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Manassas Regional Airport
Master Plan Update
Working Paper 3

RS&H

Working Paper 3
Alternatives

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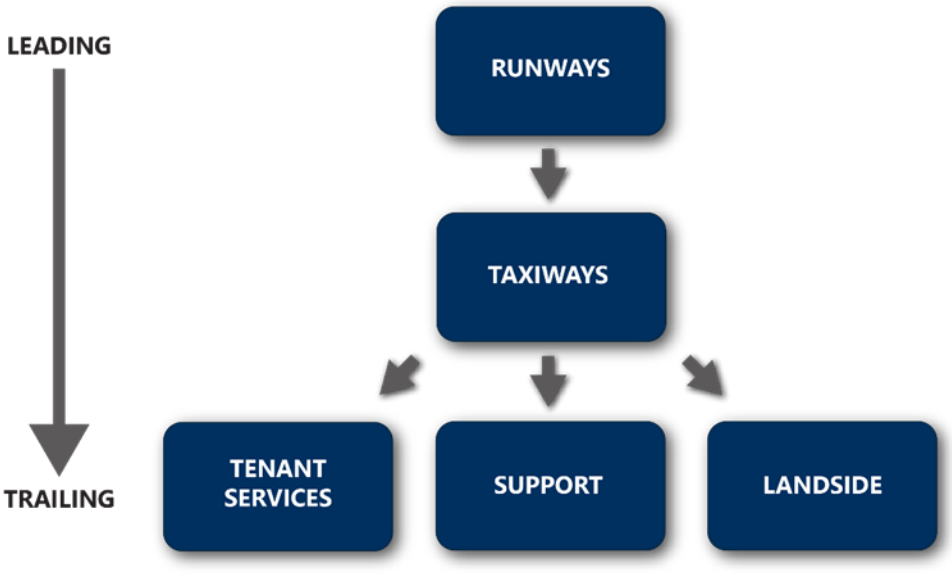
ALTERNATIVES

3.1 INTRODUCTION

This chapter identifies and evaluates facility development alternatives for Manassas Regional Airport based on the facility requirements determined in **Chapter 2, Inventory and Facility Requirements**. The goal of identifying and evaluating various development options is to ensure airport facilities are capable of meeting projected activity levels, make efficient and effective use of available airport land, meet FAA airfield design standards, and integrate with a preferred airport management strategy. Development alternatives in this chapter have been thoroughly analyzed, refined, and received input through stakeholder involvement to establish plans that reflect community values, Airport preferences, and the unique operational nature of Manassas Regional Airport.

As alternatives are developed, they follow a hierarchy of leading and trailing facility categories. Leading elements comprise of critical airport infrastructure and influence how trailing elements are developed. Leading elements are primary facilities that require significant amounts of land and/or capital investment to implement, and whose placement and configuration must take precedence when formulating alternatives. These critical airport infrastructure elements at HEF are runways and taxiways. Trailing elements are those whose placement and configuration are influenced and dependent on the leading elements. At HEF, the trailing elements include tenant services, support facilities, and landside facilities. Defining the division between leading and trailing elements allows the initial focus of analysis to be on determining solutions for those high cost, and more permanently affixed leading elements. The placement and decisions surrounding the leading elements typically influence the location and layout of the trailing elements. **Figure 3-1** displays the relationship between leading and trailing planning elements at Manassas Regional Airport.

FIGURE 3-1
AIRPORT PLANNING ELEMENTS



Source: RS&H Analysis, 2023.

3.1.1 Alternative Development Process

The process of determining viable alternatives, and ultimately selecting the alternatives that will make up the preferred development plan, was performed in a series of interrelated steps which aligned with guidance from AC 150/5070-6B, *Airport Master Plan*, **Figure 3-2**.

The airport alternatives development approach was established into the following steps:

