction required to downgrade the runway would require significant runway closures.

As a result, Runway 16-34 Design Code Alternative 1 is the recommended alternative. This alternative is recommended to be implemented in the short-term (PAL 1), during the planned rehabilitation of Runway 16-34.

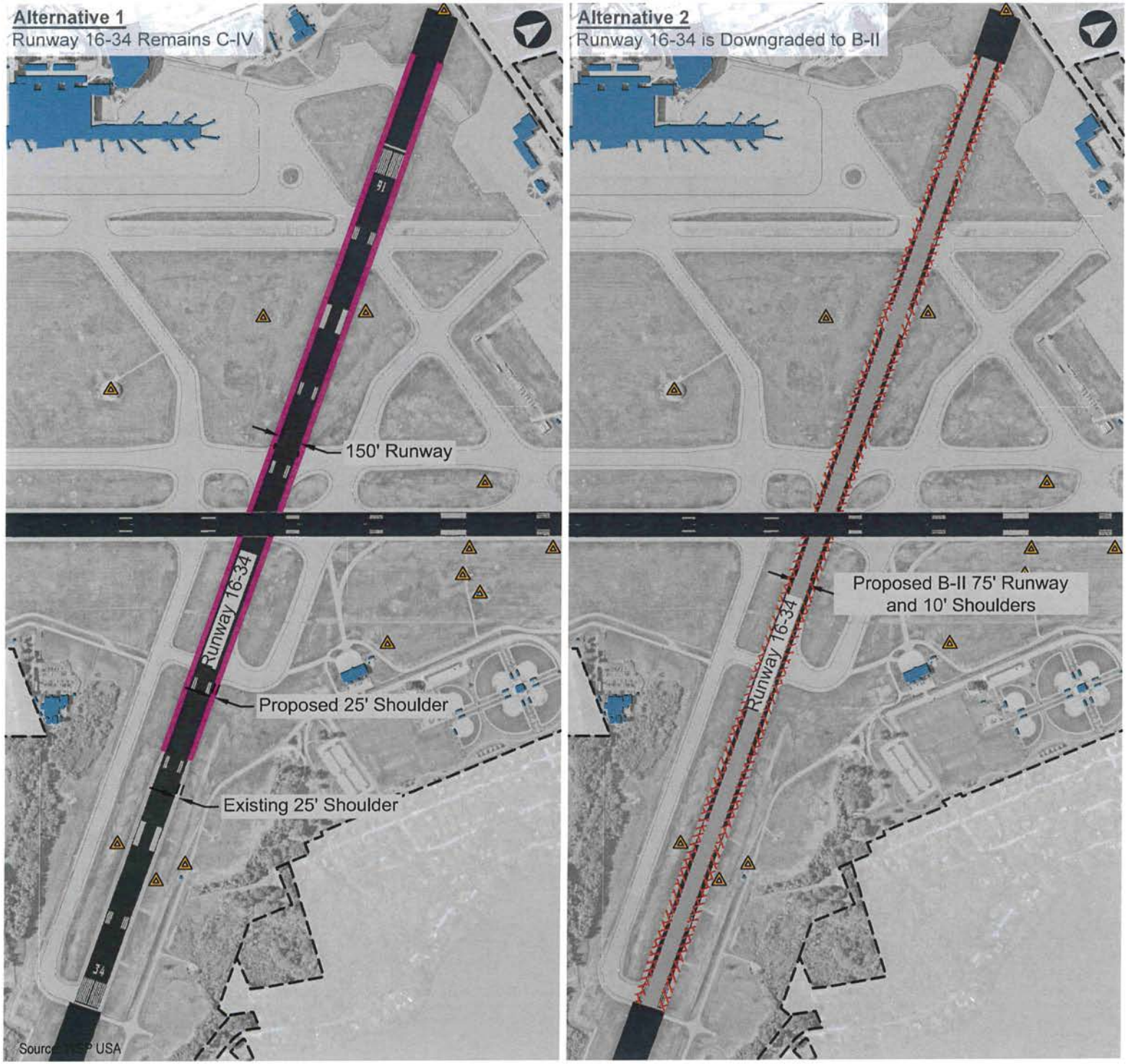

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Figure 6.1
Runway 16-34 Design Code Alternatives

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Runway Shoulder
- Proposed Pavement Demo

400' 0' 400' 800'

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6.2.1.2 Runway 16-34 to Taxiway C Separation

Figure 6.2 depicts two alternatives to mitigate the non-standard Taxiway C to Runway 16-34 separation; these alternatives are described below.

Alternative 1: Do Nothing

Alternative 1 proposes to keep the existing separation of 300 feet, which would meet standards should Runway 16-34 be downgraded to a B-II runway. If Runway 16-34 remains a C-IV runway, the current MOS would need to be extended, restricting aircraft operations on Taxiway C during air carrier operations on Runway 16-34. Use of an MOS is considered a last resort.

Alternative 2: Increase Separation to 400 Feet

Alternative 2 proposes to shift the existing portion of Taxiway C from a runway-to-taxiway separation of 300 feet to 400 feet, thus meeting ADG III and IV design standards, and removing the need for operational restrictions on Taxiway C.

Evaluation of Alternatives

As shown in **Table 6.2,** Alternative 1 requires the FAA to approve a MOS, which should always be the last resort. However, considering the low frequency of use of Taxiway C by air carrier aircraft (typically the ones requiring the larger separation), the MOS's operational restrictions would result in minimal operational impacts.

Alternative 2 has significant cost and environmental impacts. The area southwest of Taxiway C consists of wetlands and a large grade differential. Shifting Taxiway C would require wetlands relocation and significant fill to maintain airfield slope standards.

In order to comply FAA design standards, Alternative 2 is the recommended alternative. It is recommended to be implemented in the short-term (PAL 1), to reduce the duration an MOS is required.

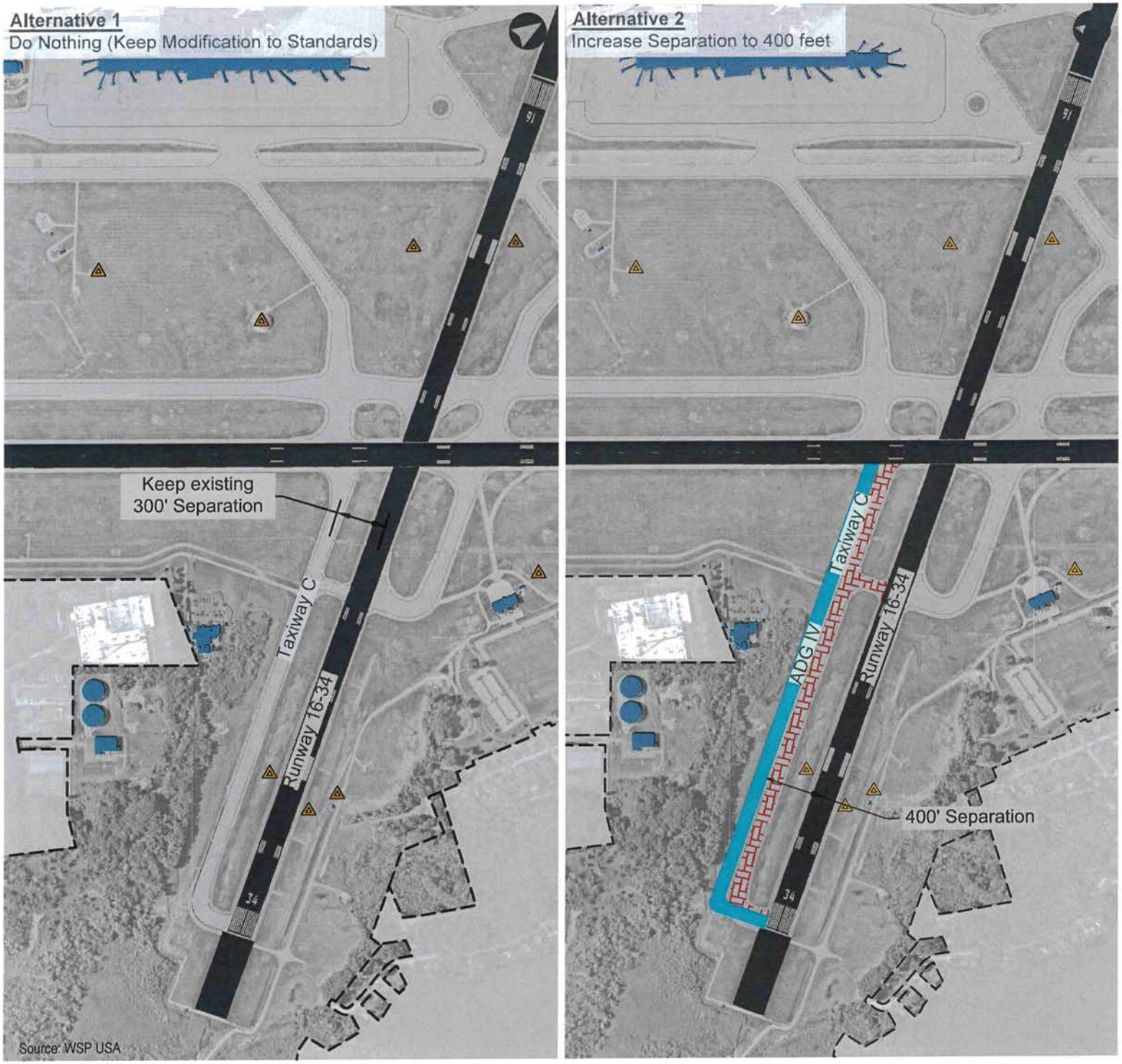

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Figure 6.2
Runway 16-34 to Taxiway C Separation Alternatives

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Taxiway
- Proposed Pavement Demo

400' 0' 400' 800'

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Table 6.2 - Taxiway C Separation Alternatives Evaluation

Criteria	Alternative 1	Alternative 2
Design Standards	Not met	
Operational	Occasional Restrictions	
Environmental		Wetlands
Financial		Grading
Feasibility		Closures
Recommended Alternative		✓

Sources: WSP USA, July 2019.

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

6.2.1.3 Runway 16-34 Parallel Taxiway

Figure 6.3 depicts the "Do Nothing" alternative, two alternatives to provide a parallel taxiway to Runway 16-34 south of the runway, and two alternatives to provide a parallel taxiway north of the runway; these alternatives are described below. Although a full-length parallel taxiway helps improve the flow of traffic on instrument runways, this can also be achieved with the right partial-length parallel taxiway configuration.

Alternative 1: Do Nothing

Alternative 1 assumes that there is no significant issue with the existing taxiway layout and proposes to keep using the existing taxiways. ATC representatives did not express concerns about the existing Runway 16-34 partial parallel taxiway network. The existing MOS would need to remain in effect.

Alternative 2: Extend Taxiway C to a Full-Length Taxiway (400/300 Feet Separation)

Alternative 2 proposes to extend Taxiway C west of Runway 5-23 to the Runway 16 end, at a 400-foot runway-to-taxiway separation. The existing portion of Taxiway C east of Runway 5-23 would still have a runway-to-taxiway separation of 300 feet and would require an MOS.

Alternative 3: Extend Taxiway C to a Full-Length Taxiway (400 Feet Separation)

Alternative 3 proposes to shift the existing portion of Taxiway C east of Runway 5-23 to provide a 400-foot separation with Runway 16-34, and extend it on the west side of Runway 5-23 to the Runway 16 end.

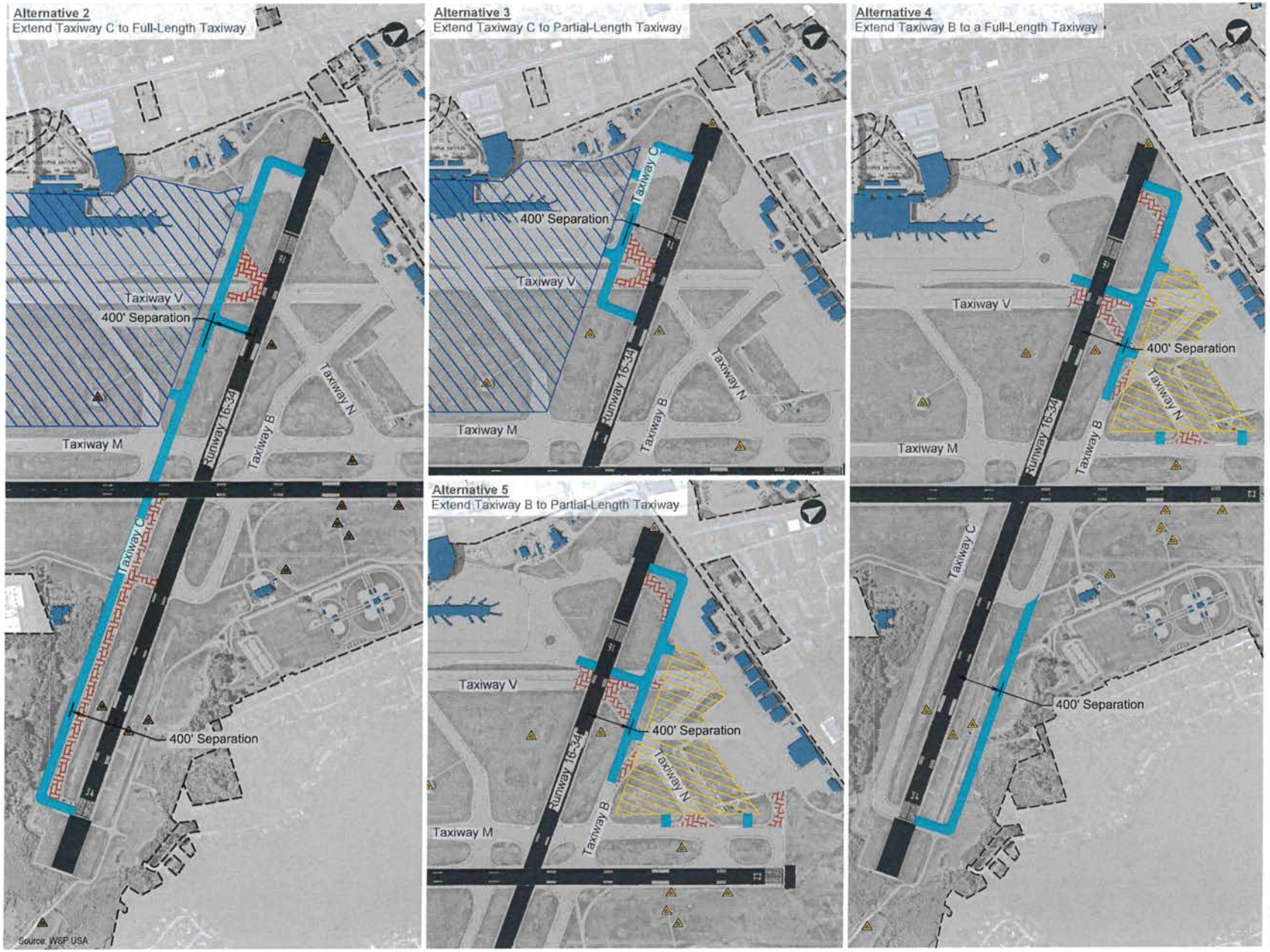

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Figure 6.3
Runway 16-34
Parallel Taxiway
Alternatives

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Taxiway
- Proposed Pavement Demo
- Potential GA/Cargol Area
- Potential Terminal Area

400' 0' 400' 800'

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Alternative 4: Extend Taxiway B to a Full-Length Taxiway (400 Feet Separation)

Alternative 4 proposes to extend Taxiway B east and west of Runway 5-23 to the Runway 16 and 34 ends, at a 400-foot runway-to-taxiway separation. A variant of Alternative 4 would be to extend the taxiway to the east only as far as not to impact the existing glide slope and its critical area (not depicted).

Alternative 5: Extend Taxiway B to a Partial-Length Taxiway (400 Feet Separation)

Alternative 5 proposes to extend Taxiway B to the west to the Runway 16 end. The runway-to-taxiway separation of the new portion would be 400 feet.

Evaluation of Alternatives

As shown in **Table 6.3,** both Alternatives 1 and 2 would not meet FAA design standards for runway-to-taxiway separation, and would require an MOS. As a result, Alternatives 1 and 2 are not recommended.

Alternative 3 comes with cost, environmental and implementation challenges, however, it would be in full compliance with FAA standards, and provide the greatest operational benefits. Aircraft access to the Runway 34 end would be interrupted during construction.

Alternative 4 has significant operational and environmental impacts. A full-length parallel taxiway on the east side of Runway 16-34 would rarely be used, since the Runway 34 end is seldom used as a departure point for aircraft originating from the Cargo/GA area (east side of Runway 16-34); aircraft originating in the terminal area would still use Taxiway C to access the Runway 34 end, and an MOS would still be required. Conversely, landings on Runway 16 requiring exiting at the Runway 34 end to then taxi to the Cargo/GA area are also rare. Alternative 4 would also require the relocation of the glide slope antenna, may require relocation of wetlands, and may result in additional noise impacts to the adjacent communities.

Alternative 5 also presents operational deficiencies. Although the extension of Taxiway B to the west would improve the flow of traffic around the cargo/GA area, and between the passenger terminal and the Runway 23 end, Alternative 5 would still require an MOS for the Taxiway C-to-Runway 16-34 separation.

As a result, Alternative 3 is the recommended alternative. It is recommended to be implemented in the short-term (PAL 1), to enable other safety critical improvement projects.

Table 6.3 - Runway 16-34 Parallel Taxiway Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Design Standards	Need MOS	Need MOS		Need MOS	Need MOS
Operational				Limited Use, Glide Slope	
Environmental			Wetlands	Wetlands, Noise	
Financial					
Feasibility			Runway 34 End Access During Construction		
Recommended Alternative			✓		

Sources: WSP USA, July 2019.

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

6.2.1.4 Runway 16-34 Crossings West of Runway 5-23

Figure 6.4 depicts two alternatives to improve the taxiway geometry where Taxiway F crosses the Runway 16 end, and where Taxiways V and N cross Runway 16-34.

Alternative 1: Two Runway Crossings

Alternative 1 proposes to realign runway entrance and exits to connect at a 90-degree angle, both at the Runway 16 end (Taxiways F and S), and where Taxiways V and N intersect and cross Runway 16-34. The runway crossings are proposed to be simplified into a single perpendicular runway crossing, to improve pilot situational awareness. This configuration assumes that Taxiways B and C are extended west of Runway 16-34 to the Runway 16 end.

Alternative 2: One Runway Crossing

Alternative 2 also proposes to realign runway entrance and exits to connect at a 90-degree angle, both at the Runway 16 end (Taxiways F and S), and where Taxiways V and N intersect. Alternative 2 however does not provide for a runway crossing at the current Taxiways V and N crossing. Access to the cargo/general aviation apron would be through the realigned Taxiways F and S, and through Taxiway M.

Evaluation of Alternatives

As shown in **Table 6.4,** Alternative 1 offers greater flexibility for aircraft travelling between the Runway 23 end and the passenger terminal area, as well as additional taxiway pavement to hold aircraft during weather delays. Although Alternative 1 comes at a greater cost, it provides optimum safety and efficiency. Alternative 2 only provides access from the passenger terminal area or the cargo/GA area to and from Runway 16-34, and does not provide for an efficiency flow of aircraft between the passenger terminal and the Runway 23 end.

As a result, Alternative 1 is the recommended alternative. Since this is a safety critical improvement project, it is recommended to be implemented in the short-term (PAL 1).

Table 6.4 - Runway 16-34 Crossings West of Runway 5-23

Criteria	Alternative 1	Alternative 2
Design Standards		
Operational		No Runway Crossing, No Taxi Route to Runway 23 End
Environmental		
Financial		
Feasibility	Closures	Closures
Recommended Alternative	✓	

Sources: WSP USA, July 2019.

Legend:

No or minimal impacts Moderate impacts Significant impacts

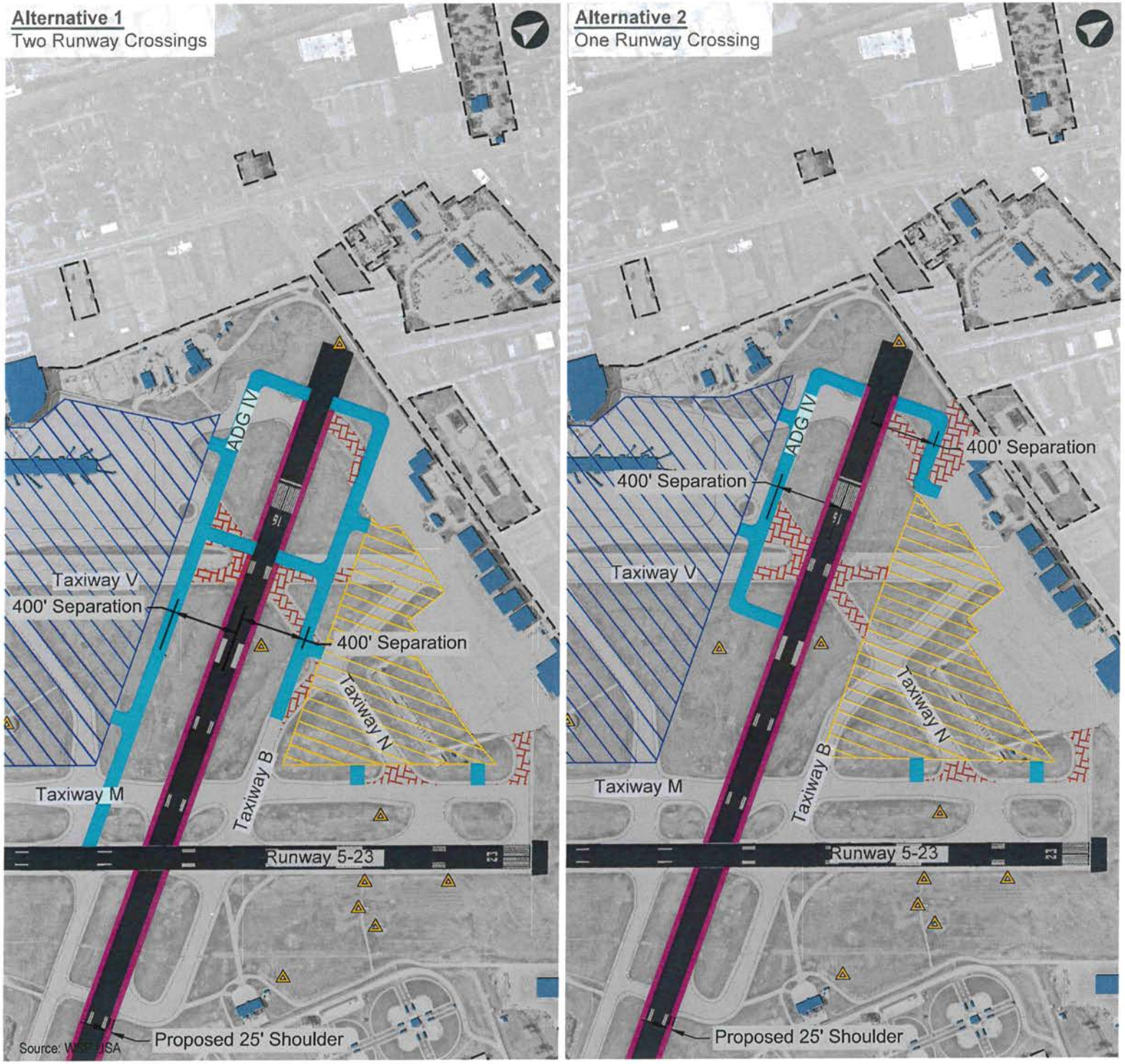

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Figure 6.4
Runway 16-34 Crossing Alternatives

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Proposed Runway Shoulder
- Proposed Pavement Demo
- Proposed Taxiway
- Proposed GA/Cargo Area
- Proposed Terminal Area

400' 0' 400' 800'

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6.2.1.5 Runway 5-23 Exit

Figure 6.5 depicts three alternatives to reduce Runway Occupancy Times (ROTs) on Runway 5-23, specifically for small and large aircraft landing on Runway 5 and for small aircraft landing on Runway 23 or departing on Runway 5.

Alternative 1: Do Nothing

Alternative 1 assumes that there is no significant issue with ROTs, and proposes to keep using the existing runway exit taxiways. This may result in occasional high ROTs, however, they are not anticipated to have significant impacts to operations.

Alternative 2: 90-degree Exit

Alternative 2 proposes to build a new 90-degree exit taxiway at an optimal location. Based on Table 4-13 in FAA AC 150/5300-13[1], a 90-degree exit taxiway located 4,500 feet from the Runway 5 landing threshold would accommodate 100 percent of small single- and twin-engine aircraft, 24 percent of large aircraft and 2 percent of heavy aircraft. This proposed exit would be located approximately 4,000 from the Runway 23 landing threshold, and as such, would accommodate 100 percent of small single-engine aircraft, 98 percent of twin-engine aircraft, and 8 percent of large aircraft landing on Runway 23.

Alternative 3: High-Speed Exit

Alternative 3 proposes to build a high-speed exit taxiway at an optimal location. However, there are several challenges to Alternative 3:

- High-speed exits are recommended when aircraft operations exceed 30 operations per hour. This threshold is not anticipated to be met throughout the planning horizon. A properly located 90-degree exit is anticipated to provide adequate runway capacity.
- The minimum runway-to-parallel taxiway separation for a high-speed exit with 180-degree turn reversal is 427 feet for ADG IV runways. Building a high-speed exit would require realigning the parallel taxiway.

[1] Federal Aviation Administration, Advisory Circular 150/5300-13 Change 1, *Airport Design*, Table 4-13, February 2014.

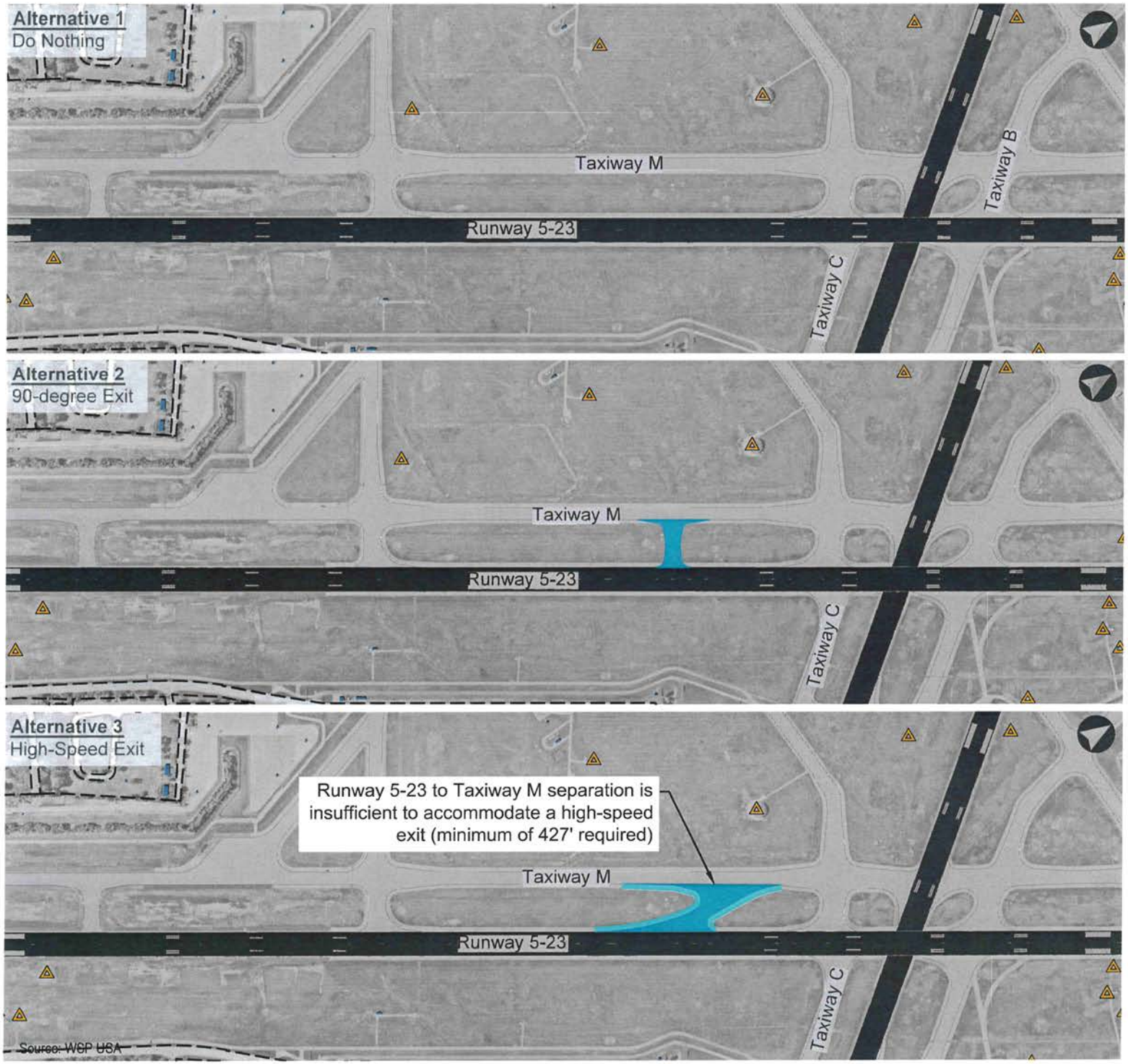

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Figure 6.5
Runway 5-23 Exit Alternatives

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Taxiway

400' 0' 400' 800'

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Evaluation of Alternatives

As shown in **Table 6.5,** Alternative 3 would not meet FAA design standards for runway-to-taxiway separation for a high-speed exit, and is impractical to implement. Alternative 1 would result in occasional high ROTs, although not anticipated to adversely impact operations. Alternative 2 would provide increased flexibility to aircraft landing on Runways 5 and 23, as well as aircraft originating in the cargo/GA area that want to perform an intersection departure on Runway 5.

As a result, Alternative 2 is the recommended alternative. It is recommended this improvement be implemented in the short- to intermediate term (PAL 2), along a taxiway or runway pavement rehabilitation project, to minimize construction impacts.

Table 6.5 - Runway 5-23 Exit Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			Insufficient Rwy-Twy Separation
Operational	Occasional High ROT		
Environmental			
Financial			
Feasibility		Runway/Taxiway Closures During Construction	Runway/Taxiway Closures During Construction
Recommended Alternative		✓	

Sources: WSP USA, July 2019.

Legend: No or minimal impacts; Moderate impacts; Significant impacts

6.2.1.6 Direct Access from Apron to Runway 23 End

Figure 6.6 depicts three alternatives to avoid direct access on Taxiway A from the apron to Runway 5-23.

Alternative 1: Do Nothing

Alternative 1 assumes that there is no significant issue with aircraft entering the Runway 23 end without clearance, because of lack of situational awareness. Alternative 1 however does not meet FAA guidance on taxiway geometry.

Alternative 2: Shift Taxiway A West of Taxiway M

Alternative 2 proposes to shift Taxiway A to the south, to require aircraft to execute a turn between the apron and the runway entrance taxiway, to increase pilot situational awareness. Shifting Taxiway A would also require reallocating apron parking on the cargo/GA apron.

Alternative 3: Close Taxiway A West of Taxiway M

Alternative 3 proposes to close Taxiway A west of Taxiway M, thus preventing aircraft from directly entering the runway from the apron.

Evaluation of Alternatives

As shown in **Table 6.6,** Alternative 1 does not meet FAA design recommendations, which discourage having a taxiway that provides direct access (i.e., no turn required) from an apron to a runway; as such, this alternative is not recommended. Alternatives 2 and 3 remove the direct access. Alternative 3, however, would result in longer taxi routes between the cargo/GA apron and the Runway 23 end, as well as potential bottlenecks at the remaining apron entrance/exit points.

Table 6.6 - Apron to Runway 23 End Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			
Operational			Longer taxi routes, apron bottlenecks
Environmental			
Financial			
Feasibility			
Recommended Alternative		✓	

Sources: WSP USA, July 2019.

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

As a result, Alternative 2 is the recommended alternative. It is recommended this improvement be implemented in the short-term (PAL 1), since it is a safety critical improvement.

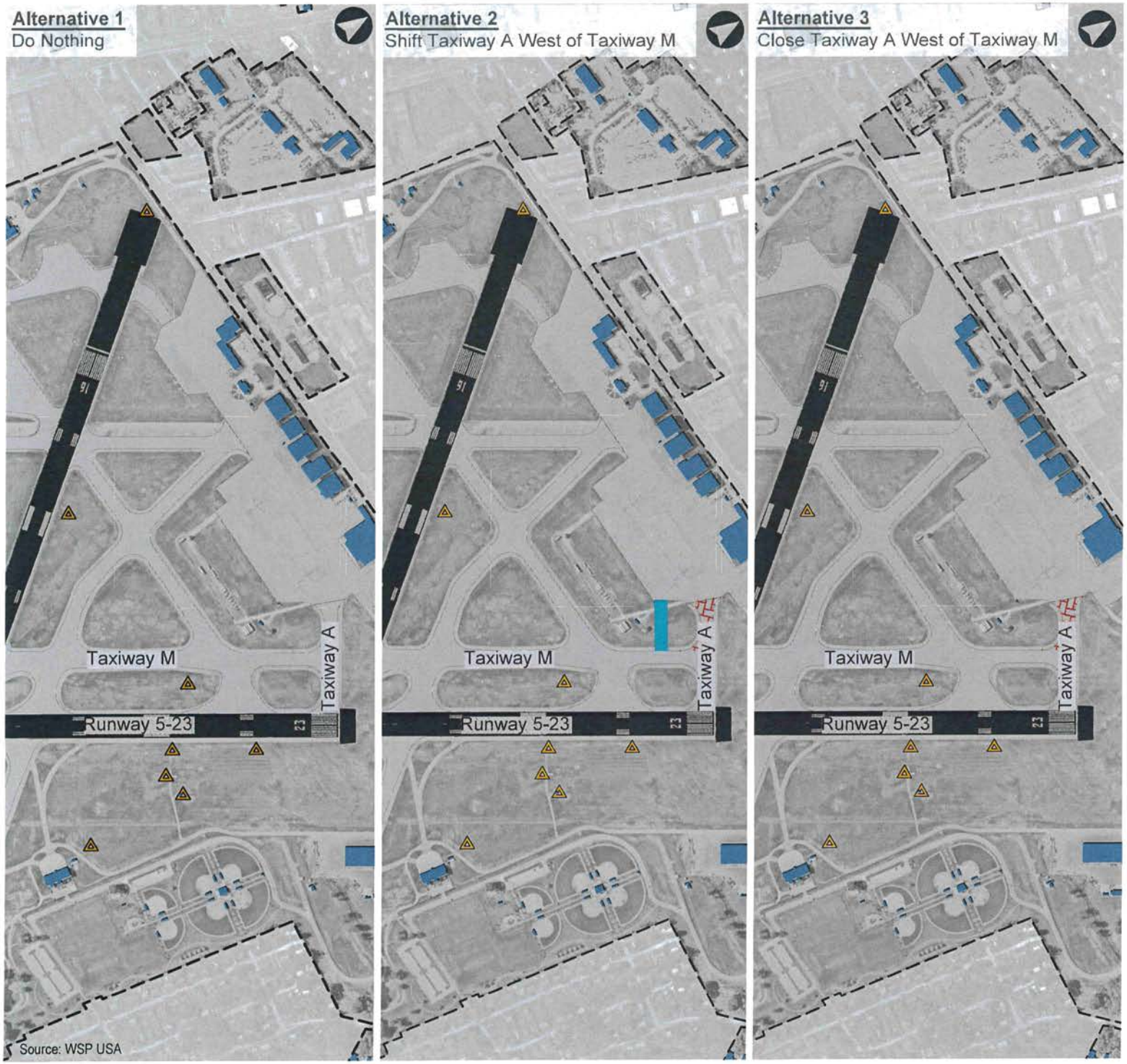

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Figure 6.6
Access to Runway 23 End Alternatives

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Taxiway
- Proposed Pavement Demo

400' 0' 400' 800'

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6.2.1.7 Runway 5-23 to Taxiway M Separation

Figure 6.7 depicts two alternatives for the Runway 5-23 to Taxiway M separation to meet ADG V standards. These improvements would only be required if, and when, ADG V aircraft become the critical aircraft at PVD (more than 500 annual operations).

Alternative 1

Alternative 1 proposes to not make any physical improvements to Taxiway M, but instead, apply for an MOS and implement operational restrictions. Operational restrictions are already in effect today to accommodate occasional ADG V aircraft operations. An MOS would be required if the critical aircraft became an ADG V, i.e. ADG V aircraft would conduct 500 or more annual operations at PVD. The MOS would require operational restrictions to be in effect during ADG V landings on Runway 5-23 when visibility is less than ½ statute mile.

Although an MOS is a last resort, the conditions triggering the need for an MOS occur so seldom at PVD (visibility less than ½ statute mile and ADG V aircraft landing on Runway 5-23), that impacts to airfield operations are anticipated to be minimal.

An MOS, however, cannot mitigate aircraft tail penetrations to the inner-transitional object free zone. A preliminary assessment of various ADG V aircraft taxiing on Taxiway M or holding short of Runway 5-23 at the existing runway hold lines did not reveal any aircraft tail penetrations to the Runway 5-23 inner-transitional object free zone. As a result, it is not anticipated that the hold lines to Runway 5-23 would require to be shifted back to the ADG V standard of 280 feet from the runway centerline.

Alternative 2

Alternative 2 proposes to shift Taxiway M 100 feet to the west, to provide a runway-to-taxiway separation of 500 feet, extend taxiway connectors between Taxiway M and Runway 5-23, and implement a controlled service road along the noise wall, where the service road is inside the ADG V taxiway object free area. This project is anticipated to result in significant constructions costs. Operational impacts during construction are also anticipated to be significant, with extended closures of Taxiway M, restricting aircraft access to portions of Runway 5-23. Additionally, it would be challenging to justify the significant cost of shifting Taxiway M for such an infrequent need (visibility less than ½ statute mile and ADG V aircraft landing on Runway 5-23).

Evaluation of Alternatives

As shown in **Table 6.7,** Alternative 1 would not only have minimal operational impacts, but also occur on a very rare basis. However, it would require the FAA to approve a MOS, which should always be the last resort. Alternative 2 would require a long and costly construction project, with significant operational impacts during construction. As a result, Alternative 1 is

the recommended alternative. This improvement is only required if and when regular ADG V operations materialize.

Table 6.7 - Runway 5-23 to Taxiway M ADG V Separation Alternatives Evaluation

Criteria	Alternative 1	Alternative 2
Design Standards	MOS for when Visibility is < ½ SM (1.1% of the Time) AND ADG V is Landing	
Operational	Occasional Restrictions Low Occurrence	
Environmental		
Financial		
Feasibility		No Access to Portions of Runway 5-23
Recommended Alternative	✓	

Sources: WSP USA, July 2019.

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

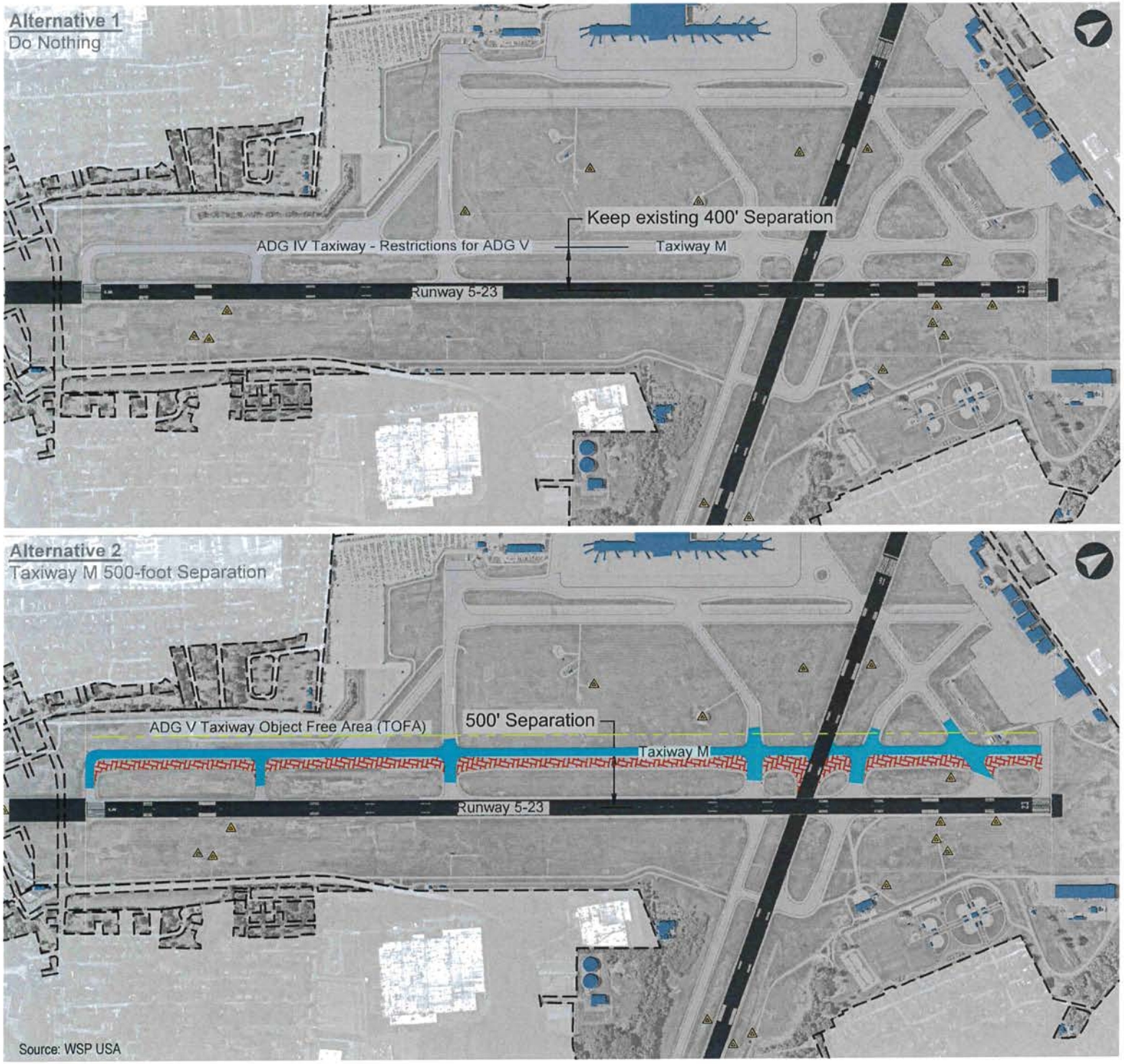

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Figure 6.7
Runway 5-23 to Taxiway M ADG V Separation Alternatives

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Taxiway
- Proposed Pavement Demo
- ADG V TOFA

600' 0' 600' 1200'

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6.2.1.8 Other Runway/Taxiway Improvements

Figure 6.8 depicts additional runway and taxiway improvements required to meet ADG IV and ADG V design standards. Improvements to meet ADG IV design standards are recommended to be implemented as soon as practical. Improvements to meet ADG V design standards will only be required if, and when, ADG V aircraft become the critical aircraft at PVD.

The following improvements are required to meet ADG IV design standards (recommended to be implemented in the short term):

- Extend existing Runway 23 end blast pad to 200' long.
- Widen shoulders of Taxiways C, C1, F and V from 15 feet to 20 feet
- Upgrade taxiway shoulders and fillets for ADG IV/TDG 5 aircraft if/where necessary
- Implement consistent taxiway lighting to reduce pilot confusion at night or in low visibility conditions

The following improvements are required to meet ADG V design standards (implement upon regular ADG V operations):

- Widen/lengthen Runways 5 and 23 ends blast pads to 400 feet long by 220 feet wide
- Relocate Runway 5-23 hold lines to 280 feet from the runway centerline
- Widen Runway 5-23 shoulders to 35 feet
- Upgrade taxiway shoulders and fillets for ADG V/TDG 5 aircraft where necessary
- Upgrade EMAS beds with ADG V EMAS design aircraft

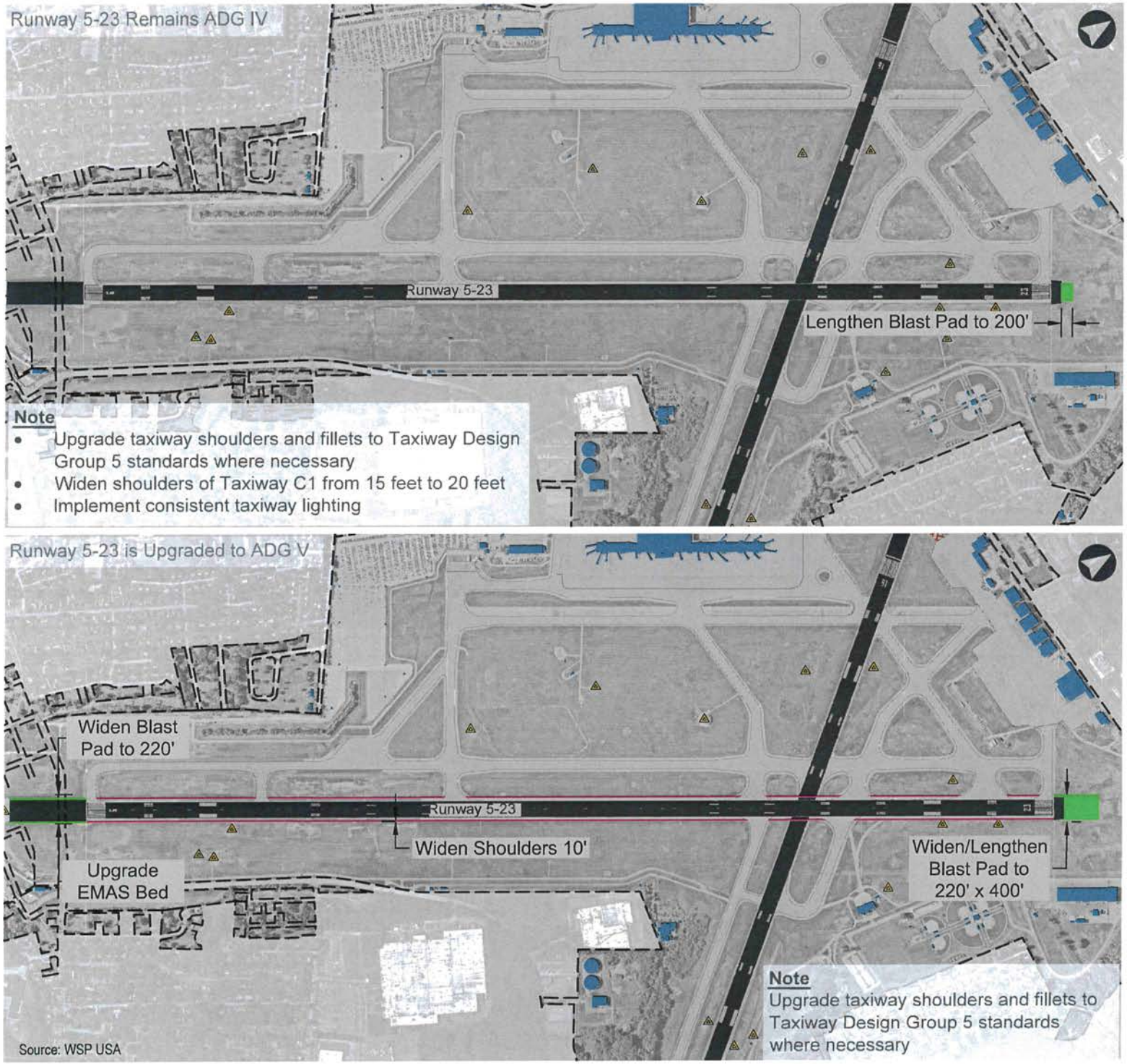

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Figure 6.8
Other Runway/Taxiway Improvements

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Runway Shoulder
- Proposed Blast Pad

600' 0' 600' 1200'

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6.2.2 Recommended Airfield Layout

Figure 6.9 consolidates the individual recommended alternatives into a recommended airfield layout that can accommodate ADG IV aircraft without restrictions.

The proposed airfield layout is designed for ADG IV and TDG 4 aircraft, based on the existing critical aircraft being the Boeing 757-200. The Boeing 767, a TDG 5 aircraft, counted 432 annual operations at PVD in 2018, and could become the critical aircraft in the short term. Should the Boeing 767 (or any other TDG 5 aircraft) become the critical aircraft at PVD, taxiway shoulder and fillet improvements would be required at taxiway intersections where TDG 5 aircraft are anticipated to operate.

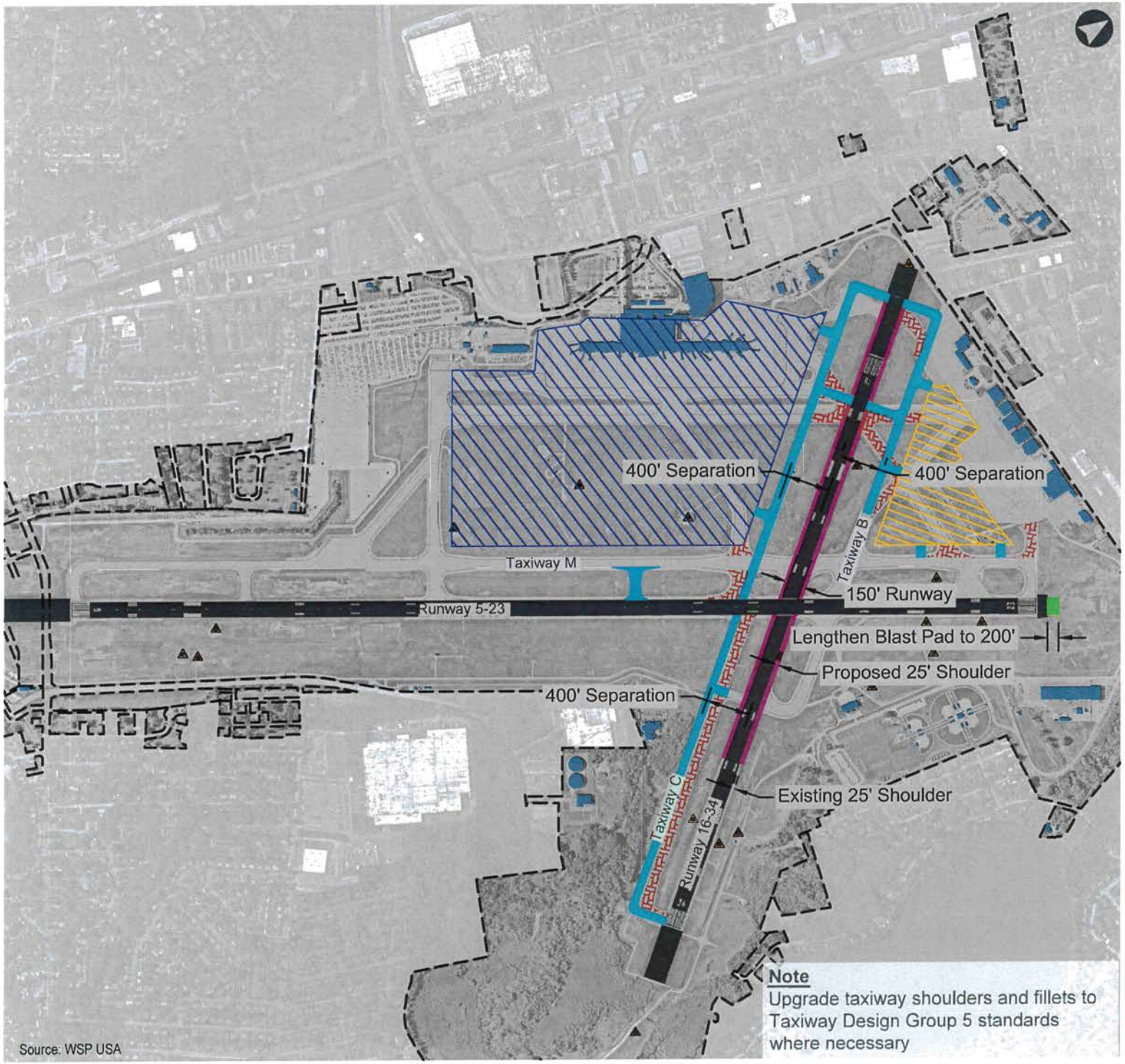
Figure 6.10 depicts additional improvements that would be required if ADG V aircraft were to become the critical aircraft.

6.2.3 Airfield Alternatives Evaluation Summary

The objective of the recommended airfield layout is to provide safe and efficient airfield operations for aircraft up to ADG IV. Safety was enhanced by meeting design standards whenever possible, and efficiency was achieved by assessing flow of aircraft operations, origin/destination on the airport, and needs during poor weather conditions. A summary of airfield improvements to meet ADG IV and ADG V design standards is provided below.