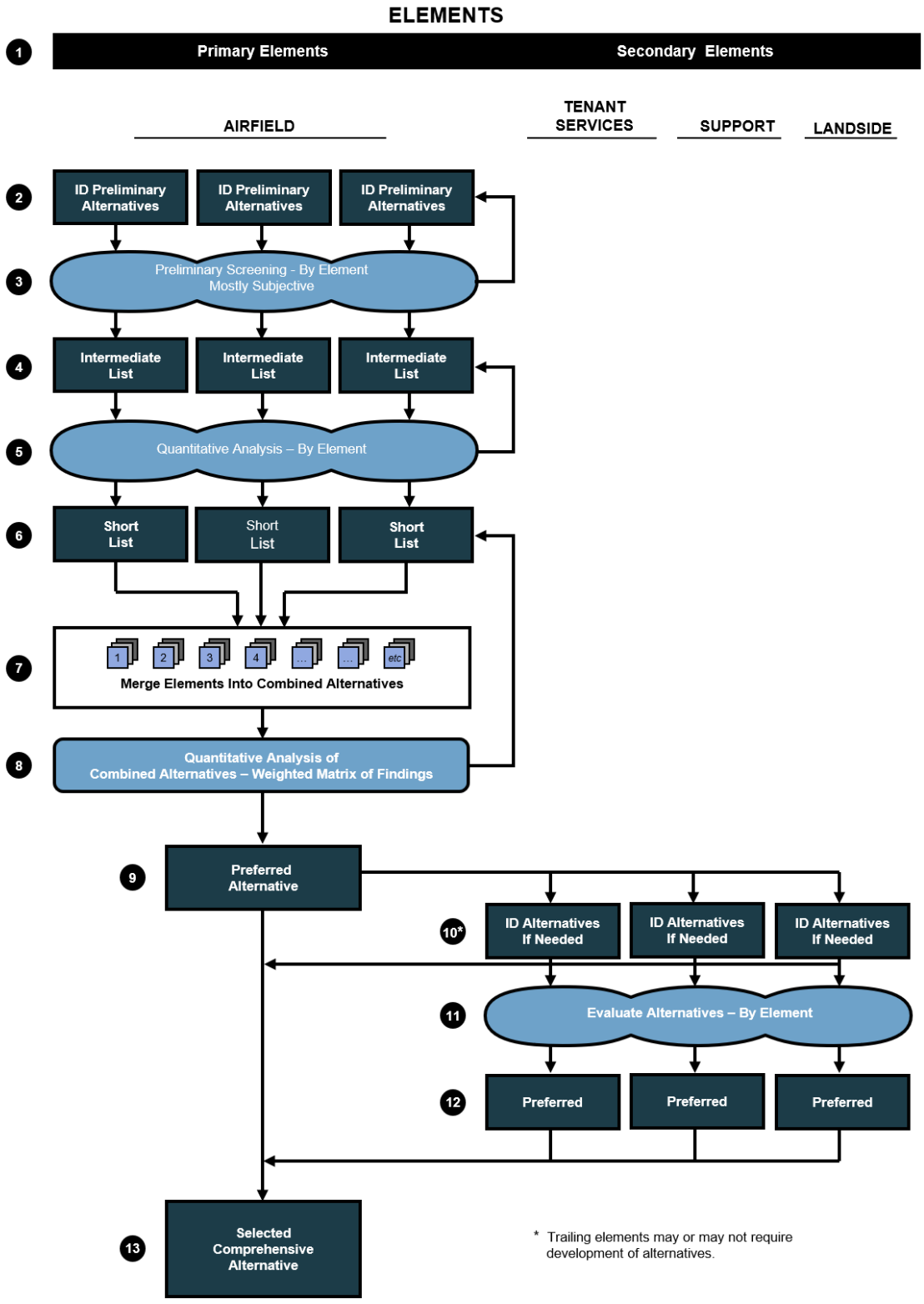
1. Define and evaluate existing airport land use patterns.
2. Define the alternatives evaluation criteria.
3. Obtain constraining factors such as environmental conditions and air space considerations.
4. Assemble an ultimate on-airport land use vision.
5. Create preliminary alternative concepts for each element to the facility requirements defined in Chapter 2.
6. Preliminary alternatives are then evaluated against the defined criteria with stakeholder input.
7. The result is a set of preferred alternatives that are carried forward into the implementation chapter where costs and needs are used to determine a logical phasing of projects.

Furthermore, development alternatives must be grounded by the Airport's vision for the future, meeting their community strategic plan, filling an established role in the National Plan of Integrated Airport Systems (NPIAS), and recognizing industry trends that may impact airport operators. For these reasons, ensuring that airport development options are weighed against the airport's Strategic Plan and Virginia Department of Aviation (DOAV) statewide Sustainability Management Plan (SMP) for its public-use airports within the Commonwealth of Virginia. Virginia's Airport SMPs sustainability initiatives are:

- Economic Performance
- Airport Community
- Energy and Emissions
- Waste
- Natural Resources

The preferred development plan at Manassas Regional Airport is driven by its ability to meet or exceed HEF's sustainability goals within each of these initiative categories. **Table 2-1** within **Chapter 2, Inventory and Facility Requirements** lists their short- and long-term goals. The evaluation process included stakeholder input, which guided the refinement of each element of study. The result, as described in this chapter, is a set of preferred alternatives carried forward into the implementation phase of the Master Plan where costs and need are used to determine a logical phasing of projects.

FIGURE 3-2
ALTERNATIVES ANALYSIS PROCESS



Source: AC 150/5070-6B – Airport Master Plan, RS&H, 2023.