Improvements to Meet ADG IV Design Standards

- Add shoulders along full-length of Runway 16-34
- Build full-length Taxiway C at 400-foot separation
- Extend Taxiway B to the Runway 16 end
- Realign Taxiways V and N intersection into a single taxiway that crosses Runway 16-34 at a 90-degree angle
- Build a 90-degree exit between Runway 5-23 and Taxiway M
- Shift Taxiway A west of Taxiway M
- Extend existing Runway 23 end blast pad to 200' long
- Improve airfield lighting on Taxiway V (south of Runway 16-34)
- Upgrade airfield lighting circuits
- Upgrade taxiway shoulders and fillets for ADG IV/TDG 5 aircraft if/where necessary



Green Airport

T.F. Green Airport
Master Plan

Figure 6.9
Preferred Airfield Layout
- ADG IV

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Runway Shoulder
- Proposed Pavement Demo
- Proposed Taxiway
- Potential Terminal Area
- Potential GA/Cargo Area
- Proposed Blast Pad

600' 0' 600' 1200'

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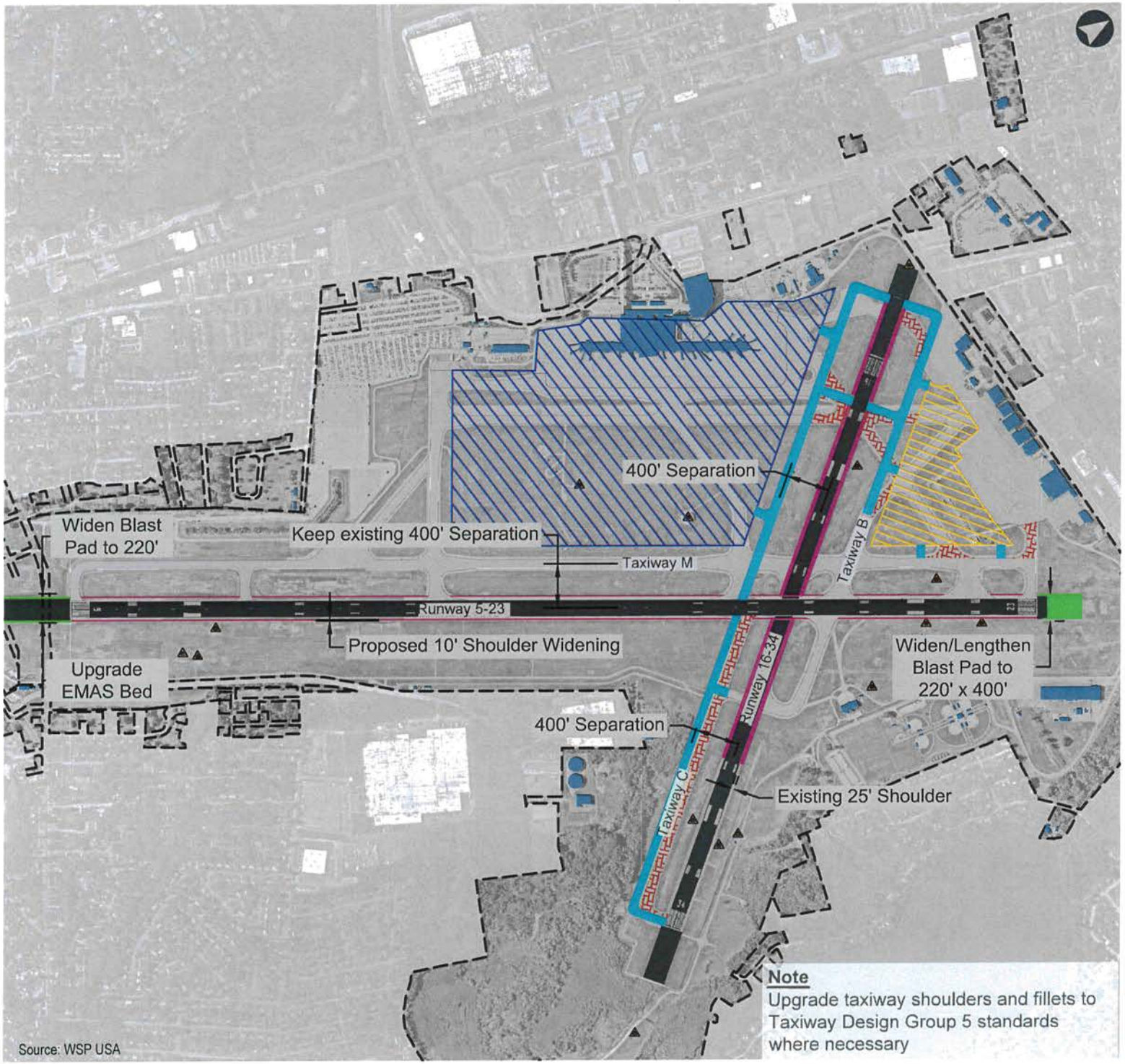

Green Airport

T.F. Green Airport
Master Plan

Figure 6.10
Preferred Airfield Layout
- ADG V

Legend

- Property Line
- Existing Buildings
- Existing Airfield Pavement
- NAVAID
- Proposed Runway Shoulder
- Proposed Pavement Demo
- Proposed Taxiway
- Potential Terminal Area
- Potential GA/Cargo Area
- Proposed Blast Pad

600' 0' 600' 1200'

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Improvements to Meet ADG V Design Standards

The proposed recommended airfield layout can accommodate occasional operations by larger aircraft (ADG V) through the use of operational restrictions, already in use today. Once regular ADG V aircraft operations materialize (more than 500 annual operations), additional improvements would be required, as outlined below:

- Widen/lengthen Runways 5 and 23 ends blast pads to 400 feet long by 220 feet wide
- Relocate Runway 5-23 hold lines to 280 feet from the runway centerline
- Widen Runway 5-23 shoulders to 35 feet
- Upgrade shoulders and taxiway fillets for ADG V/TDG 5 aircraft where necessary
- Upgrade EMAS beds with ADG V EMAS design aircraft

6.3 Passenger Terminal Alternatives

The facility requirements analysis concluded that the existing terminal is undersized in many areas. Specifically, outbound baggage make up, security screening area, holdrooms, baggage claim, concessions, and restrooms are not adequate to accommodate projected demand by the end of the planning period. Some areas like check-in, baggage screening, and the FIS facility are adequately sized, per industry standards requirements, but may not function at the optimal processing rates because of geometric conditions. Additional aircraft parking positions, active and remote, are also needed by planning activity level (PAL) 1.

It is not likely financially feasible to upgrade or expand all major functional areas of the terminal to meet the projected demand, so alternatives were developed to get the most improvement for the least cost. Short-term and long-term development alternatives were created to 1) create a long-term vision, and 2) implement development in incremental steps that give the airport "the most bang for the buck". The alternatives depicted below represent a range of development options, from incremental short-term improvements to grandiose long-term terminal vision.

6.3.1 Terminal Development Area

The terminal development area is sizable, for an existing airport. In the long-term, as much as 130 acres could be available for terminal development and apron area circulation. The existing terminal area has a set, external boundary because of surrounding facilities, multiple aeronautical uses, and various airfield and airspace standards. To the north of the site is Runway 16-34, which is not changing. The eastern edge of the site is constrained by the existing VOR. However, in the future, assuming the VOR is removed, the remaining constraint will be the Taxiway M TOFA. The southern edge of the site is constrained by Taxiway T and future cargo and/or general aviation development. The west side of the site is constrained by the existing curbside and parking infrastructure, which will not have

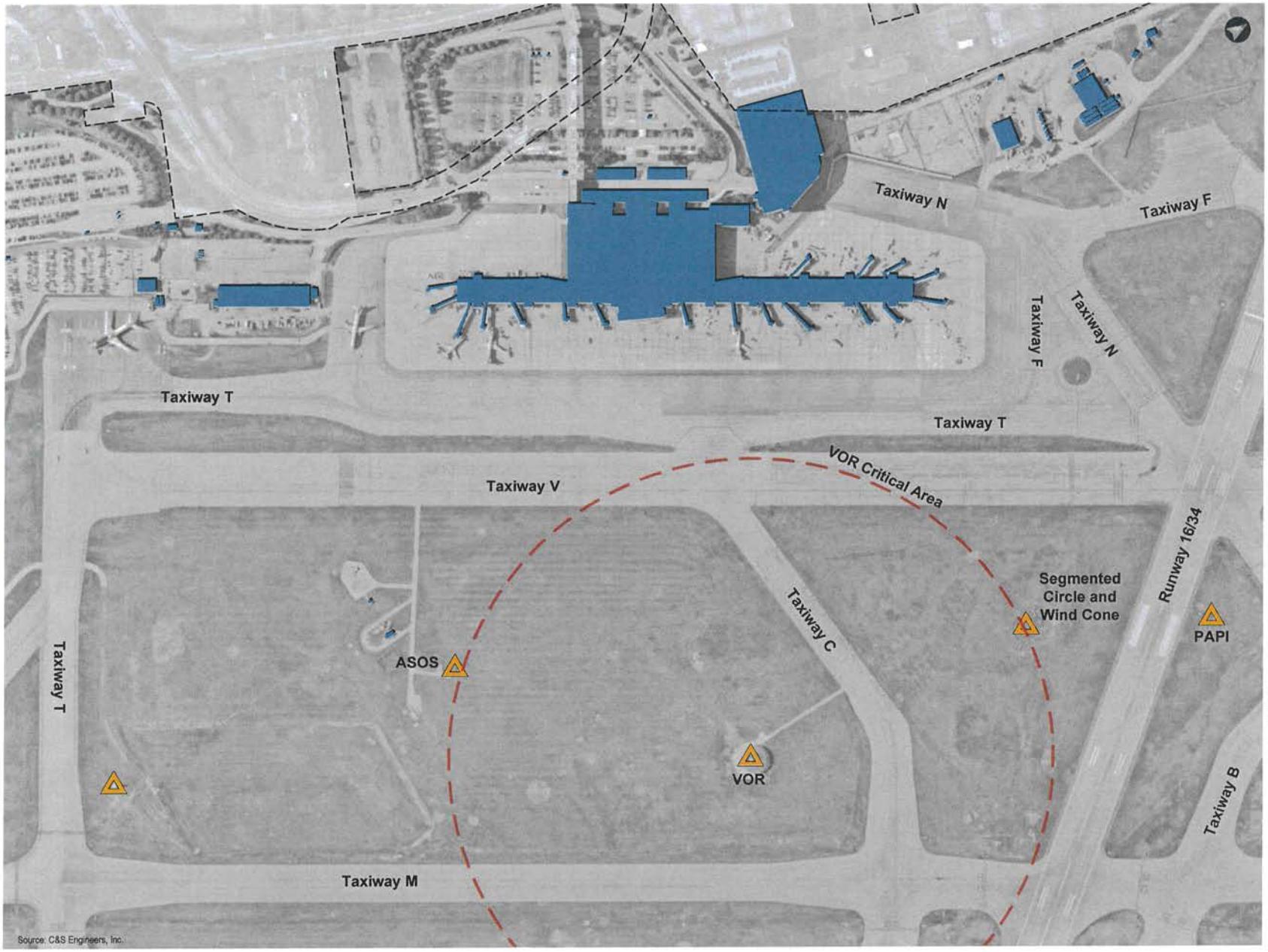
fundamental geometric changes during this planning horizon. The most promising area for development is to the east towards the VOR. For this evaluation, it was assumed that airfield improvements including a new parallel taxiway to Runway 16-34 and the intermediate term VOR decommission, should be planned for. A diagram of the general terminal development area is depicted in **Figure 6.11**.

6.3.2 Process

The process to select a recommended terminal alternative was a collaborative approach that included multiple workshops with the airport and key stakeholders, including airport tenants, FAA, airlines, and the public. The process included the following steps:

- Solicit feedback through a Technical Advisory Committee (TAC) meeting;
- Develop sketches of high-level initial concepts;
- Create a shortlist of alternatives;
- Conduct public outreach for review and comment;
- Refine alternatives to final alternatives;
- Evaluate based on comprehensive criteria listed below;
- Review during final TAC meeting (forthcoming); and
- Define the recommended alternative.

Throughout the process, continuous input from the airport occurred to focus on alternatives that were most realistic and provided the most value.



Green Airport

T.F. Green Airport
Master Plan

Figure 6.11
Terminal Development Area

300' 0' 150' 300'

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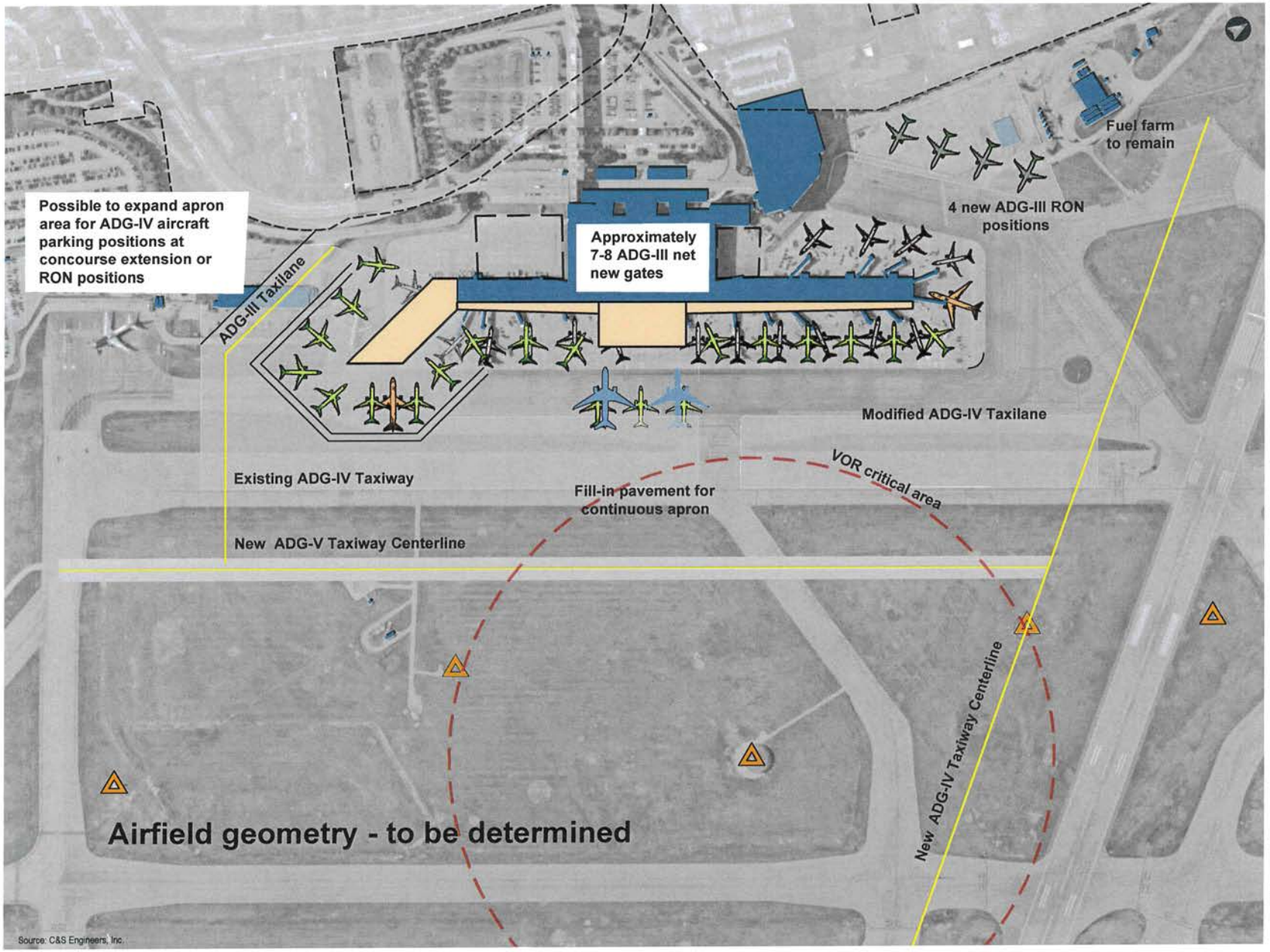
6.3.3 Alternatives

Through the collaborative process, including the first TAC meeting and airport staff input, six terminal development alternatives were generated. Below is a description of the six alternatives developed.

6.3.3.1 Alternative 1

Alternative 1 is a revision to the previous master plan update recommended terminal development. The main features of Alternative 1 are a bump out in terminal building's central area, widening of the existing concourse, and a concourse expansion to the south. The central area is bumped out approximately 200 feet to reconfigure and expand the existing security checkpoint, circulation, concessions, and FIS facility. Aircraft parking positions in front of the expanded FIS can accommodate larger international aircraft such as a B777 or B787, consistent with the projected aircraft fleet mix. The concourse is widened approximately 20-30 feet to expand the holdrooms, widening circulation, and increasing concessions area. The concourse is extended to the south to add 7-8 ADG-III aircraft parking positions. The concourse is right-sized to accommodate current trends in holdrooms and concessions programming. The former rental car area, to the northwest of the north concourse, is redeveloped for 3 or 4 ADG-III RON positions. The primary focus of this alternative is to expand facilities to accommodate gate, RON positions, holdroom, security checkpoint, and concessions requirements while avoiding development in the VOR critical area. Various airfield improvements can be considered with this alternative depending on the financial feasibility. Alternative 1 is depicted in **Figure 6.12**.



Green Airport

T.F. Green Airport
Master Plan

Figure 6.12
Terminal Development Alternative 1

Aircraft Legend

300' 0' 150' 300'

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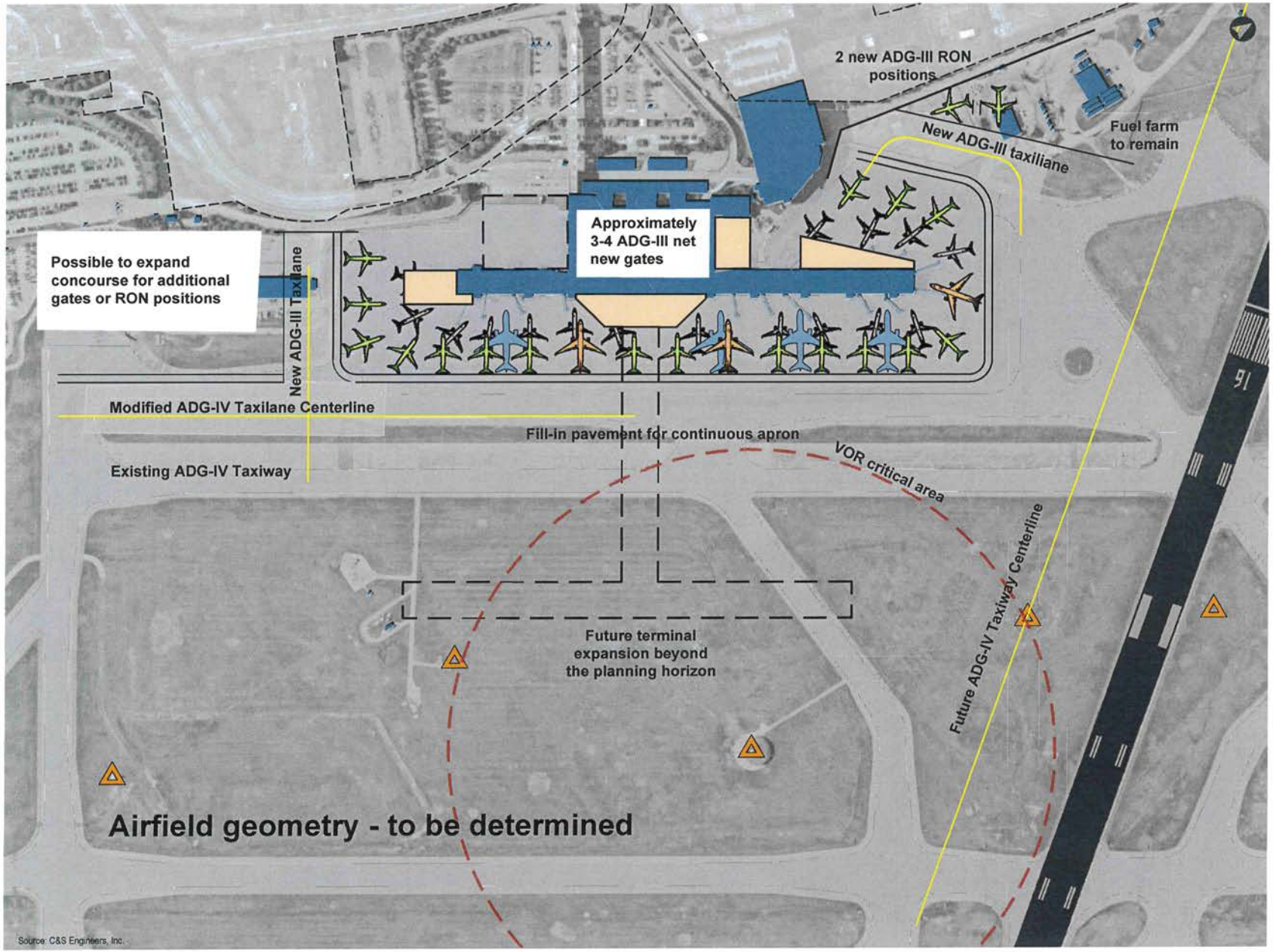
6.3.3.2 Alternative 2

Alternative 2 is an incremental approach to expanding the terminal in multiple areas without significant redevelopment. The main features of Alternative 2 are a bump out in terminal building's central area, a southern concourse expansion, a northern concourse expansion, and terminal building expansion to the north. The central area is bumped out approximately 150 feet to reconfigure and expand the existing security checkpoint, circulation, concessions, and FIS facility. The southern part of the concourse is extended approximately 200 feet to add aircraft parking positions, expand holdroom and circulation areas, and enhance concessions areas. The northern part of the concourse is widening to match proposed renovations to the southern concourse. The northern edge of the terminal building is expanded to increase baggage handling system and loading dock functions. The former rental car area, to the northwest of the north concourse, is redeveloped increased taxilane circulation and 2 ADG-III RON positions. Taxilane T is realigned so that the entire terminal apron area depth is expanded to create more flexibility, including larger aircraft, such as a B777 or B787, consistent with the projected aircraft fleet mix. The primary focus of this alternative is to expand facilities to accommodate gate, RON positions, baggage system, loading dock, holdroom, security checkpoint, and concessions requirements while avoiding development in the VOR critical area. Various airfield improvements can be considered with this alternative depending on the financial feasibility. Alternative 2 is depicted in **Figure 6.13**.



Green Airport

T.F. Green Airport
Master Plan

Figure 6.13
Terminal Development Alternative 2

Aircraft Legend

300' 0' 150' 300'

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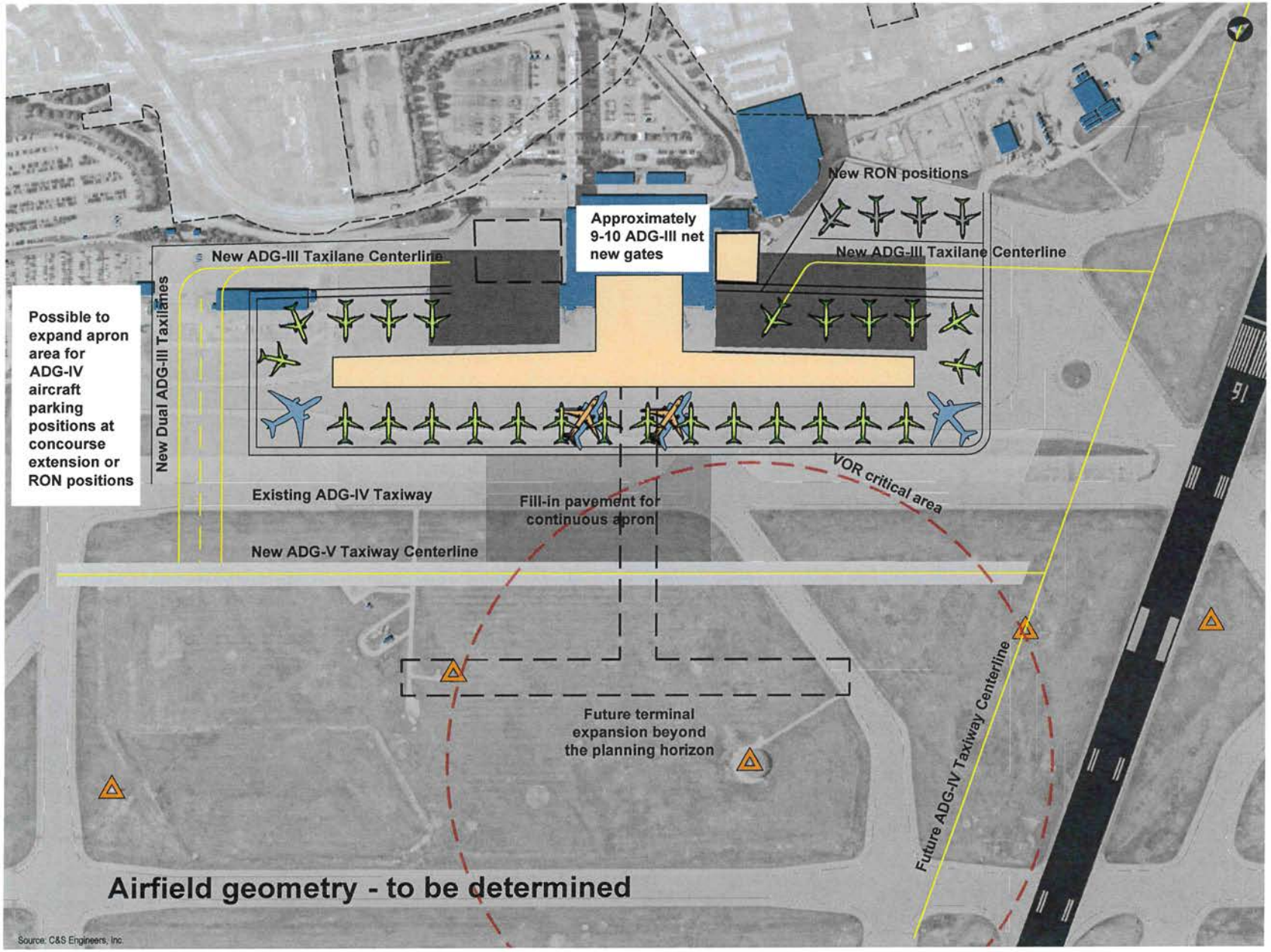
6.3.3.3 Alternative 3

The Alternative 3 is replacement of the existing concourse with a new concourse, right-sized to accommodate current industry trends. The main features of Alternative 3 are a right-sized concourse to add gates, expand security checkpoint, holdrooms, circulation, concessions, FIS facility, and a terminal processor expansion to the north. The former rental car area, to the northwest of the north concourse, is redeveloped increased taxilane circulation and 4 ADG-III RON positions. The existing belly cargo building is demolished for expanded apron area and taxilane circulation to accommodate ADG-III aircraft to the west side of the southern concourse. Taxilane T is demolished, Taxiway V is redeveloped, and a new ADG-V Taxiway is constructed to created two-way access to the new concourse. The central area and ends of the new concourse has apron depth to create more flexible aircraft parking, including B777s or B787s, consistent with the projected aircraft fleet mix. The primary focus of this alternative is to expand facilities to accommodate gate, RON positions, baggage system, loading dock, holdroom, security checkpoint, and concessions requirements while avoiding development in the VOR critical area. Although costly to replace the existing concourses, all future terminal requirements could be accommodated without moving the VOR. Various airfield improvements can be considered with this alternative depending on the financial feasibility. Alternative 3 is depicted in **Figure 6.14**.

6.3.3.4 Alternative 4

Alternative 4 is an incremental approach to expanding the terminal in multiple areas without significant redevelopment. The main features of Alternative 4 are a bump out in terminal building's central area and a new pier concourse to the east. The central area is bumped out approximately 150 feet to reconfigure and expand the existing security checkpoint, circulation, concessions, and FIS facility. From the central bump out extends a concourse to accommodate 4-5 additional aircraft parking positions. Apron depth is the corners are able to accommodate larger aircraft, such as B777 or B787 for expanded international service. The concourse also expands holdroom and circulation areas, and enhance concessions areas. The former rental car area, to the northwest of the north concourse, is redeveloped to add 4 ADG-III RON positions. The primary focus of this alternative is to expand facilities to accommodate gate, RON positions, holdroom, security checkpoint, FIS facility, and concessions requirements while avoiding development in the VOR critical area. Terminal expansion after the VOR is decommission can be accommodated easily by expanding to the east. Various airfield improvements can be considered with this alternative depending on the financial feasibility. Alternative 4 is depicted in **Figure 6.15**.



Green Airport

T.F. Green Airport
Master Plan

Figure 6.14
Terminal Development Alternative 3

Aircraft Legend

300' 0' 150' 300'

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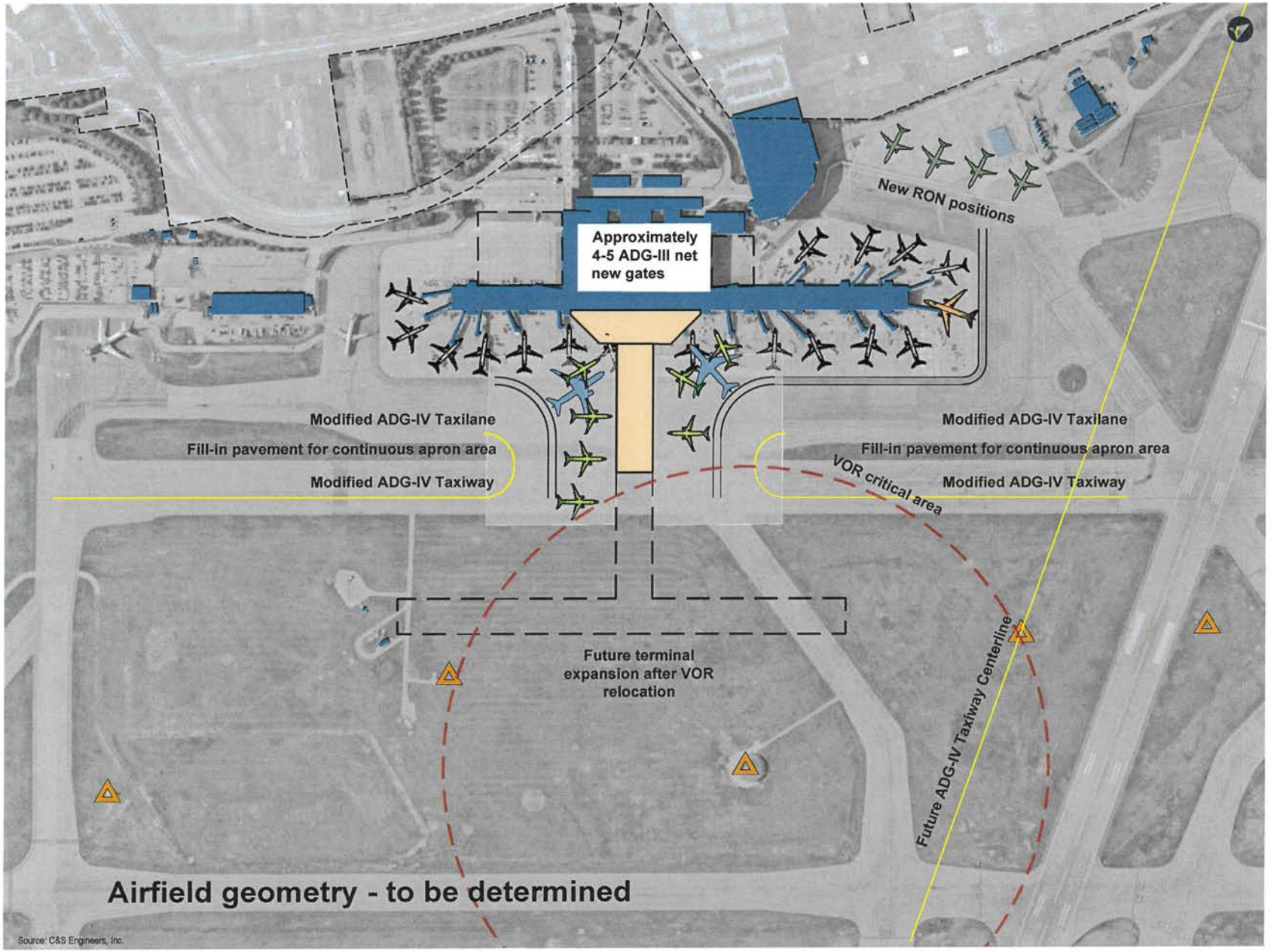

Green Airport

T.F. Green Airport
Master Plan

Figure 6.15
Terminal Development Alternative 4

Aircraft Legend

300' 0' 150' 300'

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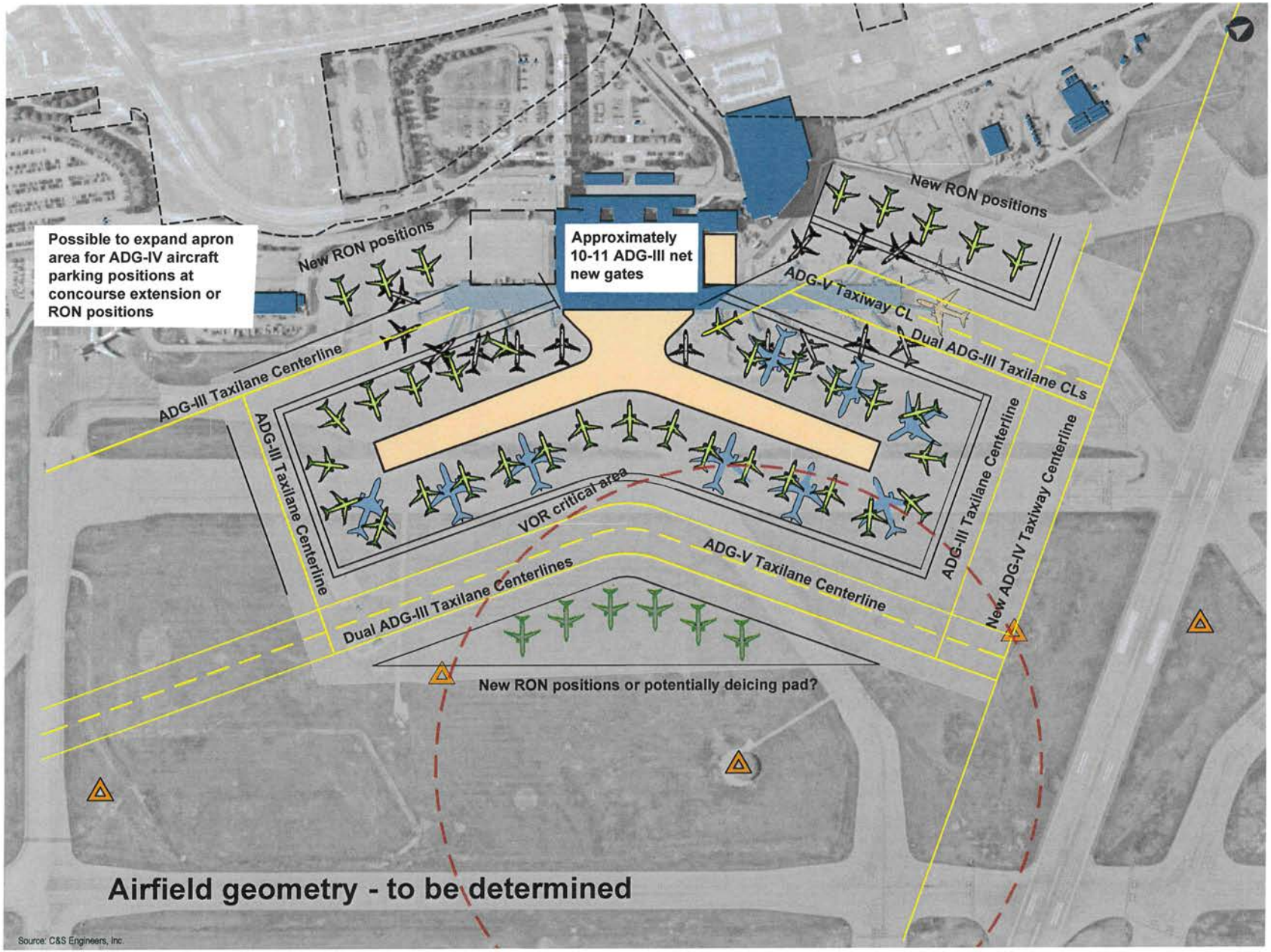
6.3.3.5 Alternative 5

Alternative 5 is replacement of the existing concourse with a new concourse, right-sized to accommodate current industry trends. The main features of Alternative 5 are a right-sized concourse to add gates, expand security checkpoint, holdrooms, circulation, concessions, FIS facility, and a terminal processor expansion to the north. The former rental car area, to the northwest of the north concourse, is redeveloped increased taxilane circulation and 5 ADG-III RON positions. The existing belly cargo building can remain, even with expanded apron area and taxilane circulation to accommodate 3 ADG-III aircraft parking positions to the west side of the southern concourse. The existing airfield and apron area taxiway and taxilane circulation is demolished and reconstructed. The entire new concourse has apron depth to create more flexible aircraft parking, including B777s or B787s, consistent with the projected aircraft fleet mix. The primary focus of this alternative is to expand facilities to accommodate gate, RON positions, baggage system, loading dock, holdroom, security checkpoint, and concessions requirements. Rebuilding the central area and south concourse would avoid the VOR critical area. In the long-term, when the VOR is decommissioned, the north concourse would be constructed. Alternative 5 is depicted in **Figure 6.16**.

6.3.3.6 Alternative 6

Alternative 6 is a replacement of the existing concourse with a new concourse, right-sized to accommodate current industry trends. Phase 1 of Alternative 6 is Alternative 4. The main features of Alternative 6 are a right-sized concourse to add gates, expand security checkpoint, holdrooms, circulation, concessions, FIS facility, and a terminal processor expansion to the north. By replacing the existing concourse far to the east, more than 20 acres are developable for non-terminal functions. In an otherwise space-constrained airport, this alternative is a way to maximize the use of the terminal envelope to accommodate the terminal, and potentially cargo, general aviation, and potentially other functions in the long-term future. The existing airfield and apron area taxiway and taxilane circulation is demolished and reconstructed. The entire new concourse has apron depth to create more flexible aircraft parking, including B777s or B787s, consistent with the projected aircraft fleet mix. The primary focus of this alternative is to expand facilities to accommodate gate, RON positions, baggage system, loading dock, holdroom, security checkpoint, and concessions requirements. Similar to Alternative 4, Phase 1 would avoid the VOR critical area. In the long-term, when the VOR is decommissioned, the concourse could be expanded to accommodate demand well beyond the planning horizon. Alternative 6 is depicted in **Figure 6.17**.



Green Airport

T.F. Green Airport
Master Plan

Figure 6.16
Terminal Development Alternative 5

Aircraft Legend

300' 0' 150' 300'

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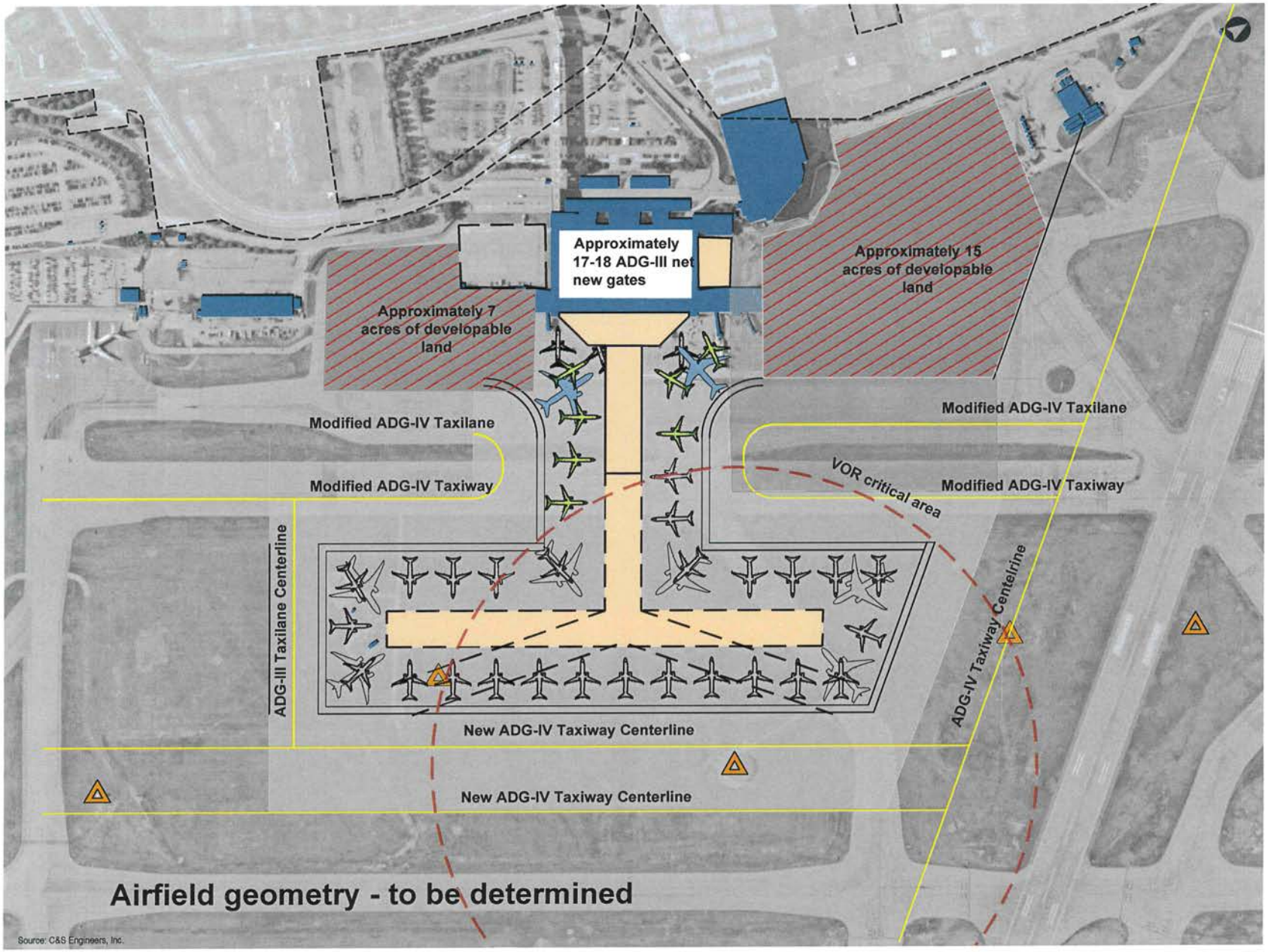

Green Airport

T.F. Green Airport
Master Plan

Figure 6.17
Terminal Development Alternative 6

Aircraft Legend

300' 0' 150' 300'

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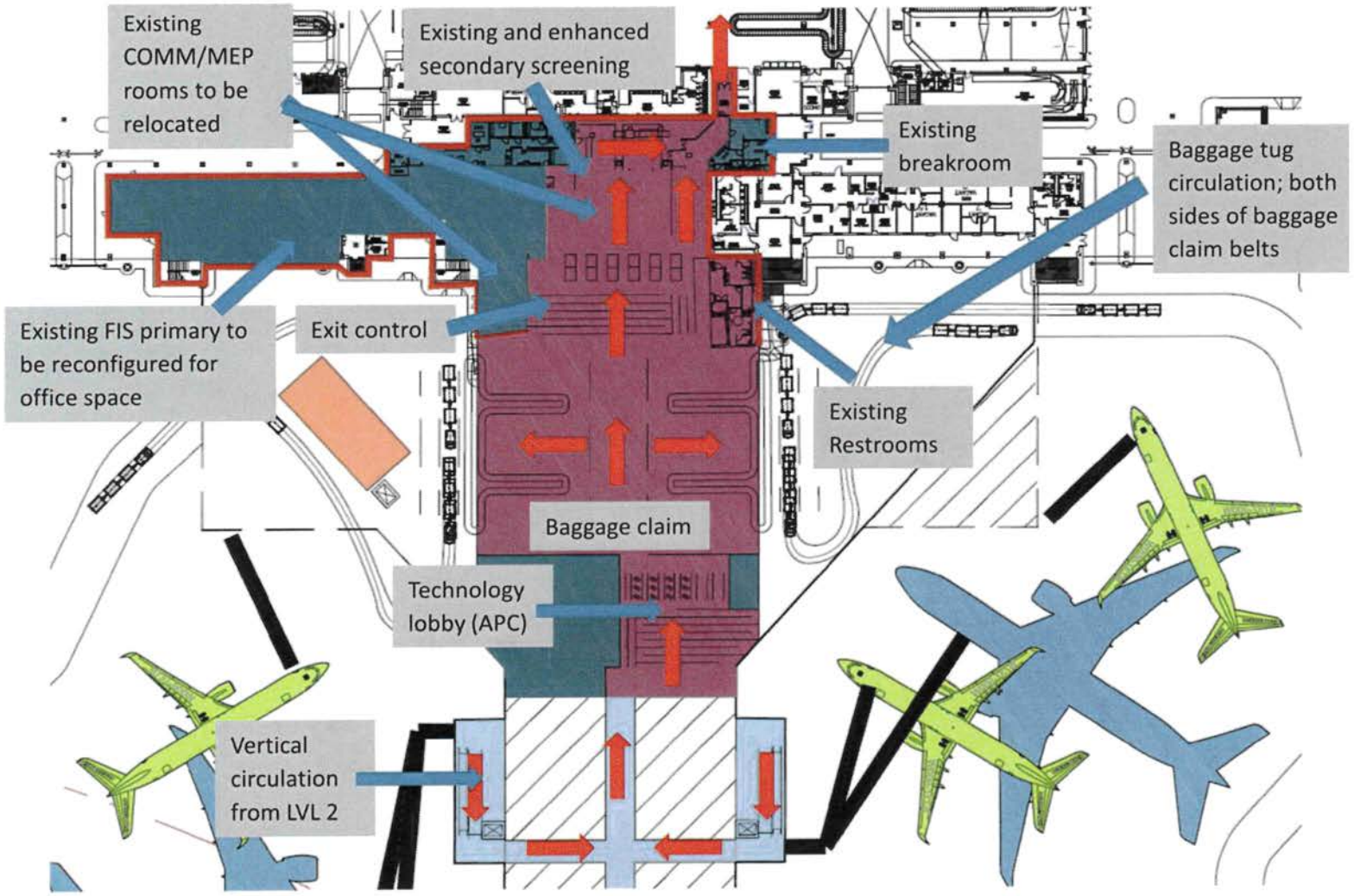
6.3.3.7 FIS Alternatives

The passenger forecast stated an estimated international arriving passenger demand of almost 500 passengers/hour in PAL 3. While the current FIS facility has enough primary processing booths, adequate secondary screening, adequate CBP office space, and minimally deficient baggage claim, the geometry of the existing space does not allow for the facility to maximize the potential throughout. Also, because of a substantial airport MEP/Comm room located in the middle of the FIS facility, site lines from various locations are not up to CBP preferred standards. Due to these, and other factors, RIAC directed the master plan team to analyze ways to increase FIS processing capacity, either through redevelopment of the existing location, or a brownfield site on the west side of the south concourse.

Alternative 1 – The existing FIS is expanded and reconfigured to increase capacity and improve passenger flow. Alternative 1 takes advantage of the recommended terminal development alternative 4 that creates a pier concourse, extruding out from the central concessions area just through the security checkpoint. At the upper level, the pier concourse provides area for security checkpoint, holdrooms, concessions, circulation, and other expansion. At the lower level, the pier concourse provides room to reconfigure and expand the FIS. The new pier concourse provides sterile vertical circulation cores to funnel international arriving passengers into the FIS. The FIS is realigned east to west instead of the current south to north flow. There is ample space for two large baggage claim devices and other passenger processing areas. The existing FIS area is reconfigured into CBP offices or other areas if not needed by CBP. The central MEP/Comm room is relocated to another location within the terminal, likely in the new pier concourse. In discussions with CBP, it is likely that the "Bags First" concept will be deployed at PVD. FIS Alternative 1 is depicted in **Figure 6.18.**

Alternative 2 – A new, single-level FIS is constructed on the west side of the south concourse. A south concourse expansion, to increase the gate holdrooms and aircraft parking capability, coincides with or can be independent from the FIS project. Arriving international passengers deplane from the second level of the south concourse, and funnel through a sterile corridor, to a vertical circulation, down to the lower level FIS. The new FIS is equal in size to Alternative 1, and the passenger flow is from south to north. There is ample space for two large baggage carousels, other passenger processing areas, and CBP office space. There is also a meeter/greeter lobby and a non-secure connector to the terminal, immediately after the exit from the FIS. A two-lane vehicle service road is surrounds the new FIS and provides baggage tug and other vehicle access to and from aircraft. This layout, and vehicle service road maintains ample space for the south check-in lobby baggage screening and make up area, needed to accommodate future airport growth. Alternative 2 is depicted in **Figure 6.19.**



Green Airport

T.F. Green Airport
Master Plan

Figure 6.18
FIS Alternative 1

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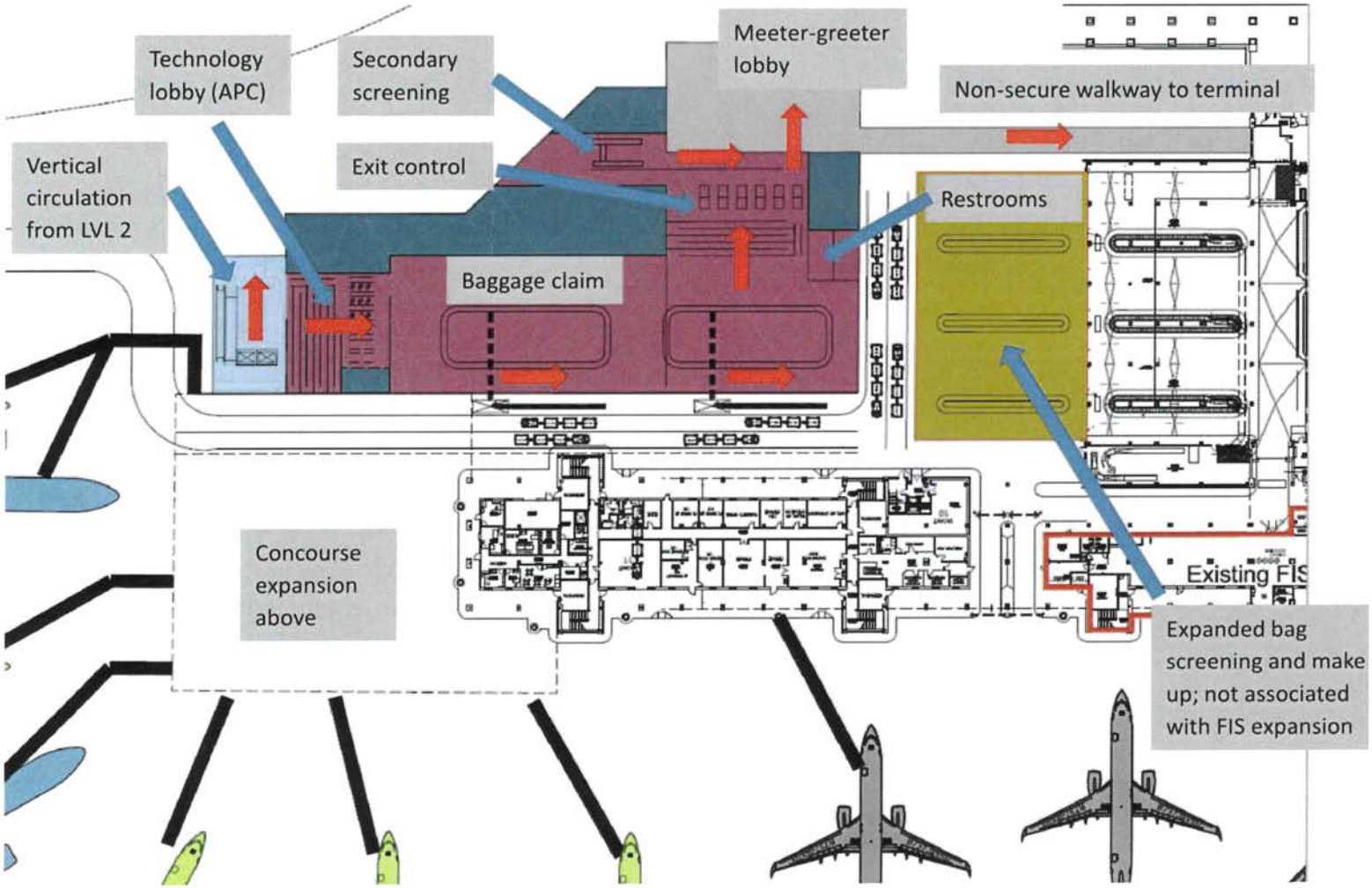


Figure 6.19
FIS Alternative 2

6.3.4 Passenger Terminal Alternatives Evaluation

6.3.4.1 Terminal Alternatives

The terminal alternatives are evaluated based on input from Airport staff and TAC members through the TAC meetings, input from the general public during the public workshops, and the evaluation criteria below, established by the Airport and Consultant at the start of the Alternatives tasks. They are:

- Design Standards – accommodates long-term passenger and aircraft facility demands. Enhance the passenger experience through amenities, convenience, ease of movement, and technology.
- Operational – improves operational efficiency of airport and tenants, and improves aircraft circulation around the terminal/concourse.
- Environmental – compares level of new construction vs. incorporation and reuse of existing facilities
- Financial – maximizes financial return on investment. Ability to facilitate enhanced concessions and revenue potential throughout the terminal facility
- Feasibility – Ability to implement in an incremental manner. Impact of relocating or not relocating the VOR

All terminal alternatives meet the design standards by accommodating the long-term demand. Each of the alternatives also have the right-sized programmatic area to enhance the passenger experience. Alternatives 1, 2, and 4 are incremental expansions that add concourse space to improve airport and tenant operations. Alternatives 3, 5, and 6 are new facilities that would be designed to optimize airport and tenant operations. Alternative 1 and 4 change the airfield geometry. Alternative 2 is the most simplistic way to maintain or improve airfield circulation. Alternatives 3, 5, and 6 improve operations, but have a high capital cost which would impact tenants and the airport in a different operational way. Alternatives 1, 2, 4, and 6 are the alternatives that reuse most of the existing terminal infrastructure. This maximizes the investment in existing facilities before expanding. Alternatives 3 and 5 eliminate the existing concourses which is not the most appropriate use of existing facilities. Alternatives 1, 2, and 4, quantitatively, are the most financially feasible. Alternatives 3 and 5 are not feasible because the concourses are completely rebuilt. Alternative 6, is expensive, but it is a placeholder and will not be implemented during the master planning horizon. Alternatives 2 and 4, or a combination of both, can be implemented in incremental steps. Ultimately, it is logical to develop the terminal from Alternative 4 to 2 to 6. Alternative 1 can be implemented incrementally, but will not provide a long-term vision. Alternatives 3 and 5 would have to be constructed at one time, rendering them financially burdensome and unable to implement in an incremental manner. All

terminal alternatives appropriately look to work around the VOR critical area with the assumption that it will not be decommissioned until PAL 2 or beyond.

Table 6.8 depicts the full evaluation of each terminal alternative. The evaluation concluded that Alternative 2 and 4 ranked the highest. Alternative 6 represents the possible expansion, beyond the planning horizon, and reserves space for terminal development once the VOR is decommissioned, replaced or relocated. A combination of Alternatives 2 and 4 represents what should be implemented in the short-term to intermediate term while the VOR is still operational. Alternatives 2 and 4 would provide the most return on investment. More detailed phasing analysis and financial feasibility to determine timing of terminal implementation will be discussed in the Section 7, Implementation Plan.

Table 6.8 - Terminal Development Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Design Standards						
Operational						
Environmental						
Financial						
Feasibility						
Recommended Alternative		✓		✓		✓

Source: C&S Companies, July 2019.

Legend: Best, Better, Good

6.3.4.2 FIS Alternatives Evaluation

The FIS alternatives were evaluated using the same criterion used for the overall terminal development alternatives. Both FIS alternatives take advantage of new construction. Alternative 1 is a combined project with other concourse-level improvements above. Alternative 2 is a brown field site west of the existing south concourse. Therefore, both alternatives have enough programmatical area to accommodate the long-term passenger demand, and can be design to enhance the inbound international arriving passenger experience through amenities. Both also enable CBP to implement latest and future technology and innovation to increase the passenger processing throughput. Alternative 2 is marginally better because it is a new facility compared to Alternative 1 which is a combination of new and reconfigured existing space. However, the site constraints of Alternative 2 allows may dictate an unusual geometric layout which could lead to a less efficient building as opposed to typical open sites.

Both FIS alternatives improve the operational efficiency of passengers and CBP. CBP seems to prefer Alternative 1 over Alternative 2, assuming the existing MEP/comm room is relocated, for open visual connections throughout the entire space. From an aircraft parking and passenger flow perspective, both are equal because there are short walking distances to the FIS, and only one vertical circulation down to the lower level to access the FIS. Alternative 1 allows for the international gates to be centralized on the concourse, near the main concessions area; Alternative 2 is isolated to the south end of the existing concourse. Some airports prefer the former, to best accommodate high-spend international travelers. CBP does like the location of Alternative 2 because of direct access to the landside roadways in case there is a need to quickly extract an incoming international passenger.

The environmental impact of both alternatives are mixed. Alternative 1 gives the airport more 'bang for the buck' and reuses existing infrastructure because it would be a part of a larger concourse development, including reconfiguring of some existing space. Alternative 2 is all new construction, not using any existing space, but there is limited impact to the existing airfield. Alternative 1 would alter the existing airfield flow, and include significant airfield/taxiway reconstruction.

The financial impact of both alternatives is significant. However, Alternative 1 will be less than Alternative 2 because Alternative 1 is a part of a larger concourse development. Alternative 1 also has more opportunity to facilitate increased revenue enhancement through concessions because it is a part of the larger concourse project; Alternative 2 does not. At the same time, Alternative 2 is a brown field site and there is minimal impact to the existing concourse to implement. Meaning, in order to building Alternative 1, the larger concourse project must be completed at the same time. Whereas, Alternative 2 can be significantly built as a standalone project, even if other concourse development is not needed.

Implementation and phasing is similar to the financial evaluation above. Overall Alternative 1 is more efficient and more 'bang for the airport's buck' because it is incorporated into another project. However, for the same reason, it is also more of a challenge to implement, if other concourse development is not needed. Alternative 2 is primarily a standalone project, and does not need significant development outside of the FIS to be operational.

Table 6.9 depicts the full evaluation of each the FIS alternatives. The evaluation concluded that Alternative 1 ranked the highest.

Table 6.9 - FIS Alternatives Evaluation

Criteria	Alternative 1	Alternative 2
Design Standards		
Operational		
Environmental		
Financial		
Feasibility		
Recommended Alternative	✓	

Source: C&S Companies, July 2019.

Legend:

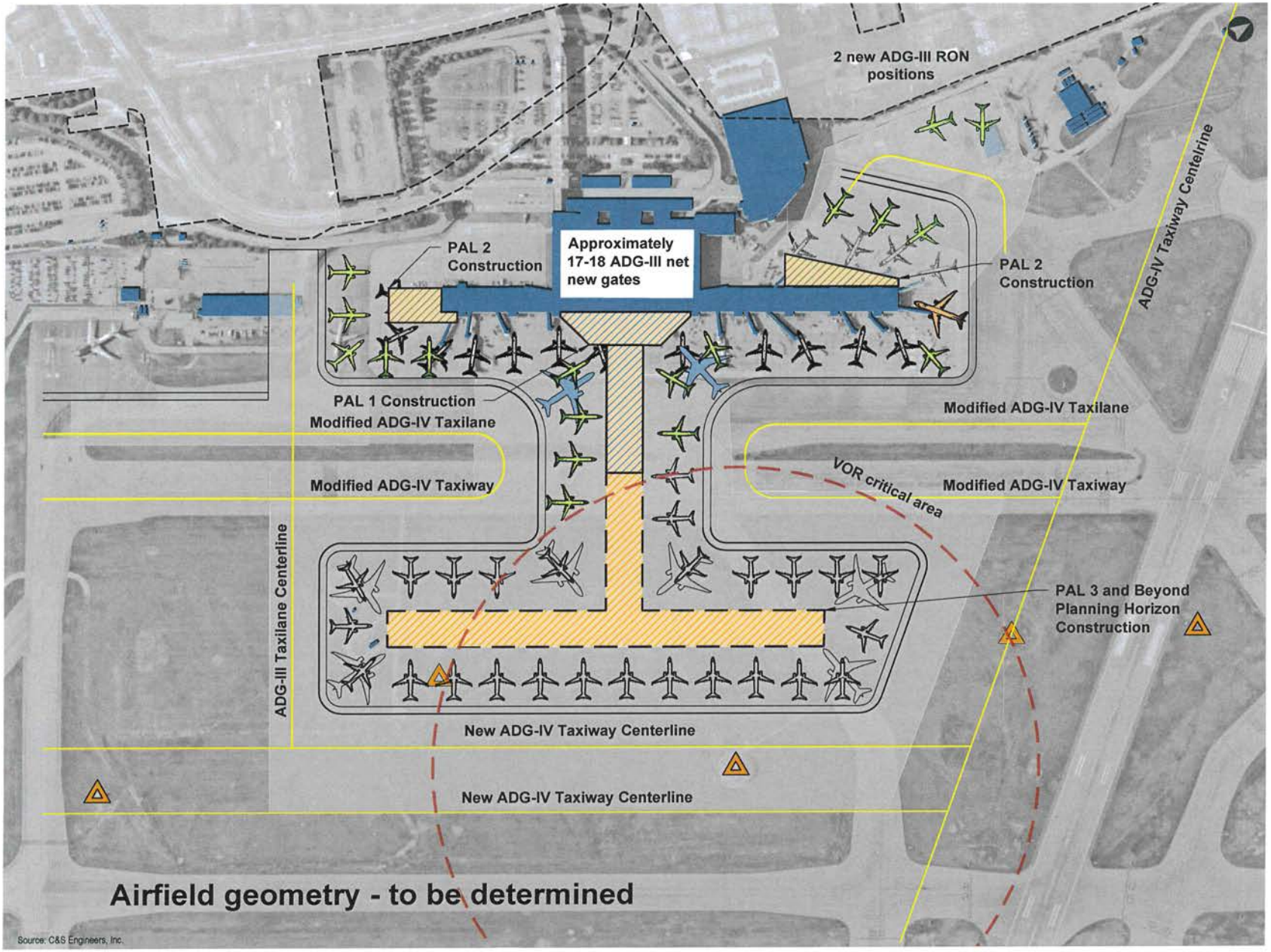
Best Better Good

6.3.5 Recommended Terminal Alternative

The recommended terminal alternative is a combination of Alternatives 2, 4, and 6. In the PAL 1 and PAL 2 timeframe, incremental expansion to achieve a few more gates, holdroom area, enhanced security screening, FIS improvements, and more post-security concessions space are priorities. A combination of Alternative 2 and 4 will accommodate all of these short-to-intermediate-term priorities. And, it can all be developed whether or not the VOR remains or is decommissioned. Once terminal development is started with a pier concourse to the east, and logical further expansion is to the east, then north and south, in a "T" configuration. The phasing is ideal because it is possible to incrementally add a few gates or 10+ gates without impact to the existing terminal. **Figure 6.20** depicts the Recommended Terminal Alternative. The most financially feasible and easiest to implement phases will be determined in the next chapter of the Master Plan.

6.3.6 Recommended FIS Alternative

Based on the evaluation above, the recommended FIS alternative is Alternative 1. Throughout the master plan process, one of the Airport's main objective is to maximize the bang for their buck with terminal development options. Alternative 1 takes advantage of the concourse expansion at the upper level, that accommodates more gates, expanded security checkpoint, and increased revenue generating areas. The cost of the expansion is included in the overall projects to improve the terminal operation, instead of a stand-a-lone cost. Alternative 2 is an acceptable option if a FIS is needed, but no other expansion is required.



Green Airport

T.F. Green Airport
Master Plan

Figure 6.20
Recommended
Terminal Alternative

Aircraft Legend

300' 0' 150' 300'

C&S COMPANIES

6.4 Airport Ground Transportation and Roadway Access Alternatives

Providing safe, efficient access to the airport is a key part of ensuring travelers have a seamless travel experience and that cargo and other goods are moved efficiently in and out of the airport property. This includes egress and ingress to and from the airport, vehicular and pedestrian circulation within the airport, pick-up and drop-off activity, and parking. The section discusses the issues that were identified during the existing conditions / facilities requirement process and presents alternatives to address each of the issues.

6.4.1 Process

In addition to the analyses performed as part of the facilities requirements process, additional site visits and feedback from RIAC staff and the public were used to inform and develop a list of ground transportation and roadway access issues. A range of short-term and long-term solutions to these issues were then developed and evaluated using both quantitative traffic analysis software and methodologies as well as qualitative assessments, including feedback from RIAC staff, environmental impacts, and construction impacts.

6.4.2 Alternatives

Alternatives were developed for each of the issues identified in the facilities requirements process, and these alternatives (and their tradeoffs) are presented by issue in order of implementation timeline, from PAL 1 to PAL 3. The alternatives developed for each issue went through a comparative analysis process consisting of various factors. For the purposes of ground transportation, factors are defined as follows:

- Design Standards: Do roadway, intersection, and signage projects meet or deviate from state and national standards?
- Operational: Negative impacts to traffic flow and curbside operations (most of these alternatives are designed to mitigate current traffic and curbside operations issues, so most alternatives will have positive impacts)
- Environmental: How alternatives relate to environmental impacts as well as permitting. Most of the proposed alternatives are on land that has already been developed.
- Cost: How alternatives relate to each in terms of cost and project planning
- Implementation: Impacts related to stakeholder coordination and/or public support

Each criteria was qualitatively analyzed using the following rating system:

Legend:

No or minimal impacts Moderate impacts Significant impacts

Although each issue was considered individually, alternatives were developed with a goal of developing complementary solutions that addressed multiple issues simultaneously.

Table 6.10 summarizes the issues and presents the recommended timeline for issues to be resolved.

Table 6.10 – Issues and Implementation Timeline

Issue	Description	Timeline
Issue #1	Airport Connector Road Sight Distance	PAL 1
Issue #2	Airport Connector Road Wayfinding	PAL 1
Issue #3	Pedestrian Connectivity & Wayfinding	PAL 1
Issue #4	Airport Connector Road Wayfinding	PAL 1
Issue #5	Curbside Congestion	PAL 1
Issue #6	Curbside Dwell Times	PAL 2
Issue #7	Redundant Circulation	PAL 2
Issue #8	Airport Connector at Evans Road Future Capacity	PAL 3
Issue #9	Future Parking Capacity	PAL 3

Source: WSP USA

6.4.2.1 Issue #1 Airport Connector Road Sight Distance

Site assessments and measurements indicate that the sight distance along the southwest curb of the Airport Connector Loop road is inadequate, as shown in **Figure 6.21**. The figure illustrates there is only 149 feet of available sight distance, which is six (6) feet less than the 155 required for vehicles traveling 25 mph. Inadequate sight distance presents safety issues, as drivers may not be able to come to a complete stop in advance of objects in the roadway. Also, the limited sight distance in combination with multiple decisions results in reduced saturation flow rates as drivers approach the signalized intersection.

Figure 6.21: Existing Airport Connector Road Sight Obstructions

Source: Google Earth / WSP USA

The following alternatives could mitigate the lack of sight distance:

Alternative 1: Do Nothing (No Build)

Alternative 1 is the Do Nothing, or No Build condition, in which no improvements would be made to improve sight distance at this location.

Alternative 2: Trim Trees and Shrubbery

The sight distance assessment indicated that simply removing the trees and shrubbery on the inside of the curve (between the roadway and the red line drawn in the figure) on the southwest corner of the Airport Connector Road would increase the sight distance such that it is compliant with prevailing vehicle speeds. This alternative could be completed within the PAL 1 timeframe.

Alternative 3: Reduce Speeds

Because there is no speed limit signage along the Airport Connector Road, vehicles may be traveling faster than desired. Installing additional signage reinforcing the desired speed (recommended to be a maximum of 20 mph) would help drivers to have appropriate reaction and decision-making time and distance. This alternative could be completed within the PAL 1 timeframe.

Alternative 4: Reconfigure roadway geometry

Reconstructing the existing roadway to increase the radius of curvature as shown in **Figure 6.22** would also increase the available sight distance available to drivers. This modification would be more significant, would require greater resources, and would likely be completed in

conjunction with other potential projects discussed in this section that would address other issues. As such, this alternative would likely be completed within the PAL 2 or PAL 3 timeframes.

Evaluation of Issue #1 Alternatives

Table 6.11 summarizes the impacts of each of the alternatives. Alternative 1 (No Build) would have operational and safety impacts, as these are existing issues. Alternatives 2 and 3 would be low cost, low impact treatments that would deliver safety and operational benefits through the form of improved sight and decision making distance, although Alternative 3 is dependent on driver compliance.

Alternative 4 would have greater cost, environmental, and implementation impacts, as realigning the roadway would be more expensive than trimming trees or adding signage. The added impervious pavement could have environmental or drainage impacts, and constructing it could briefly disrupt existing traffic or parking in Lot D.

Alternative 2 is recommended due to its effective, ease of implementation, and cost.

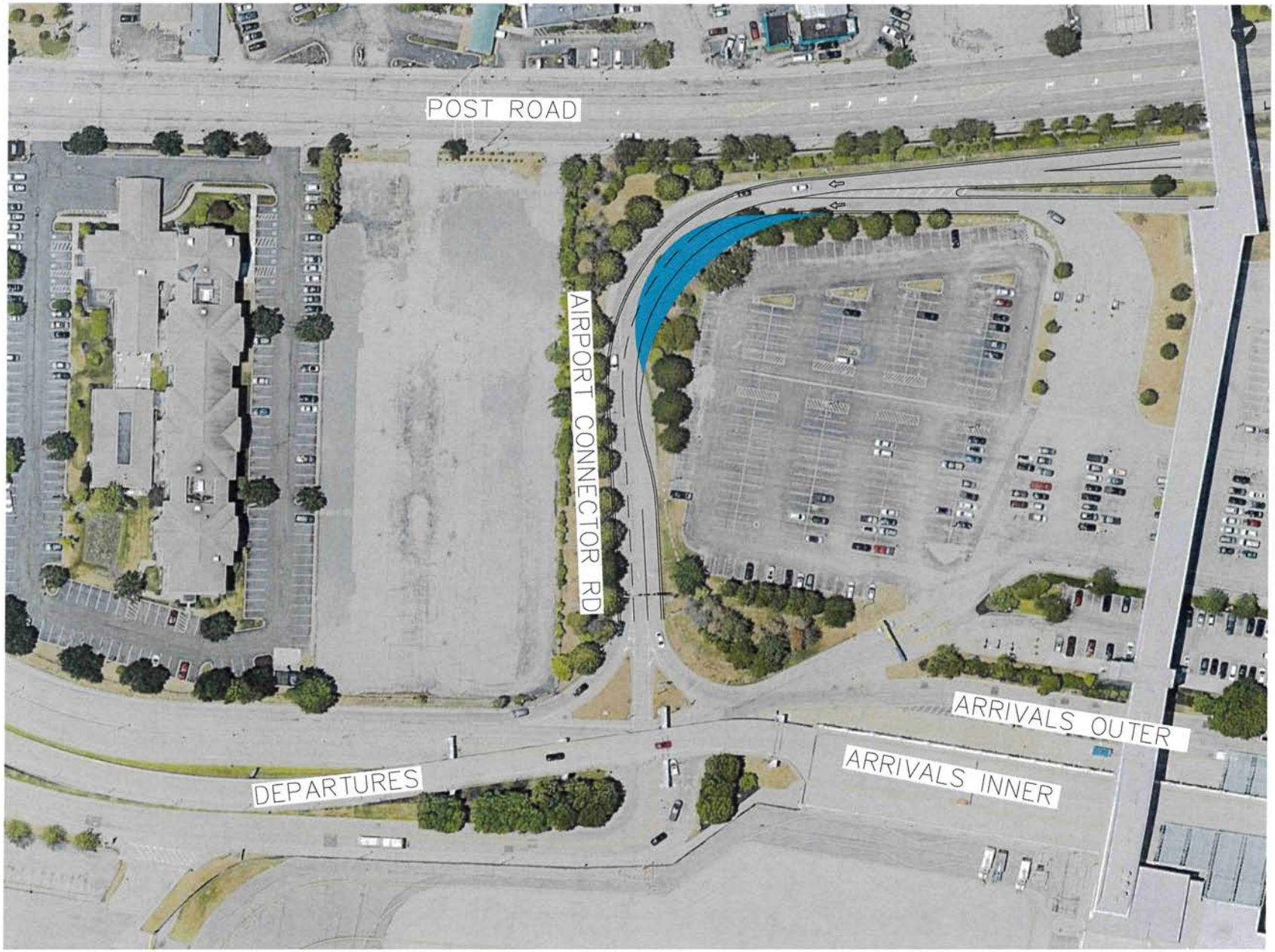
Table 6.11: Airport Connector Road Sight Distance Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Design Standards	Does not meet sight distance			
Operational	Safety & capacity impacts		Reduces speed/flow	Construction impacts/delays
Environmental				
Financial				Cost to re-align roadway
Feasibility				
Recommended Alternative		✓		

Sources: WSP USA, July 2019.

Legend:

No or minimal impacts Moderate impacts Significant impacts



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6.4.2.2 Issue #2 Airport Connector Road Wayfinding

Visual evidence as well as anecdotal evidence from drivers who provided comment indicates that drivers approaching the Evans Road signalized intersection would prefer additional or more redundant signage along the Airport Connector Road to have additional decision making time to properly navigate the roadway alignment. **Figure 6.23** illustrates a driver's view as they approach the southwest curve along the Airport Connector Road. The sign in the figure provides guidance to Post Road, but does not give clear direction to I-95 or Lot E.

Figure 6.23 Airport Connector Road Signage

Source: WSP USA, July 2018

Alternative 1: Do Nothing (No Build):

Alternative 1 is the Do Nothing, or No Build condition, in which no improvements would be made to improve signage on the Airport Connector Roadway, and any existing issues would remain.

Alternative 2: Add Roadside Signage

Add roadside signage with navigation and directions to additional destinations to improve driver decision making and certainty and improve flow rate at the intersection, as drivers would be less confused. These signs could be installed in the PAL 1 timeframe.

Alternative 3: Add Overhead Gantry Signage

An alternative to adding roadside signage would be to replace the existing roadside signage with an overhead gantry sign that co-locates all wayfinding and navigation information at a single location over the roadway. This sign could be implemented in the PAL 1 horizon.

Evaluation of Issue #2 Alternatives

The evaluation of Issue #2 alternatives is summarized in **Table 6.12.** The table indicates that the existing safety and operational issues would remain if Alternative 1 (No Build / Do Nothing) were selected. Alternatives 2 and 3 would provide operational and safety benefits

in the form of additional signage, with Alternative 3 recommended due to the greater visibility overhead signage provides. This greater visibility would come with a higher cost and brief impacts from implementation.

Table 6.12: Airport Connector Road Wayfinding Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			
Operational	Traffic flow impacts		
Environmental			
Financial			Relatively higher gantry cost vs. wayside signage
Feasibility			Brief night construction impacts
Recommended Alternative			✓

Source: WSP USA, July 2019

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

6.4.2.3 Issue #3 Pedestrian Connectivity & Wayfinding to Post Road

The existing pedestrian connectivity to/from the Terminal to Post Road is circuitous and has opportunities for improved wayfinding to improve safety and comfort. The existing conditions are illustrated in **Figure 6.24**.

Figure 6.24: Pedestrian Route from Terminal to Post Road

Source: WSP USA, 2018, 2019

Improving the route and wayfinding along the route would improve pedestrian safety and better integrate the airport with the surrounding community, which is especially important in advance of the City Centre Warwick development.

Alternative 1: Do Nothing (No Build)

Alternative 1 represents the Do Nothing, or No Build alternative, in which no improvements would be made to pedestrian wayfinding and connectivity, and any existing issues would remain.

Alternative 2: Improve Lighting, Signage, and Markings

While there are signs that direct travelers exiting the airport to Garage, Garage, B, and the Red Beam garage, additional (and larger) signage could improve wayfinding – especially for those walking all the way to Post Road. Similarly, wayfinding infrastructure could be installed to improve safety for those walking *from* Post Road to the terminal, as numerous pedestrians were observed walking with luggage in the circulating roadways. Along the route, lighting, pavement markings, and new and additional sign would help confirm the path (in both directions). These improvements could be made within the PAL 1 timeframe.

Alternative 3: New at-grade Pedestrian Route to Post Road

Constructing another path from the airport terminal to Post Road that bypasses the garages would provide improved connectivity to Post Road, especially in advance of the City Centre Warwick development. This route would be in addition to the existing overhead Interlink that connects travelers to the terminal from the rental car center, parking garages, and

MBTA commuter rail station. One potential alignment would be to cross the Airport Connector Road at Evans Road and use the existing vacant lot between Lot D and the Hampton Inn hotel to access Post Road. This facility would need to be constructed in conjunction with other potential projects and would likely be implemented in the PAL 2 - PAL 3 timeline.

Evaluation of Issue #3 Alternatives

Table 6.13 summarizes the impacts of each alternative. The table indicates that Alternative 1 (Do Nothing) would have operational and safety impacts, as the existing connectivity, wayfinding, and safety issues would remain. For minimal cost, the existing pedestrian route to Post Road through the parking garages could be improved with better and more redundant signage, higher contrast markings, and linear lighting. For additional cost, a new, safer, and more intuitive pedestrian route to Post Road could be added by routing pedestrians along the outer curb, having them cross the Airport Connector Road approach at Evans Road, and then continuing through the vacant lot. In addition to higher cost, this new connection would potentially have environmental or drainage impacts, and would impact vehicular operations at the Airport Connector Road at Evans Road intersection.

Table 6.13: Pedestrian Connectivity and Wayfinding Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			
Operational	Existing wayfinding issues remain		Impact to traffic flow
Environmental			Potential environmental / runoff impacts
Financial			
Feasibility			
Recommended Alternative		✓	

Source: WSP USA 2019

Legend:

No or minimal impacts Moderate impacts Significant impacts

6.4.2.4 Issue #4 Airport Connector Road at Evans Road Wayfinding

Site observations and anecdotal evidence from comments indicate that drivers on all approaches have difficulty navigating the Airport Connector Road at Evans Road intersection and seeing existing traffic control devices. The navigation issues stem from the

multiple departing roadways that exit the intersection from each approach combined with a lack of corresponding signage and pavement markings. This leads to reduced saturation flow rates at the intersection, as drivers reduce speeds due to uncertainty on the approach. The following measures would improve signal head visibility and driver information on approach.

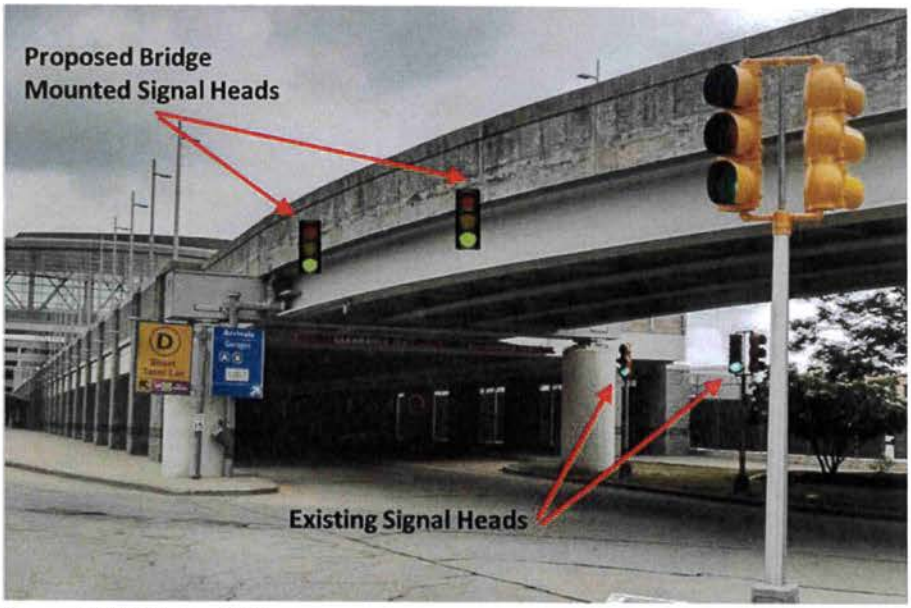
Alternative 1: Do Nothing (No Build)

Alternative 1 represents the Do Nothing, or No Build alternative, in which no improvements would be made to intersection wayfinding or signal visibility and any existing issues would remain.

Alternative 2: Add redundant signal heads and/or relocate signal heads to improve visibility

The overhead departures level roadway and associated structures block sight lines and create shadows that can make it difficult to see traffic signals. Adding redundant signals and/or relocating them, as shown in **Figure 6.25** would improve sight lines, providing additional decision making time. This is particularly needed for vehicles turning left from the Airport Connector Road into the curbside areas, and relocating signal heads would significantly improve sight distance and driver certainty.

Figure 6.25: Existing and Proposed Signal Head Locations



Source: WSP USA, June 2018

Alternative 3: Add Signage, Striping, Pavement markings

Additional approach signage, striping along intersection departure pathways and pavement markings, as shown in **Figure 6.26**, would clarify turning paths for drivers, especially those turning left from the Airport Connect Road and those turning right from Evans Road.

Figure 6.26: Example Signage on Evans Road Approach

Source: WSP USA

Evaluation of Issue #4 Alternatives

Table 6.14 is a summary of the evaluation for each alternative. Under Alternative 1 (Do Nothing), the existing safety and operational impacts would remain. Alternatives 2 and 3 would incur moderate costs relocating signal heads (Alternative 2) and add markings and signage (Alternative 3). In concert, they would provide operational and safety benefits, with Alternative 2 providing greater safety benefits via improved sight distance. Implementation impacts for Alternatives 2 and 3 would be minimal, as both would incur minimal construction- impacts. It is advised that both alternatives move forward as the recommended alternatives, given their relatively low cost and complementary benefits.

Table 6.14: Airport Connector Road at Evans Road Wayfinding Alternative Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards	Sight distance issues remain		
Operational	Poor signal visibility		
Environmental			
Financial			
Feasibility		Brief construction impacts	
Recommended Alternative		✓	✓

Source: WSP USA, July 2019

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

6.4.2.5 Issue #5 Curbside Congestion

Extensive data collection efforts were performed along the departures and arrivals levels curbsides in order to collect curbside volumes and dwell times to model these operations in traffic simulation software and calculate curbside level of service using best practice industry tools. While site observations did show congestion – especially at the arrivals level in the early evening and late night – the observations also indicated that improved signage could better disperse curbside occupancy.

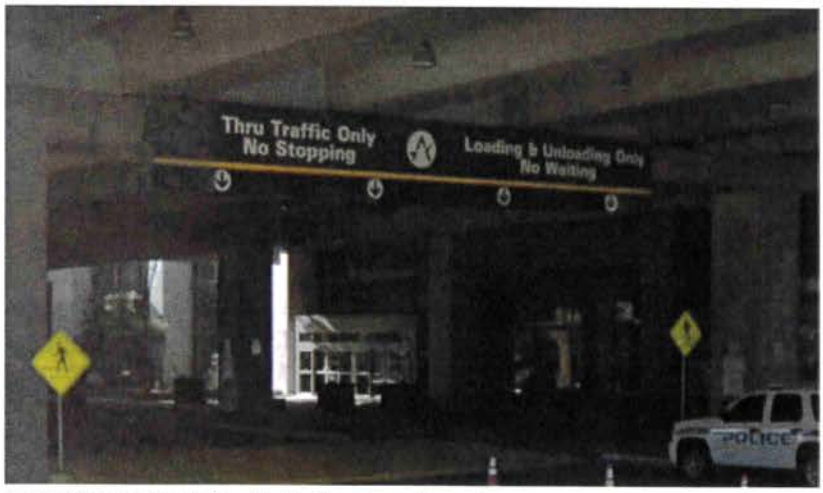
Alternative 1: Do Nothing (No Build)

Alternative 1 represents the Do Nothing, or No Build alternative, in which no improvements would be made to mitigate existing congestion along the curbsides.

Alternative 2: Add Overhead Signage

Installing overhead signage, the arrivals level that clarifies lane assignments to drivers will help to communicate which lanes are to be used to pick-ups and which lanes are used to continue and exit the arrivals level. An example of this signage is shown in **Figure 6.27**, which emulates an example found at Austin Bergstrom International Airport.

Figure 6.27: Overhead Lane Assignment Signage, Austin Bergstrom Int'l Airport



Source: Google Streetview, Austin Bergstrom Airport

Alternative 3: Encourage Drivers to use Full Curb Length

Site observations indicated that while curbside congestion occurred, it was concentrated near the terminal doors, and that as one moved upstream (Near "Zones" 1-4 marked on the columns), that was available capacity for pick-up activity. Adding signage to encourage drivers to wait in this area and to use the Zone numbers on columns as a reference would better distribute activity and increase capacity. This signage could be added on the existing

numbered columns or on overhead signage (see Alternative 2). Addressing this issue would also improve safety, as passengers and drivers are more exposed to moving vehicles when they use the 2nd and 3rd lanes near the terminal versus using the curb lane further from the terminal doors. These improvements could be implemented in PAL 1.

Evaluation of Issue #5 Alternatives

Table 6.15 summarizes the alternatives evaluation for Issue #5. It indicates that the existing Operational and Safety issues would remain under the Do Nothing alternative (Alternative 1), and that Alternatives 2 and 3 would provide operational and safety benefits.

Alternative 2 is the recommended alternative due to its greater visibility to drivers and greater likelihood to result in higher rates of compliance.

Table 6.15: Curbside Congestion Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			
Operational	Existing issues remain		
Environmental			
Financial			
Feasibility		Brief traffic disruption with installation	
Recommended Alternative		✓	

Source: WSP USA, July 2019

Legend:

No or minimal impacts Moderate impacts Significant impacts

6.4.2.6 Issue #6 Long Curbside Dwell Times

In addition to drivers not utilizing the full extent of the curbside (as discussed in Issue #5), numerous drivers were observed dwelling excessively at the curbside. In most cases, the driver arrived too early to pick up their contact, and instead of driving to the Cell Phone Lot or parking, they either waited for several minutes (sometimes up to 10 or 20 minutes) at the curbside, or circulated continuously around the loop road (see Issue #7). The alternatives below outline ways to reduce long dwell times through implementable projects or enforcement.

Alternative 1: Do Nothing (No Build)

Alternative 1 represents the Do Nothing, or No Build alternative, in which no improvements would be made to mitigate the existing long dwell times along the curbside.

Alternative 2: Optimize Targeted Enforcement

Site observations indicated many vehicles dwelled at the curbside for more than 5 minutes, and in some cases, in excess of 15 or even 20 minutes. Optimizing and targeting enforcement efforts to occur during peak activity levels and at peak congestion locations would reduce excessive dwelling and increase curbside capacity. This policy could be implemented in the PAL 1 time horizon.

Alternative 3: Relocate Cell Phone Lot adjacent to Lot D

Currently, the existing cell phone lot is located outside of the main airport property with access from Post Road with relatively small signage and no amenities. Drivers arriving via I-95 must exit prior to the airport, drive away from the airport, and then park two signals away from the curbside in an area with no food, WiFi, or other options.

Relocating the cell phone lot to the vacant lot just east of Post Road and south of the Airport Connector Road / Lot D, as shown in **Figure 6.28** would bring it to the main airport confines and closer to the arrivals level curbsides. Drivers would enter the airport from I-95 and Post Road as they do now and then navigate to the cell phone lot using internal airport roadways. This more proximate location would appeal more and be more convenient to drivers waiting to pick up arriving passengers and mitigate excessive curbside wait times.

In addition, this location allows for potentially adding a revenue-generating land use between the cell phone lot and Post Road, as shown in **Figure 6.28**. This site would be accessed via right-in, right-out access from Post Road and would provide for pedestrian (but not automobile) access from the cell phone lot, allowing waiting drivers convenient access.

Due to its proximity to alternatives addressing other solutions, it is recommended that it be addressed in conjunction with Issues #7-9, likely in the PAL 2 or PAL 3 timeline.

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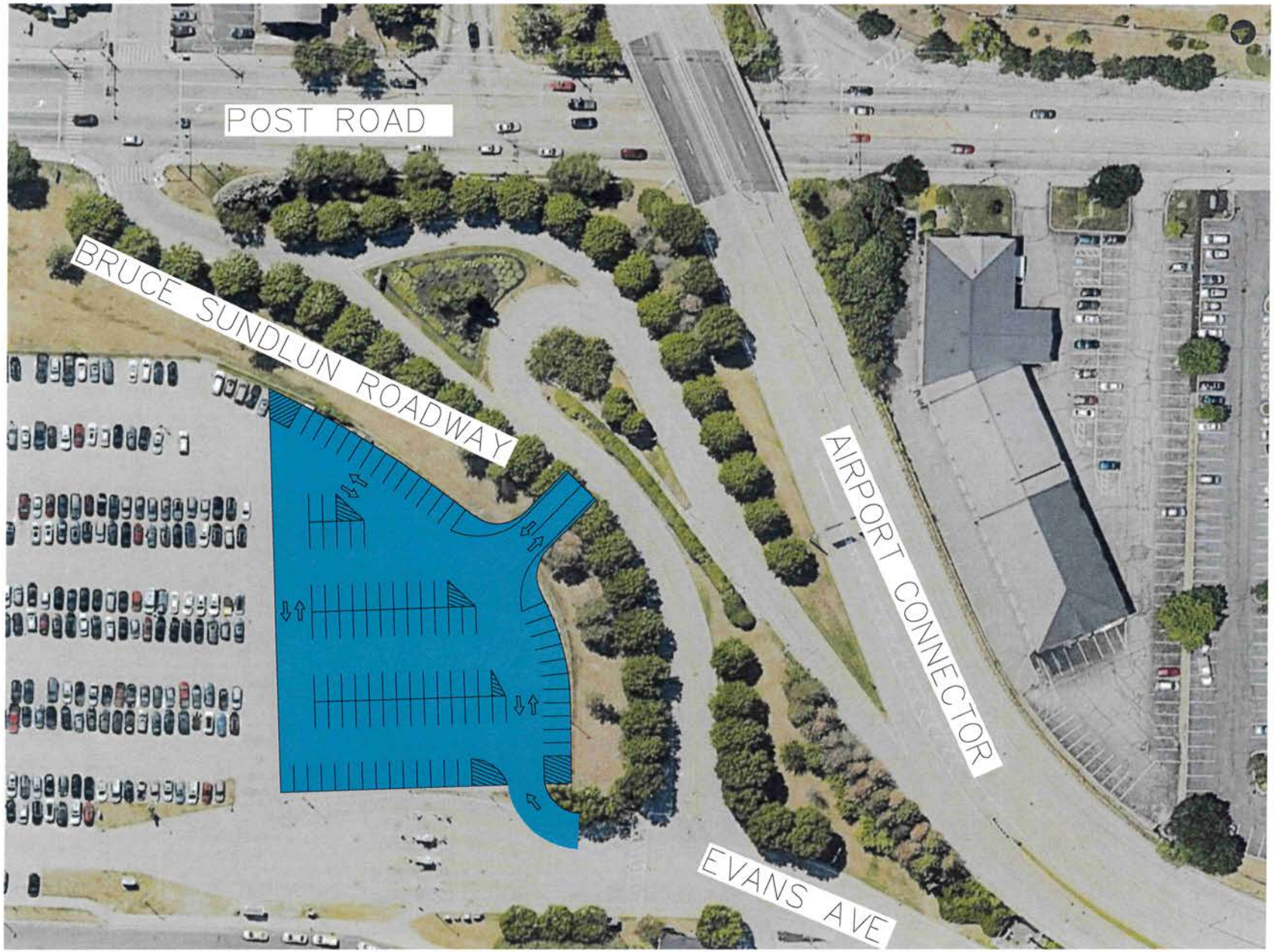
Alternative 4: Relocate Cell Phone Lot to Lot E at Bruce Sundlun Roadway

Currently, the existing cell phone lot is located outside of the main airport property and off of Post Road with relatively small signage and no amenities. Drivers arriving via I-95 must exit prior to the airport, drive away from the airport, and then park two signals away from the curbside in an area with no food, WiFi, or other options.

Relocating the cell phone lot to Lot E (just south of Bruce Sundlun Roadway, as shown in **Figure 6.29**, would bring it within the main airport confines and closer to the arrivals level curbsides. Drivers would enter the airport from I-95 and Post Road as they do now and navigate to the cell phone lot via Bruce Sundlun Roadway. This more proximate location would allow drivers waiting to pick up arriving passengers somewhere nearby to wait outside of the curbside. One impact of this alternative is that it would consume part of Lot E, and thus this alternative would need to be planned in conjunction with future parking needs (see Issue #9).

Due to its proximity to alternatives addressing other solutions, it is recommended that it be addressed in conjunction with Issues #7-9, likely in the PAL 2 or PAL 3 timeline.



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Evaluation of Issue #6 Alternatives

Table 6.16 shows the evaluation of Issue #6 alternatives across five criteria. The table indicates that the existing operational and safety issues would remain under Alternative 1 (Do Nothing). Alternative 2 is a policy solution that would improve operations and safety; costs for Alternative 2 would but operational (vs. capital) and be based on an assessment of the staffing schedules and capacity needed to effectively patrol and oversee curbsides during their peak activity levels.

Alternatives 3 and 4 both propose to relocate the airport's cell phone lot closer to the terminal to increase its usage and reduce curbside circulation. While both alternatives project to have similar cost and environmental impacts, Alternative 3 would allow for a potential revenue-generating use adjacent to Post Road and Alternative 4 would decrease Lot E parking capacity. Alternative 3 could also be planned and designed to function independently of other future circulation improvements and thus is the recommended alternative.

Table 6.16 – Curbside Dwell Time Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Design Standards				
Operational				
Environmental				
Financial		Enforcement costs		Alternative 4 would be most expensive
Feasibility			Coordinate new access with RIDOT	Reduces Lot E capacity
Recommended Alternative			✓	

Source: WSP USA, July 2019

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

6.4.2.7 Issue #7: Redundant Circulation Through Arrivals Level

The airport's roadway network currently requires drivers exiting the departures level and Lot D destined for Post Road to circulate around the Airport Connector Road loop, turn left at the Evans Road signalized intersection, continue along either the inner or outer curb, and then exit to Post Road at the approach opposite of Coronado Road. This leads to unnecessary circulation and inflated curbside traffic volumes, especially during peak flight

activity. In addition, comments from drivers during site visits indicate this travel pattern is confusing to those unfamiliar with the airport, which can lead to even further circulation and congestion. These additional volumes add to vehicle-vehicle and vehicle-pedestrian conflicts. To reduce circulation, two alternatives were developed to add an additional exit to Post Road.

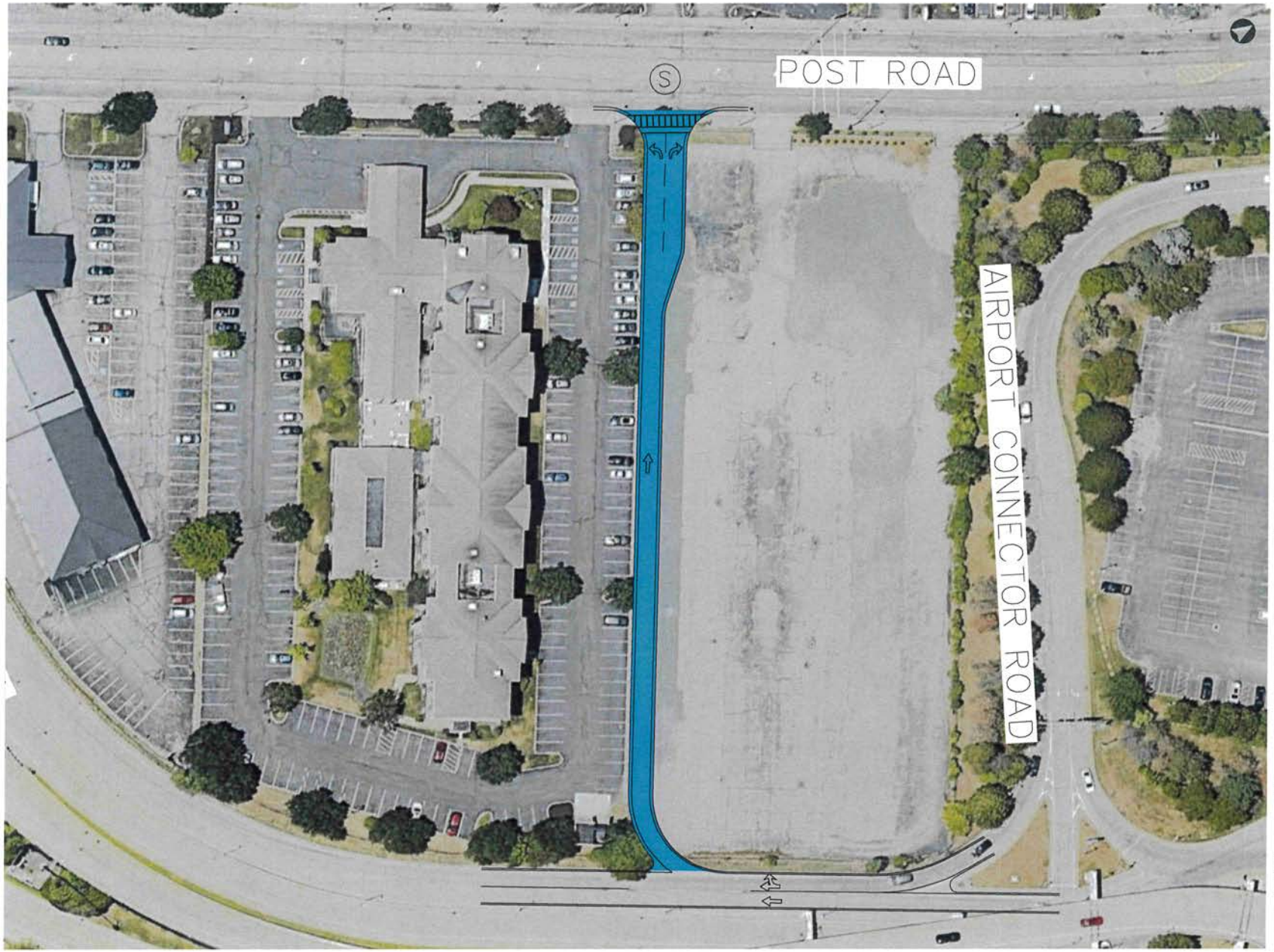
These new roadway connections will help to reroute departures and Lot D volumes circulating around Airport Connector Loop. The volumes will turn right through the channelized lane at the signalized intersection of Airport Connector road and Evans Avenue. Approximately, 33 vehicles per hour (vph) in the AM peak, 72 vph in the PM peak, and 110 vph during the departures peak will be reduced from circulating around the loop. These vehicles will exit on Post Road intersection using either of the proposed alternatives.

Alternative 1: Do Nothing (No Build)

Alternative 1 represents the Do Nothing, or No Build alternative, in which no improvements would be made to mitigate the existing redundant circulation occurring at the airport.

Alternative 2: New Exit to Post Road from Airport Connector to I-95

Figure 6.30 illustrates Alternative 2, which would add a second exit point to Post Road from the airport between the Airport Connector Road and the Hampton Inn & Suites hotel. This alternative would likely be implemented in the PAL 2 – PAL 3 horizon, after PAL 1 horizon improvements had been made to address Issues #1-5. Because Alternative 1 would limit potential expansion opportunities of Parking Lot D, it is recommended that parking impacts from other projects – and more refined parking needs - would need to be understood before deciding between alternatives.



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Alternative 2 would provide the following benefits:

- The location of the new access to Post Road (located from the Airport Connector (to I-95), as shown in the figure) would allow vehicles exiting the departures level and Lot D to access Post Road without re-circulating along the inner or outer curb areas. In addition, vehicles would be routed through the higher capacity free-flow right turn lane instead of through the intersection.
- Alternative 2 makes efficient use of the vacant lot, through additional access, a relocated cell phone lot, and potential options for additional revenue generation.

This alternative would have the following impacts:

- The proximity of the added access to Post Road may be located too close to the signalized intersection to allow left-turning vehicles from Evans Road to safely merge prior to turning to Post Road, meaning that vehicles from Lot E and other airport facilities accessed from Evans Road would need to circulate through the curbside area to access Post Road.
- This alternative would add a signal to Post Road (US 1). The signal would be approximately 600 feet north of the existing Airport Connector at Post Road ramps intersection and approximately 1,000 feet south of the existing signalized intersection at Coronado Road. The proposed signal timing would need to be "coordinated" with adjacent signals (i.e., its signal timing parameters would need to be adjusted such that traffic progresses efficiently along Post Road).
- Although the additional signal would require coordination between adjacent signals and implemented in collaboration with the Rhode Island Department of Transportation, a benefit of adding a signal is that it could potentially be located opposite of the City Centre Warwick development, which would allow vehicles exiting TF Green Airport to directly access the development. Allowing access both out of and into the airport at this new exit to Post Road was explored in order to provide a potential two-way connection to the City Center Warwick development. However, it was determined that providing access into the airport at this location would significantly exacerbate existing traffic circulation and weaving issues.

Table 6.17: Delay and Level of Service – Alternative 2

	Existing		Build 2027		Build 2037	
Intersection	Delay	LOS	Delay	LOS	Delay	LOS
Post Road and Coronado Road	18.1 (23.6)	B (C)	21.4 (26.9)	C (C)	25.6 (36.2)	C (D)
Post Road at Vacant Lot (New)	NA	NA	8.1 (7.1)	A (A)	9.3 (8.4)	A (A)

Note: Delay AM (Delay PM)
Source: WSP USA, July 2019

As shown in **Table 6.17**, the intersection delay is expected to increase at the Post Road at Coronado Road intersection with the introduction of a new signalized intersection at the vacant lot and projected traffic growth in 2027 and 2037. The intersection delay at the new signalized intersection on Post Road at Vacant Lot is also expected to increase in Build condition 2037 as compared to Build condition in 2027, but maintain LOS A in both peak hours. The intersection analysis assumed that the new signal on Post Road at the Vacant Lot would be coordinated (northbound and southbound through movements).

The existing signalized intersection at Coronado is expected to see increases in delay, due to projected traffic growth along Post Road, Coronado Road, and the existing airport exit at this location; however, the introduction of the new signal at the vacant lot is not projected to significantly increase delays. The detailed Synchro reports are attached in **Appendix C**.

Alternative 3: Modify Post Road at Bruce Sundlun Roadway Intersection to provide Airport Exit

Alternative 3 explores converting Bruce Sundlun Roadway into a two-way facility as shown in **Figure 6.31**. The roadway is currently a one-way road that connects Post Road to the terminals, Lot E, and the rest of the airport roadways. This alternative would likely be implemented in the PAL 2 horizon, after PAL 1 horizon improvements had been made to address Issues #1-5. Because Alternative 3 would reduce the parking capacity of Lot E, it is recommended that parking impacts from other projects – and more refined parking needs - would need to be understood before deciding between alternatives.

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Alternative 3 would provide the following benefits:

- Converting this facility to two-way traffic, as shown in **Figure 6.31**, would allow drivers exiting the departures level and Lot D to continue straight through the Evans Road signalized intersection to exit to Post Road and would allow drivers exiting Lot E to exit quickly to Post Road after turning left out of Lot E.
- This option would preserve all of the vacant lot for other, potentially revenue generating uses
- The configured intersection and roadway circulation near Bruce Sundlun Way / Post Road would allow for the creation of a grander airport entry

Alternative 3 would likely have the following impacts:

- Although Lot D and Departures level vehicles would no longer recirculate through the inner or outer curbsides, they would still have to travel straight through Evans Road intersection, meaning intersection delays would not be reduced versus existing.
- While the Bruce Sundlun Way at Post Road intersection is already signalized, additional pavement would be needed to convert the Bruce Sundlun Way into a two-way facility as well as intersection modifications to accommodate additional signal equipment and two-way traffic.

Table 6.18 – Delay and Level of Service – Alternative 3

	Existing		Build 2027		Build 2037	
Intersection	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
Post Road and Bruce Sundlun Roadway	8.1 (16.6)	B (B)	9.9 (18.6)	A (B)	11.4 (22.5)	B (C)
Evans Avenue and Bruce Sundlun Roadway (Eastbound Approach)	9.0* (10.1)*	A* (B)*	9.4* (11.7)*	A* (B)*	9.7* (13.6)*	A* (B)*
			4.9 (7.8)	A (A)	5.1 (8.9)	A (A)

Note: Delay AM (Delay PM)
Note: * Unsignalized operations
Source: WSP USA, July 2019

As part of Alternative 3, the Post Road and Bruce Sundlun Roadway intersection was converted to a two-way facility to add a westbound airport exit. This alternative was then analyzed using Synchro in both the 2027 and 2037 Build conditions under both the signalized and unsignalized conditions.

The Post Road and Bruce Sundlun Roadway intersection is expected to experience minimal increases in delays in the Build conditions regardless of the Bruce Sundlun Roadway and Evans Avenue intersection configuration (signalized or unsignalized).

However, the analysis indicates that while both the a signalized and unsignalized intersection would function acceptably at the Evans Avenue at Bruce Sundlun Roadway intersection, the analysis projects the signalized option to function more acceptably, as indicated in **Table 6.18.** The detailed results are attached in **Appendix C**.

Evaluation of Issue #7 Alternatives

Table 6.19 shows the evaluation of Issue #7 alternatives. The table illustrates that the existing operational and safety issues will remain under Alternative 1 (Do Nothing). Alternatives 2 and 3 both provide new airport exits to Post Road in order to reduce arrivals level curbside traffic volumes.

Both alternatives would provide similar operational and safety benefits as well as flexibility to work with solutions to other ground transportation issues. Both alternatives would require signal timing coordination with the existing signal system on Post Road, although Alternative 3's signal-related costs would be lower, as there is already a signal at this location. Alternative 2 would require greater coordination with RIDOT and the City of Warwick to implement a new signal; however, a signal at this location would allow for connectivity with the City Centre Warwick development.

Operations analysis indicates that traffic would operate acceptably in both alternatives under current projections, but that efficient signal timing would be critical in either.

Alternative 2 was selected as the recommended alternative as it provides free-flow movements for Departures and Lot D vehicles exiting to Post Road whereas vehicles would have to continue through the signalized intersection in Alternative 3. Alternative 2 also complements other potential projects more seamlessly than does Alternative 3.

Table 6.19 – Redundant Circulation Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			
Operational	Existing issues remain		
Environmental		Potential drainage impacts	
Financial			
Feasibility		Requires RIDOT coordination for new signal	Construction would impact existing traffic; requires RIDOT coordination
Recommended Alternative		✓	

Source: WSP USA, July 2019

Legend: No or minimal impacts; Moderate impacts; Significant impacts

6.4.2.8 Issue #8: Future Evans Avenue at Airport Connector Road Intersection Capacity

The facilities requirements analysis evaluated analyzed several signalized intersections in and around the airport. This analysis indicated that within the PAL 3 timeframe, the Airport Connector Road at Evans Road intersection would experience a failing level of service – meaning that its volume would exceed its capacity on critical approaches. It is important to note that this analysis grew existing approach volumes at equal rates, which means that recirculating volumes were not reduced, and that all of the problems aforementioned in Issues #1-6 discussion would persist. As alternatives to address Issues #1-6 are implemented, the team recommends periodically evaluating delays at the intersection to assess the need of and timeline for improvements.

To improve capacity, multiple concept-level alternatives were evaluated. One key constraint in developing concepts was the departures level structural supports, the position of which limited how the intersection could be expanded at its currently location.

Alternative 1: No Build

Alternative 1 is the Do Nothing, or No Build condition, in which no improvements would be made to improve intersection capacity. As a result, the facilities requirements analysis indicates that operations would worsen by PAL 2 and decline significantly by PAL 3, with long intersection queues and delays.

Alternative 2: Move Signalized Intersection and Increase Capacity

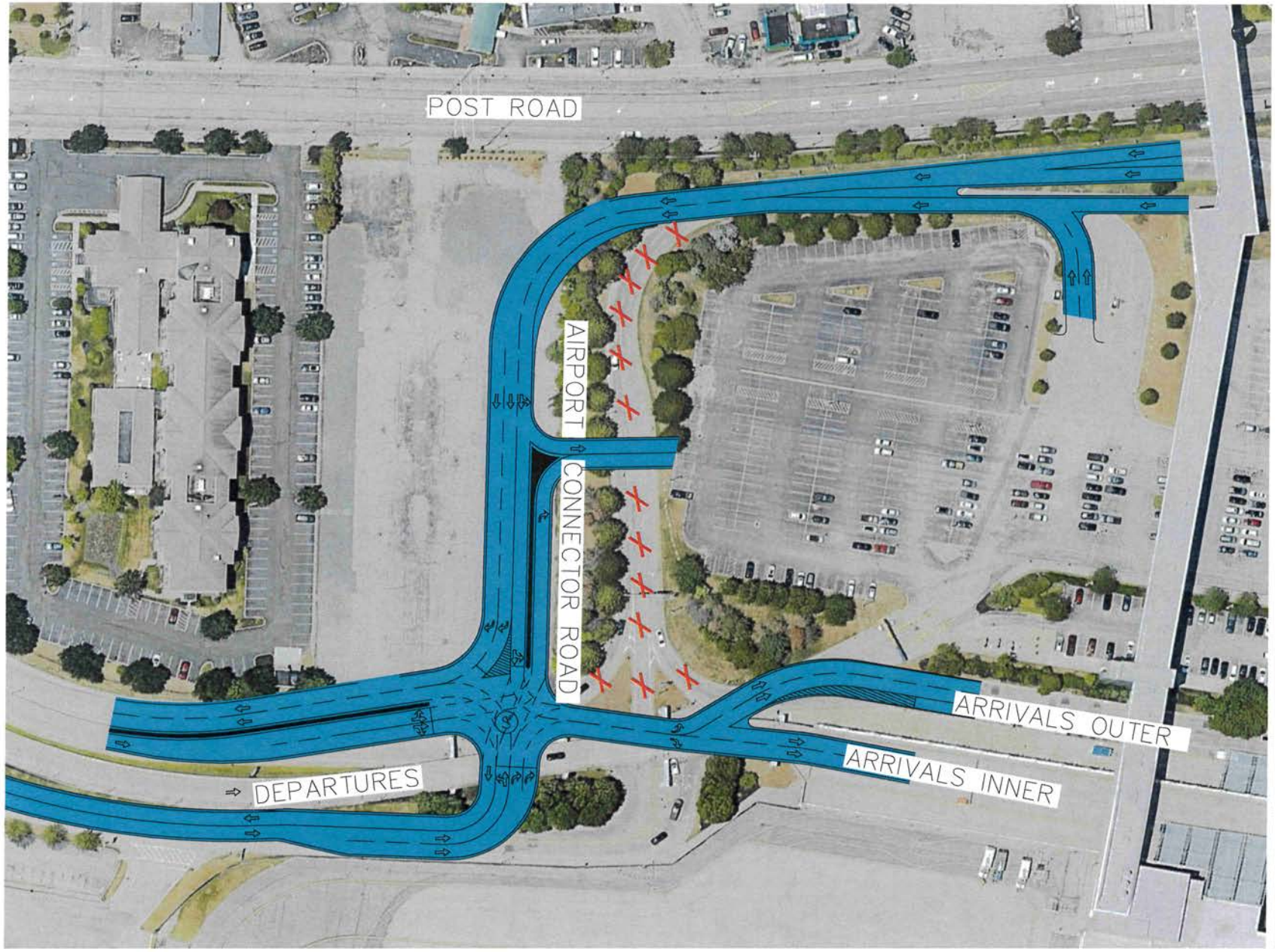
Relocating the existing intersection to the west of its current location (away from the departures level structural supports) as shown in **Figure 6.32** would allow for greater design flexibility and the following benefits:

- Additional turn lanes and increased overall intersection capacity
- Moving the intersection further from the inner and outer curbsides would allow for clearer routing through the intersection to the inner and outer curbside
- Relocating the intersection would also allow for a potential re-design of the Airport Connector Road's southwest curve to make it gentler, with increased sight distance, and potentially greater lane change distance.
- Relocating the intersection could also coincide with increasing the footprint of Lot D, for either additional surface lot parking or and increasing the size of Lot D or future garage

This alternative would also result in the following potential impacts:

- Although moving the intersection away from the departures level roadway allows for increased capacity, the Evans Road approach would still be constrained by the structural supports and additional study is needed to assess vehicle height restrictions, due to the slope of the departures level.
- This alternative would require re-aligning the Airport Connector slightly to the west to tie-in to the new intersection and avoid the overhead structural supports.

This alternative would be implemented within the PAL 3 timeframe. The success of alternatives implemented in the PAL 1 time horizon will need to be considered in conjunction with the impacts of other airport projects – especially those that impact Lot E parking supply.



Green Airport

[illegible] reen Air[illegible] ort
Master [illegible] lan

Figure 6.32
Relocation o[illegible]
[illegible] i[illegible] nali[illegible] ed
[illegible]ntersection

[illegible] egend

[illegible] ro[illegible] osed [illegible] ur[illegible]

[illegible] irectional Arrow

[illegible] ro[illegible] osed Roadway
[illegible] [illegible] rove[illegible] ents

(S) [illegible] i[illegible] nal

X Re[illegible] ove

80' 0' 80' 160'

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Alternative 3: Move Intersection and Convert to Roundabout

In addition to moving the intersection and adding capacity, moving the intersection and converting it to a roundabout was also considered. This alternative would likely be implemented within the PAL 3 timeline.

This alternative would provide the following benefits to airport circulation and traffic flow:

- Additional traffic operations capacity
- Improved alignment and wayfinding from intersection to departures inner and outer curbsides
- Allows for greater merge/weave distance along Airport Connector Road and a potentially larger Lot D footprint or parking garage
- A roundabout may allow for relocation of both the entry and exit to/from Lot D. Relocating the exit from would also help with Issue #6, depending on its timeline, as it would reduce merging and weaving issues on the Airport Connector Road and reduce recirculation

This alternative would also result in the following potential impacts:

- The size and location of the roundabout may impact the size of the relocated cell phone lot
- The relocated intersection may also require realigning the Airport Connector from I-95
- Roadway alignment and curvature subject to limitations imposed by location of departures level structural supports
- Some drivers' lack of familiarity with roundabouts may require an education or outreach campaign

Evaluation of Issue #8 Alternatives

Table 6.20 shows the alternatives evaluation for Issue #8. Under Alternative 1 (Do Nothing), the existing and operational safety issues would remain. Alternatives 2 and 3 propose to shift the intersections toward the vacant lot to add additional lanes and capacity at the intersection. Both alternatives would incur significant costs and would require traffic detour plans during construction due to the proposed relocation amidst existing active roadways. As future parking alternatives are refined (see Issue #9), the orientation of approach and departure roadways may be reconfigured to provide improved access into and out of Lot D (or the structure that replaces it) than would a signalized intersection.

Because PAL 3 is the likely time horizon for these improvements, it is recommended that additional studies be conducted after PAL 1, when many of Issues #1-6 have been addressed in order to see how those solutions mitigate the need for increases in capacity at

the intersection. Alternative 2, realigning the existing signalized intersection, is the recommended alternative, as additional future parking and travel demand information would better inform a future roundabout design.

Table 6.20 – Airport Connector Road at Evans Road Intersection Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			
Operational	Existing issues remain		
Environmental		Potential drainage impacts	
Financial		Significant intersection relocation costs	Significant intersection relocation costs
Feasibility		Significant construction related impacts	Significant construction-related impacts
Recommended Alternative		✓	

Source: WSP USA, July 2019

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

6.4.2.9 Issue #9: Future Parking Capacity

Based on projected increases in airport traffic, existing parking garages and Lot D will reach capacity, leaving Lot E to accommodate future growth and demand. Lot E is also furthest from the terminal and not ideal to some users, and other airport projects may reduce its capacity. In addition, Garages A and B will be close to reaching their useful lives and will need replacement. Because of this, additional parking capacity near the terminal will be needed.

Alternative 1: Do Nothing (No Build)

Alternative 1 represents the Do Nothing, or No Build alternative, in which no improvements would be made to the existing parking capacity.

Alternative 2: Expand Lot D

As shown in **Figure 6.33**, this alternative would modify the alignment of the existing Airport Connector Road, extending it into the existing vacant lot, which would allow for a larger Lot D. Lot D would remain as surface parking but would add 75-100 spaces at a minimum. This facility would need to be designed in coordination with the solutions developed for Issues #6-8 and would likely be implemented within the PAL 2 or PAL 3 time horizons.

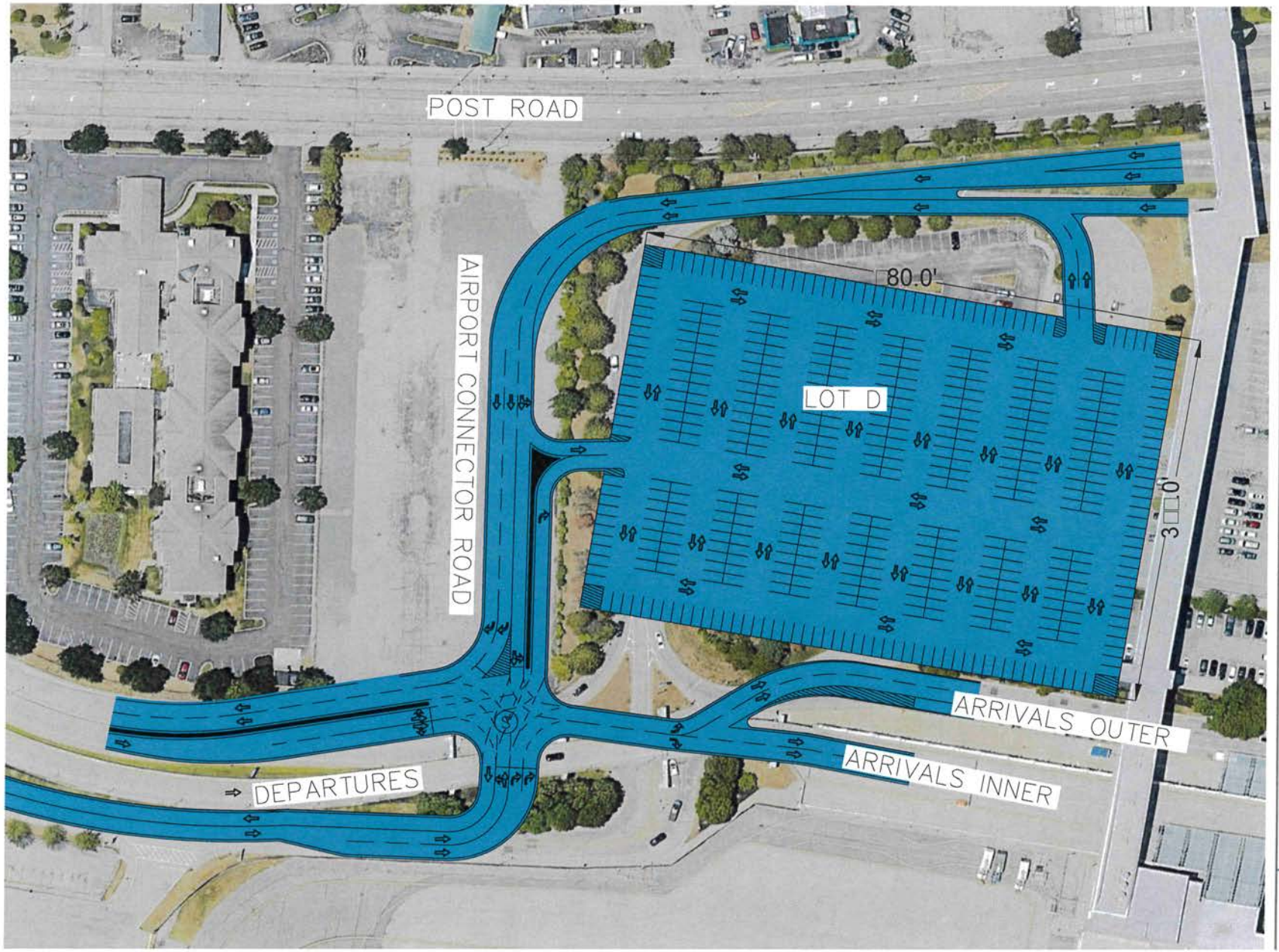

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Figure 6.33
Lot D Expansion

Legend

- Proposed Curb
- Directional Arrow
- Proposed Roadway Improvements
- (S) Signal

80' 0' 80' 160'

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Alternative 3: Expand Lot D Footprint, Add Structured Parking

This alternative would modify the alignment of the existing Airport Connector Road, extending it into the existing vacant lot, which would allow for a larger Lot D footprint and the option to build structured parking southwest of the Interlink. This would be implemented in conjunction with Issue #8, such that the parking garage itself would not solely increase. **Figure 6.34** illustrates proposed Lot D footprint. It is estimated that the garage could be up to 300 feet x 500 feet and would have a capacity of at least 425 cars per level. Another benefit is that TNC staging could be located either in front of the garage or on the first level. This would free up additional space for parking. Considering the proximity/direct access to the departure terminal from this structured parking and easy exit to I-95, the facility would be used by the drivers using either of the parking garages A, B or C. Additionally, it will help to reduce the circulating traffic and curbside congestion. Sizing would be further refined as other information became available, including:

- Continued review and assessment of parking demand, given changes in travel trends
- Other RIAC projects that may reduce existing parking capacity – especially at Lot E
- Continued assessment of existing garages' useful life

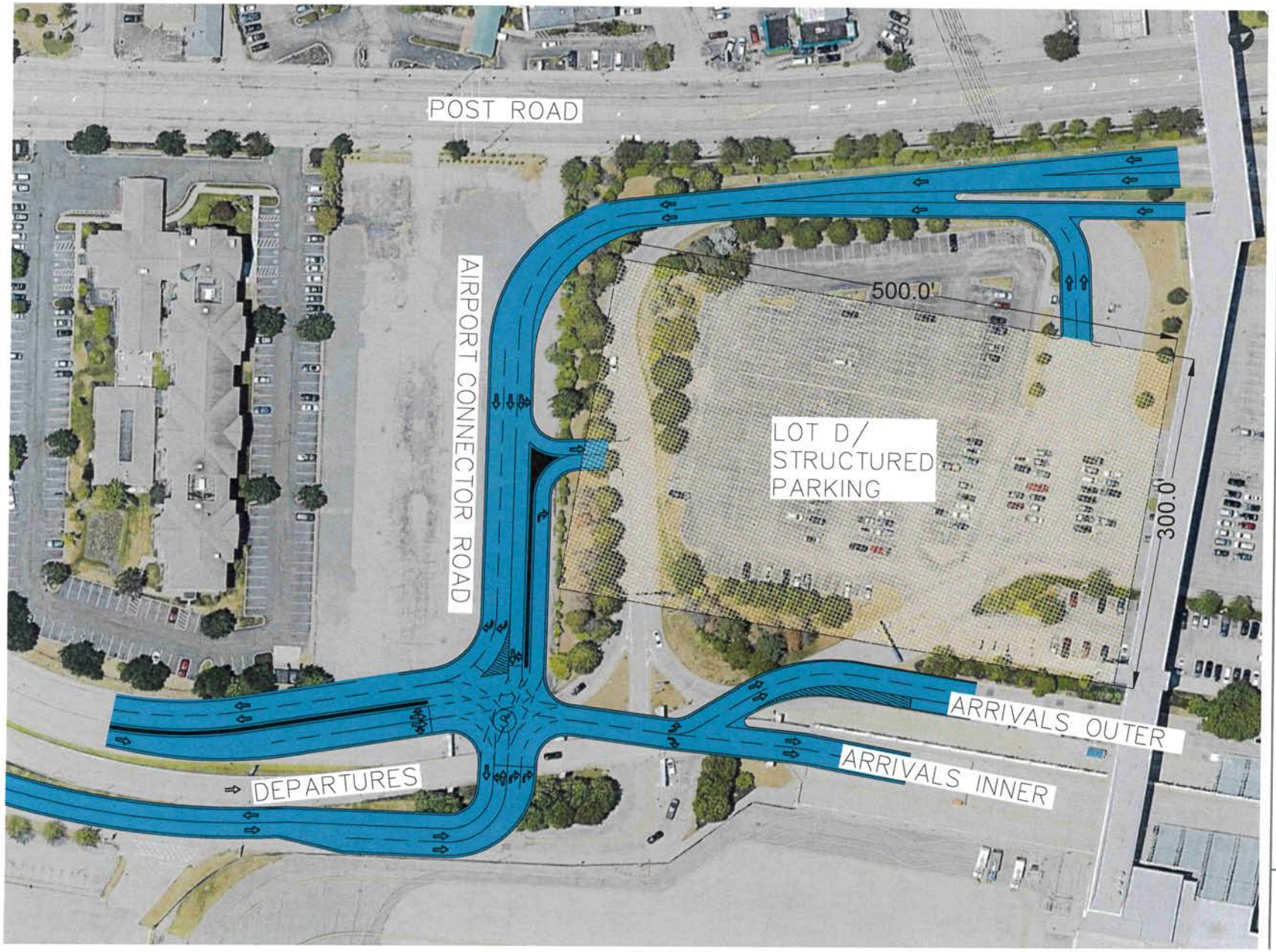

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Figure 6.34
Lot D Expansion and Structured Parking

Legend

- Proposed Curb
- Directional Arrow
- Proposed Roadway Improvements
- (S) Signal

80' 0' 80' 160'

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Evaluation of Issue #9 Alternatives

Table 6.21 illustrates the evaluation of the Issue #9 alternatives. The table indicates that the existing operational and safety impacts would remain under Alternative 1 (Do Nothing). Alternatives 2 and 3, which would be addressed during the PAL 3 timeline, could be implemented in conjunction with projects that address other issues. Alternative 2 would provide limited additional capacity to address future parking needs while Alternative 3 could add significant capacity, but would be orders of magnitude more expensive.

Alternative 3 is the recommended alternative due to the significant increase in capacity it would provide and its location adjacent to the terminal and Interlink, and the operational benefit it would be provide in conjunction with potential projects to address other issues. A garage could also provide for a clearly defined storage area for ride-hailing services.

The need for future parking capacity should be considered in conjunction with other airport projects that impact Lot E capacity, the useful lifespan of existing parking facilities, and continuing changes in how travelers access the airport (future parking demand trends).

Table 6.21 – Parking Needs Alternatives Evaluation

Criteria	Alternative 1	Alternative 2	Alternative 3
Design Standards			
Operational	Existing issues remain		
Environmental		Potential drainage impacts	
Financial		Cost to expand existing surface parking	Significant structured parking costs
Feasibility		Magnitude of construction impacts dependent on timeline of new or relocated intersection to address Issue #8	
Recommended Alternative			✓

Source: WSP USA, July 2019

Legend:

No or minimal impacts | Moderate impacts | Significant impacts

6.5 General Aviation and Air Cargo Alternatives

General aviation and air cargo generally operate in the area of the airport between the Runway 23 and Runway 16 ends off of Airport Road. While there was limited need for new cargo and general aviation facilities per the master plan facilities requirements, the north area of the airport is fairly congested and is laid out inefficiently. The alternatives within this section are presented as options to consider when the demand for this type of development may occur, not based on the previously stated facility requirements.

6.5.1 Mitigation of General Aviation and Air Cargo Issues

The following provides five alternatives, three in the north area, and two in the south area of the airport, that could help to alleviate the issues identified.

North Alternative 1

This alternative shows a reconfiguration and addition of aircraft ramp space allowing for general aviation aircraft parking to the west accommodating a hardstand for ADG IV in the center, while reconfiguring the existing aircraft ramp space to accommodate four ADG IV aircraft parking positions, assumed to be used for cargo and GSE movement. This alternative assumes taxiway access to and from the area via a new parallel Taxiway B and adjustments to Taxiways M and N. In addition, the alternative includes an option to redevelop Hangar 2 to a more traditional cargo processing building with truck dock space. Further west, two sites for redevelopment are identified that could provide up to a total of 32,500 SF of conventional hangar space. All improvements identified are constrained as a result of being within existing leaseholds, and would present operational challenges during construction. The apron improvements and facility redevelopments shown are independent of each other. North Alternative 1 is depicted in **Figure 6.35**.

North Alternative 2

Alternative 2 assumes cargo in the north area moves to another location on the airport. This alternative assumes two hardstand positions for ADG IV aircraft and up to 135,000 SF of conventional hangar space. 80,000 SF of these hangar options are located mid-field and would likely be used as storage hangars with no vehicle access. This area could also continue to be used for aircraft ramp parking instead of hangar space. This alternative also assumes the redevelopment of Hangar 2 with two separate 40,000 SF hangars, and in addition the redeveloped hangar area identified in Alternative 1, it adds another 22,500 SF hangar to either relocate or incorporate the Old Terminal Building. The Old Terminal Building would require additional analysis to understand the potential use of the historic building to be incorporated, relocated, or demolished. This alternative assumes taxiway access adjustments to Taxiways M and N. All projects could be independent of each other. North Alternative 2 is depicted in **Figure 6.36**.

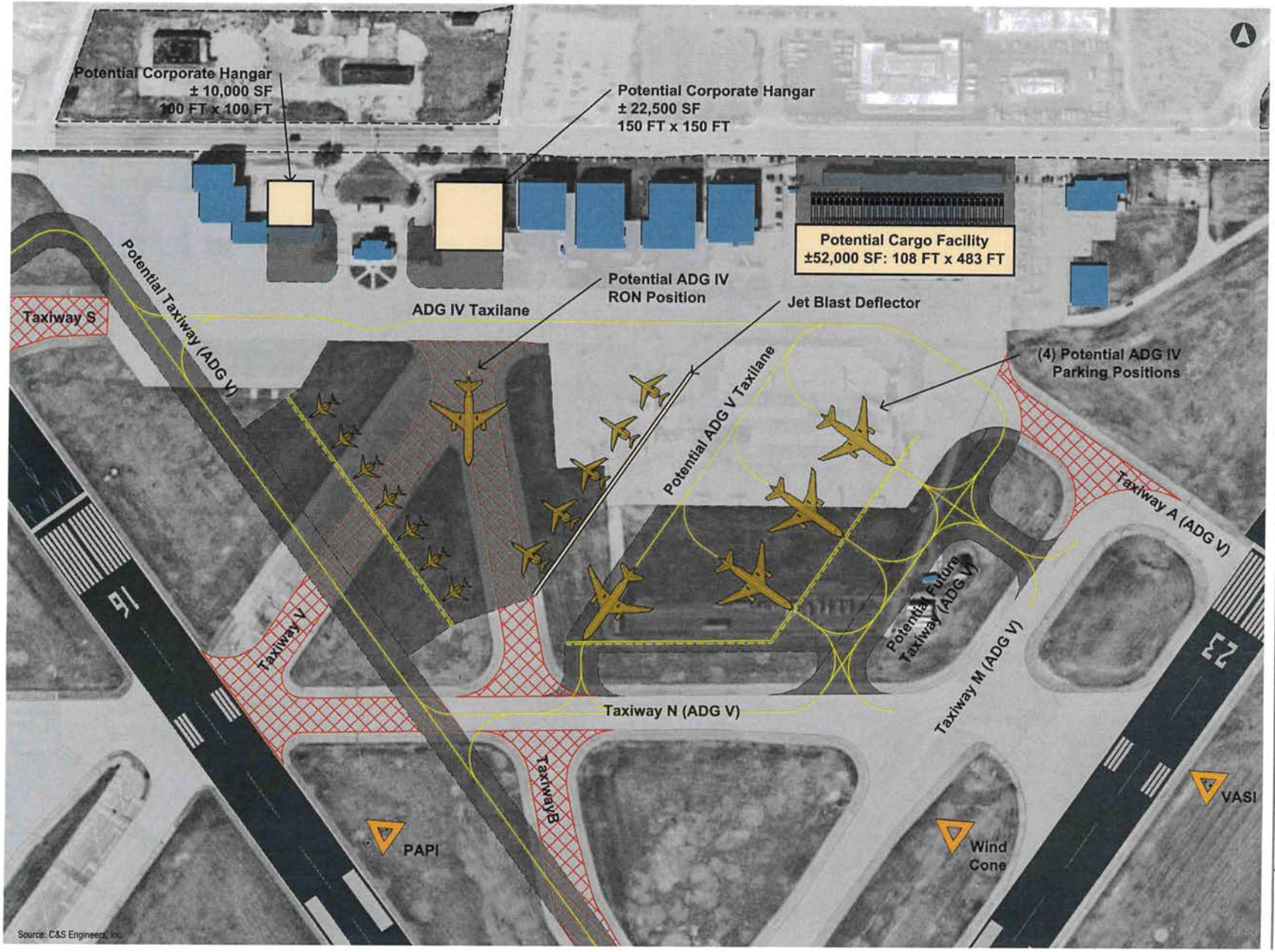

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Figure 6.35
General Aviation and
Air Cargo
North Alternative 1

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement
- NAVAID

100' 0' 100' 200'

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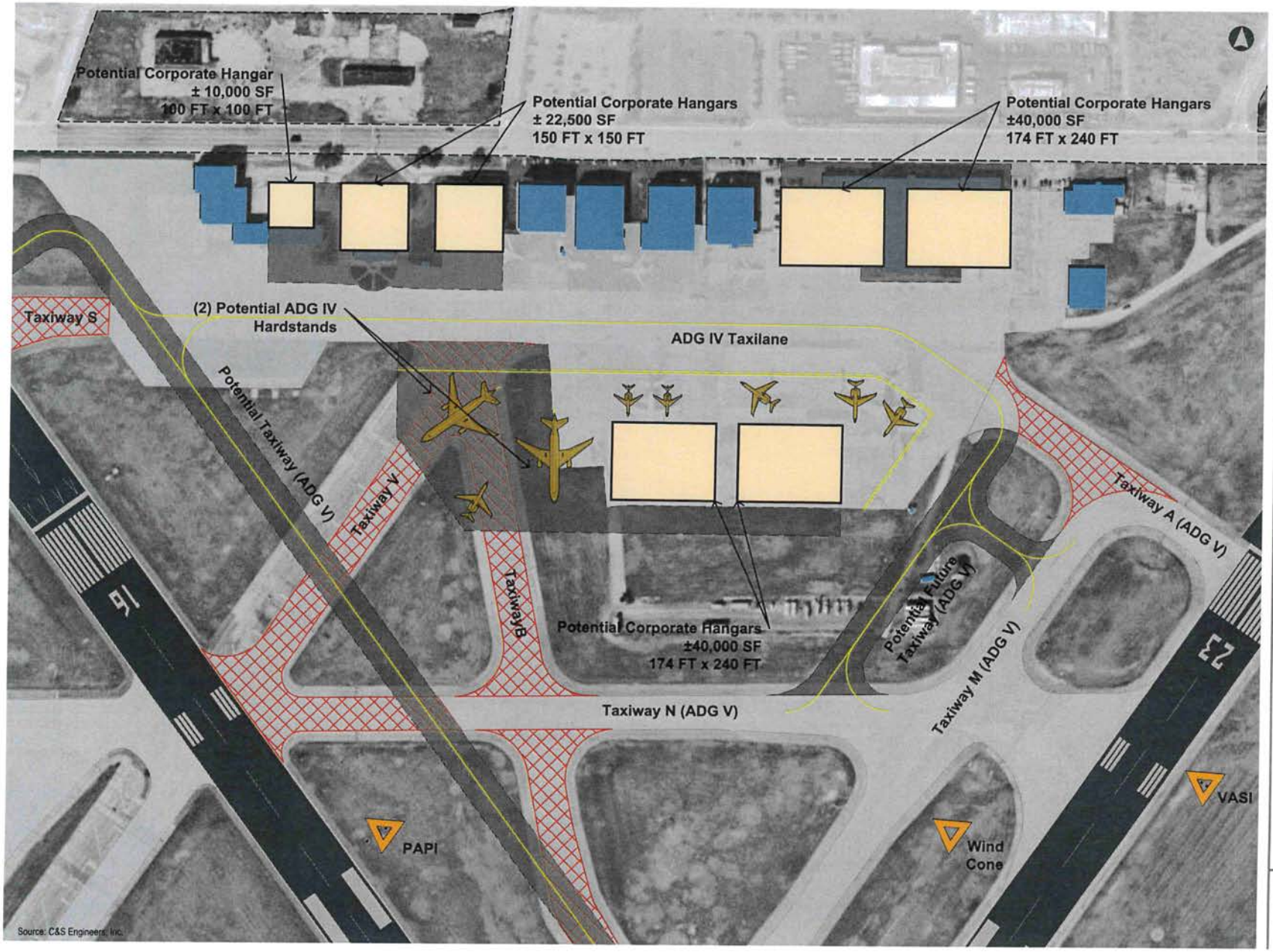

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Figure 6.36
General Aviation and
Air Cargo
North Alternative 2

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement
- NAVAID

100' 0' 100' 200'

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North Alternative 3

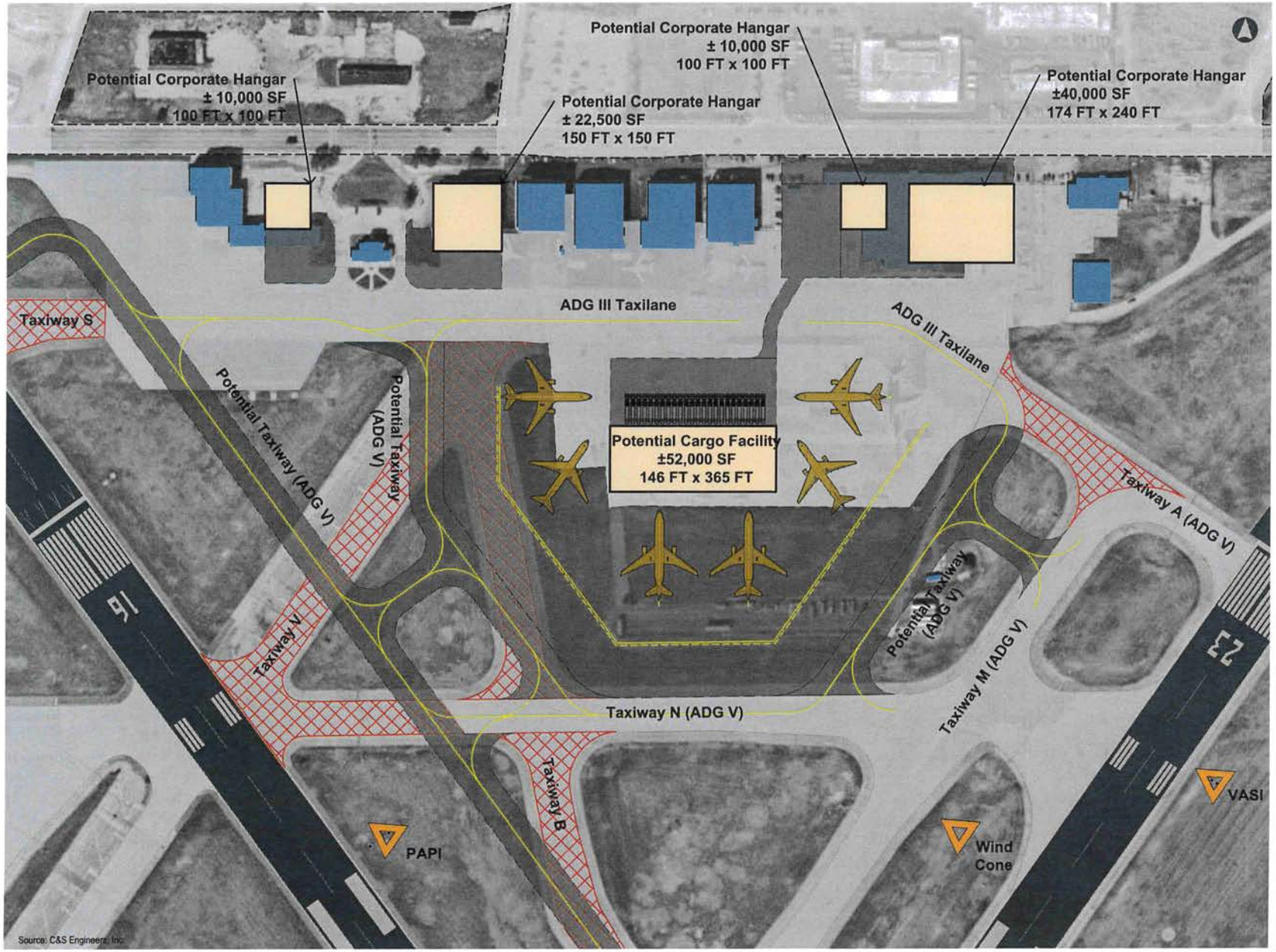
Alternative 3 is similar to both 1 and 2, but in different ways and provides very limited apron space for GA aircraft. This alternative maintains the west end hangar redevelopment options of Alternative 1, but instead of redeveloping Hangar 2 for cargo processing, it assumes up to 50,000 SF of conventional hangar space. And similar to Alternative 2, it assumes building development in the midfield area, but instead of conventional storage hangars, it assumes a cargo processing facility as shown. This includes truck dock space as well as up to six aircraft parking positions for cargo activity at ADG IV. The largest limitation to this alternative is the need for a truck access route that would essentially cutoff the east/west taxilane access in front of the existing hangar facilities, but would not be detrimental to the operation. All projects shown here could be done independently. North Alternative 3 is depicted in **Figure 6.37**.

South Alternative 1

South alternative 1 provides two 40,000 SF conventional hangars along Taxiway T just north of long-term parking Lot E with two ADG IV hardstand positions to the east of the hangars facilities. Vehicle access would be from Strawberry Fields Road. The hangars were sited to be as far away from the residential community as possible while still maintaining ADG V taxiway object free area protection of Taxiway T. South alternative 1 is depicted in **Figure 6.38**.

South Alternative 2

South alternative 2 replaces the conventional hangar facilities with a cargo processing facility of approximately 53,000 SF, three cargo aircraft parking positions, and truck dock space. Truck and vehicle traffic would be along Lot E and enter and exit through the existing airport roadway network to avoid access through Strawberry Fields Road. South alternative 2 is depicted in **Figure 6.39**.



Green Airport

T.F. Green Airport
Master Plan

Figure 6.37
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[illegible] ort[illegible] Alternative 3

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement
- NAVAID

100' 0' 100' 200'

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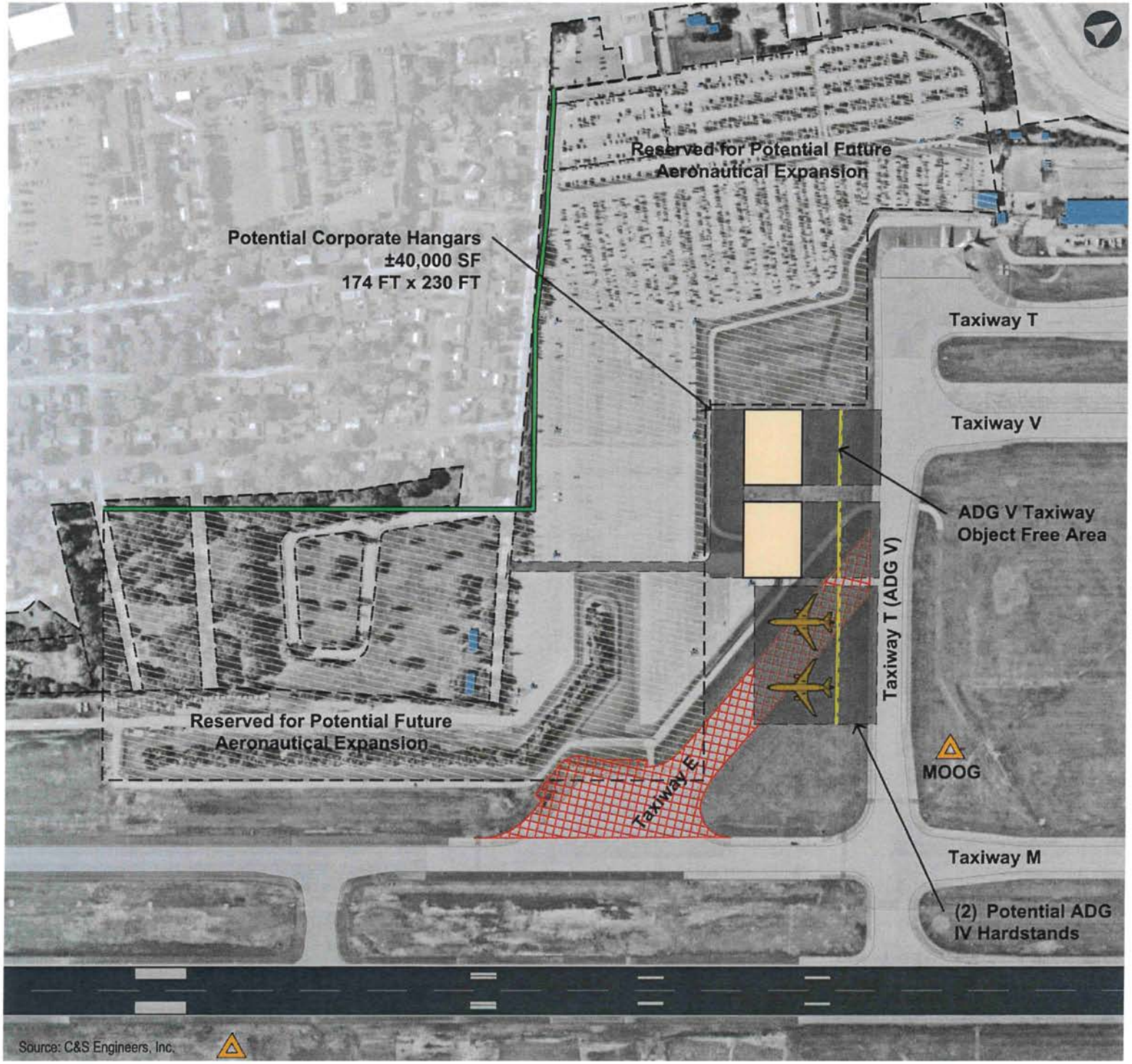

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T.F. Green Airport
Master Plan

Figure 6.38

General Aviation and Air Cargo South Alternative 1

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement
- NAVAID

600' 0' 600' 1,200'

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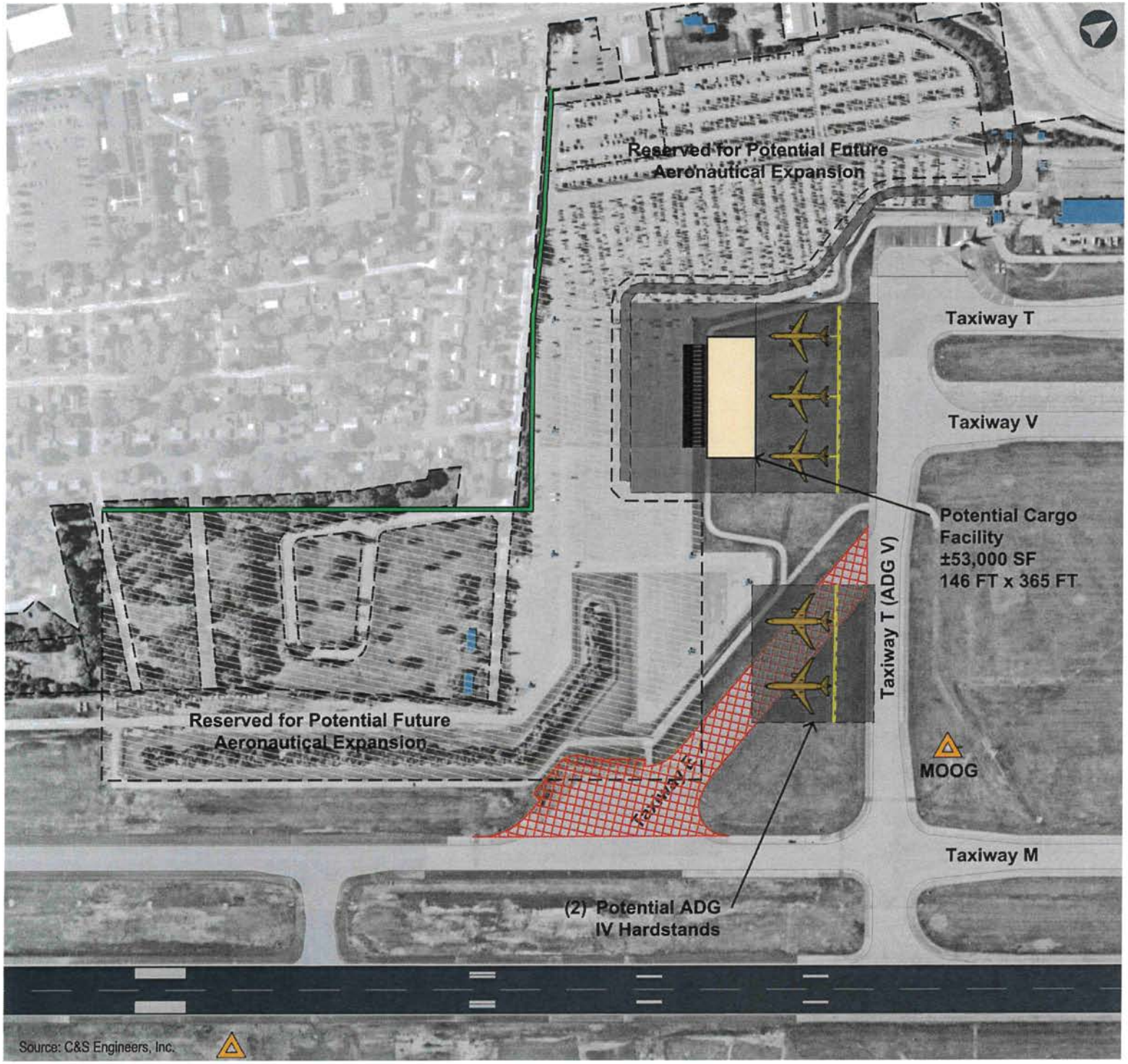

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Figure 6.39

General Aviation and Air Cargo South Alternative 2

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement
- NAVAID

600' 0' 600' 1,200'

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Evaluation of Alternatives

The cargo and general aviation alternatives are challenging to evaluate because of various factors that come into play that include impacts to multiple tenants, existing leaseholds and agreements, and assumptions that not all parties may be in agreement with. In addition, the facility requirements did not identify any immediate needs in these areas. With that said, these are alternatives that could be acted upon should the demand or needs change. At this point, these are evaluated based on input from Airport staff and TAC members through the TAC meetings, input from the general public during the public workshops, and the evaluation criteria below, established by the Airport and Consultant at the start of the Alternatives tasks. They are:

- Design Standards – accommodates aircraft and airspace safety.
- Operational – improves operational efficiency of tenants, and improves aircraft circulation around the north ramp. More ramp space is highest operational need.
- Environmental – compares level of new construction vs. incorporation and reuse of existing facilities.
- Financial – maximizes financial return on investment. Although most of these alternatives would require third-party investment.
- Feasibility – Ability to implement in an incremental manner.

As shown in **Table 6.22,** North Alternative 1, South Alternative 1 and 2 generally rank better than North Alternatives 2 and 3. The reality is that there is likely a combination of these three alternatives that is the best solution, but is ultimately tied to the third-party development and finance options. Overall, this master plan provides some development options for the airport and tenant to further develop.

Table 6.22 - General Aviation and Air Cargo Alternatives Evaluation

Criteria	North Alternative 1	North Alternative 2	North Alternative 3	South Alternative 1	South Alternative 2
Design Standards					
Operational					
Environmental					
Financial					
Feasibility					
Recommended Alternative	✓			✓	✓

Source: C&S Companies, July 2019.

Legend: Best, Better, Good

6.6 Support Facilities Alternatives

Support facilities at the airport were considered in the facility requirements based on available information through project documentation or conversations with airport staff based on their identified issues or needs as a result of daily operations. This sections looks to identify potential solutions for these issues or needs, but does not provide multiple alternatives considering that most of the issues or needs are just expansion or reconfiguration in the same location. Below are options for the airport to consider to address the fuel farm, maintenance facility, and ARFF facility.

6.6.1 Fuel Farm

The fuel farm located just north of the terminal facility is in a good location providing ease of access to fuel passenger aircraft at the terminal, as well as good landside access for fuel truck deliveries. The facility requirements identified the need for three additional 50,000 gallon tanks, one by PAL 1; the second by PAL 2; and the third by PAL 3. These tanks can be accommodated as shown in **Figure 6.40**. In addition, airport staff indicated issues with the current configuration for truck deliveries. The figure identifies an option to reconfigure the area by consolidating two access points into a new one that is just north of the existing access road providing better turning radii for the delivery trucks.

6.6.2 Maintenance Facility

Two primary maintenance facility issues were identified during the master plan process to include the need for more storage capacity, as well as snow removal equipment access to and from the airfield. **Figure 6.41** identifies an option for the existing building to be expanded by 11,000 SF to the south. In addition, a 19,000 SF staging area to be built to the south of the existing building along with an airfield access route to the Runway 23 end. This location was identified to avoid the large snow removal equipment from traveling the airport perimeter road around the Runway 23 end and accessing the airfield through the north ramp where they comingle with aircraft of all sizes.

6.6.3 ARFF Facility

The ARFF facility may need to be rehabilitated during the planning period. The current location does provide centralized access to the airfield, but currently requires two runway crossings for access to the terminal facilities. **Figure 6.42** identifies an area adjacent to the existing facility for a new or expanded ARFF facility to be built. In addition, when terminal alternatives are implemented, a satellite support facility for ARFF should be considered in closer proximity or within the terminal facilities.

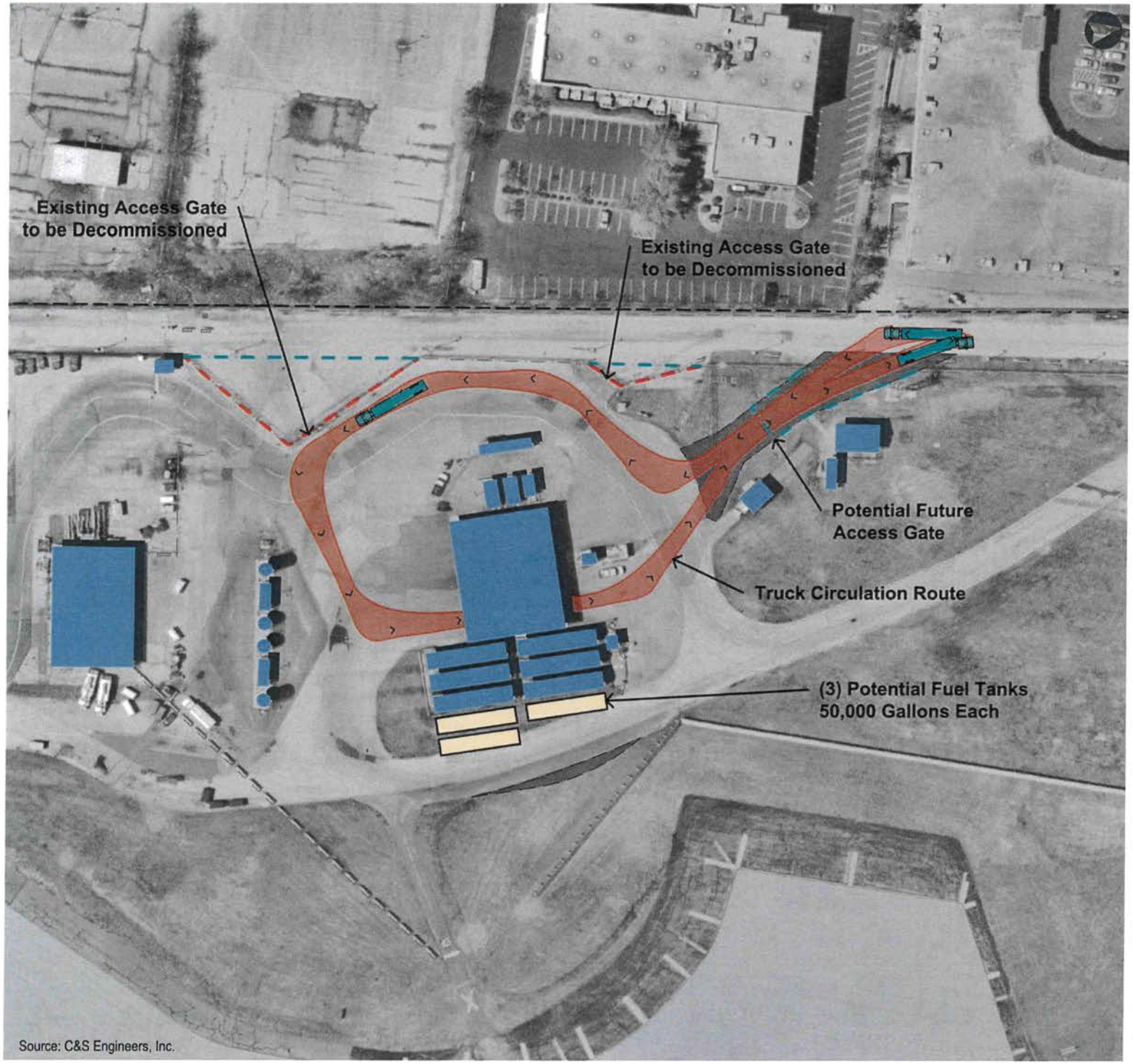

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Figure 6.40

Fuel Farm Alternative

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement
- Proposed Fence
- Proposed Fence Demolition

50' 0' 50' 100'

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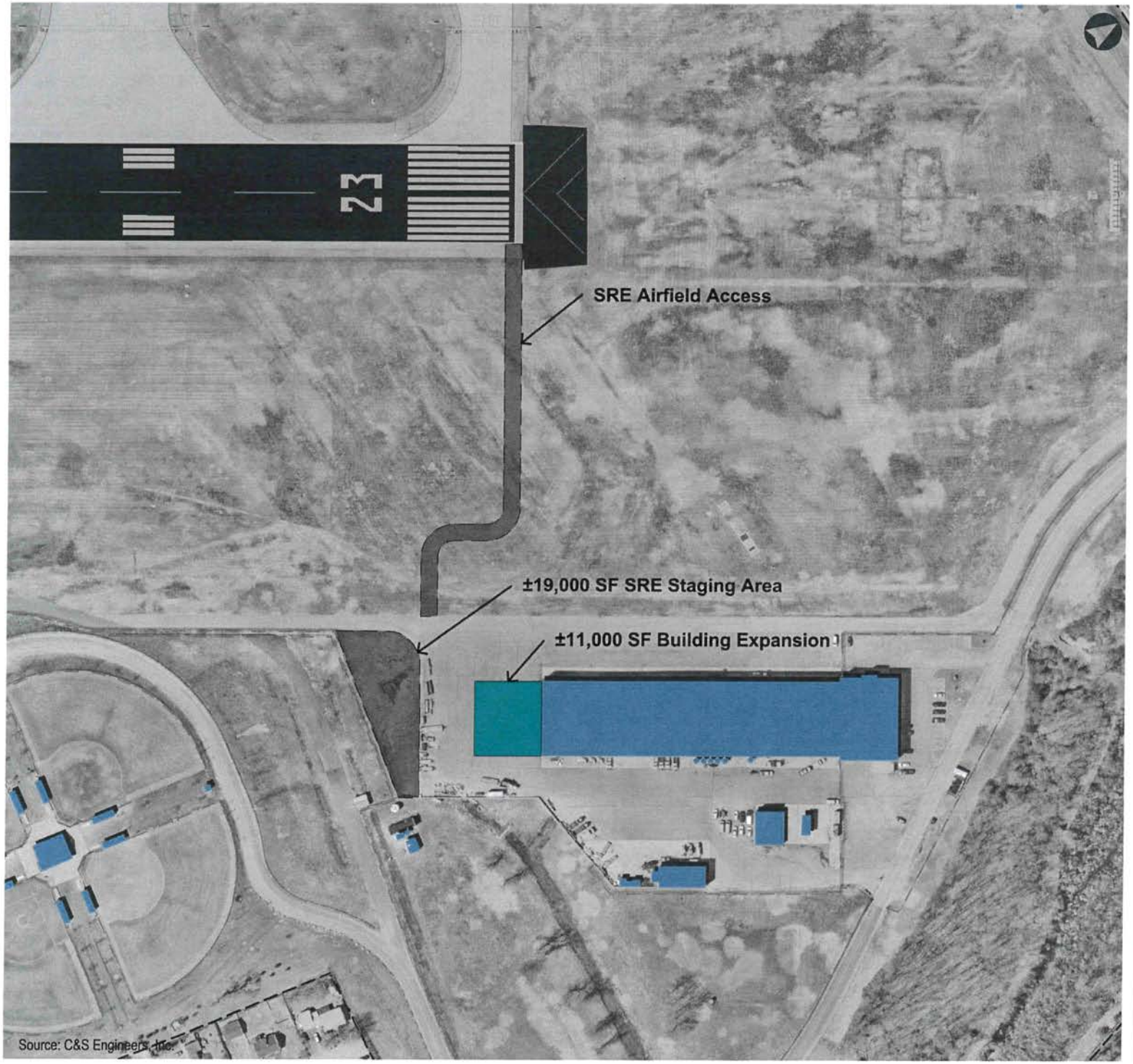

Green Airport

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Figure 6.41

Maintenance Facility Alternative

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement

100' 0' 100' 200'

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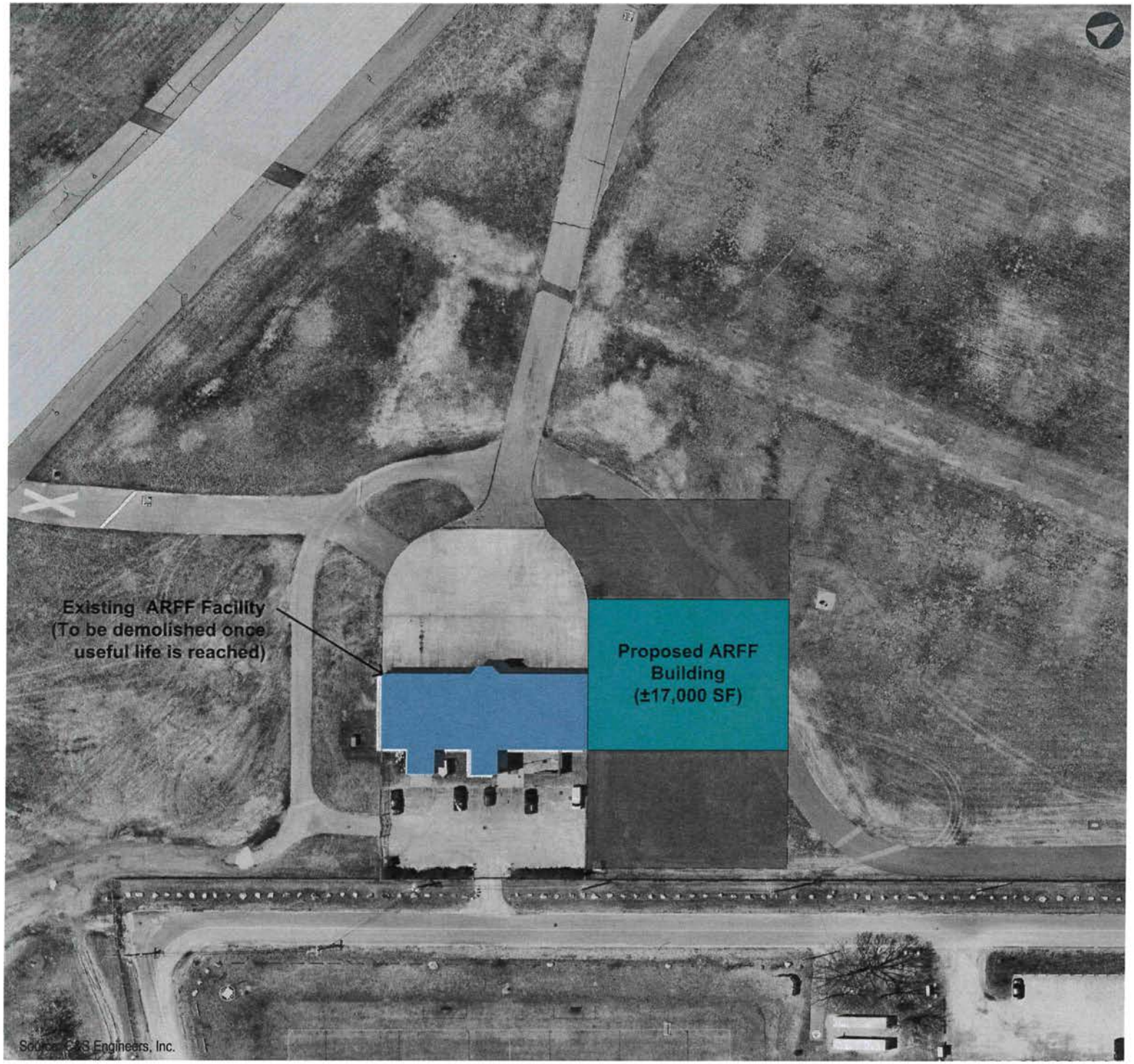

Green Airport

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Figure 6.42

ARFF Facility Alternative

Legend

- Property Line
- Existing Buildings
- Proposed Buildings
- Existing Airfield Pavement
- Proposed Pavement

50' 0' 50' 100'

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6.6.4 Other Considerations

Other considerations to be factored into projects as they are implemented or considered for implementation include the need to accommodate de-icing facilities; airfield electrical improvements, and utility information. Specifically, redundancy in utilities to allow for the airport to be resilient during times of natural disasters and other events. The airport has various studies on-going and the results of which should be taken into account as projects from this master plan are implemented or further considered.