3.1.2 Alternative Evaluation Criteria

The alternatives process must establish a set of evaluation criteria by which all facility development concepts can be measured. Throughout the alternative development process, evaluations are performed based on guidance provided in the Airport visioning process, aviation industry research, established planning best practices, and direct feedback from airport management and stakeholders. At a high level, each facility alternative is evaluated against the following criteria:

- Operational safety and public safety
- Operational efficiency
- FAA airfield design standards for critical aircraft
- Balance of airfield, terminal and landside facilities or target user groups needs met
- Resolution of current issues
- Adequate/appropriate level of service provided
- Long-term facility requirements are met
- Ease of implementation
- Costs (capital and operating)
- Flexibility and future expansion potential
- Virginia's Airport SMPs sustainability initiatives

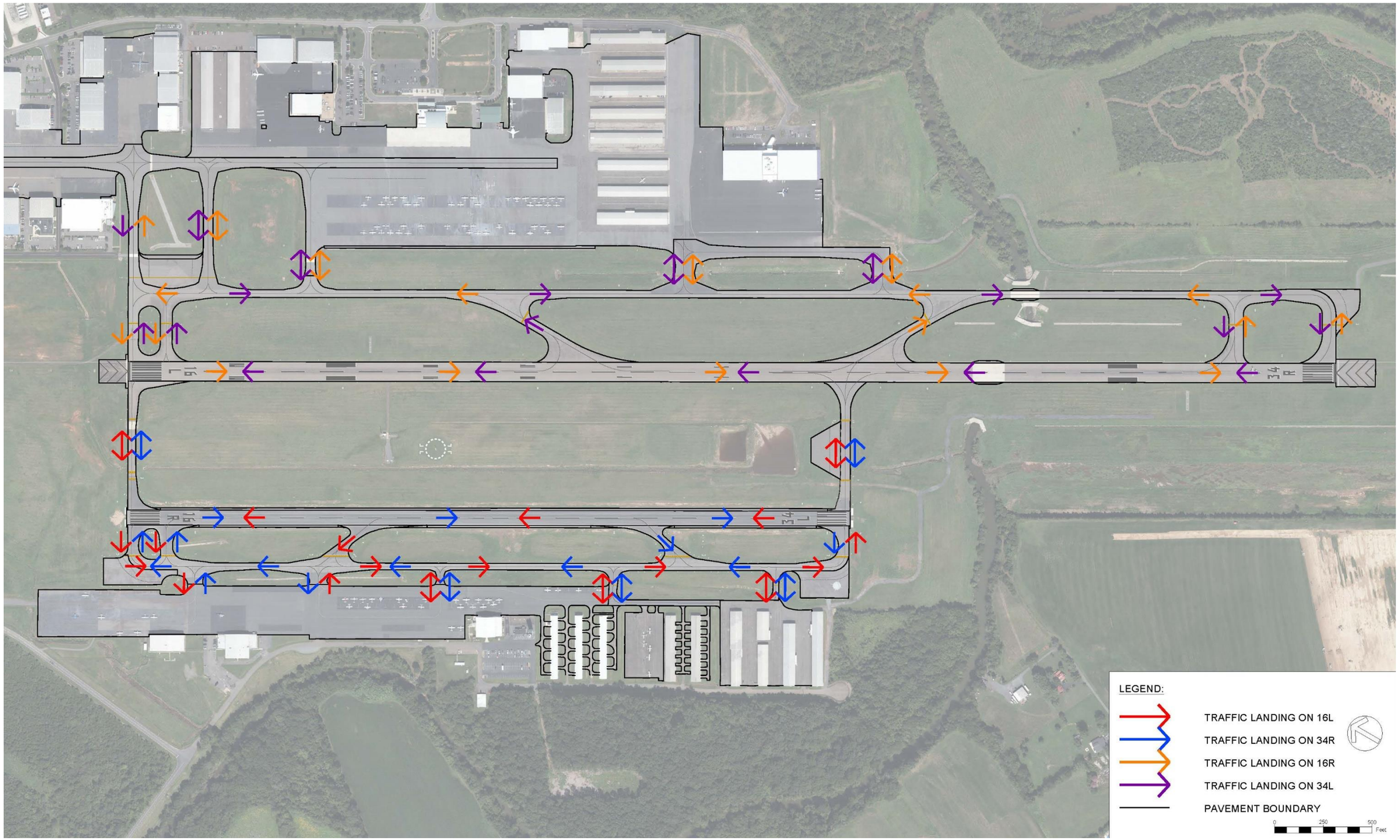
3.2 EXISTING LAND USE AND FUTURE LAND USE

Effective identification of land use is critical to identify where opportunities exist for land development or redevelopment. These decisions guide airport decisions over the long term in a way that maintains airport growth, service to the community, and minimizing costly counterproductive or inefficient development.

The Airport currently has a mix of general aviation (GA) facilities dispersed around the airport property, ranging from flight schools to FBOs servicing general aviation transient and charter jet traffic. With a dynamic and fast-paced environment which this mix of users generates, it is important to ensure that the flow of traffic on the airfield is organized, and that these facilities can provide services to their users efficiently and effectively. Currently, the airfield maintains two FBOs and a terminal facility on its East Apron. Corporate hangars are dispersed around the airfield, however, primarily located on the East Apron. T-hangars can be found situated between the Chantilly Jet Center FBO and the terminal facility on the East Apron, as well as at the southern end of the West Apron.

With this configuration of exiting land use, larger, turbine/jet aircraft tend to operate on Runway 16L-34R and park/stage on the east side of the airfield. Smaller, single-engine aircraft tend to operate on Runway 16R-34L. The Airport's vision for smaller, single-engine aircraft is to have them park/stage on the west side of the airfield. **Figure 3-3** displays the flow of the resulting aircraft ground traffic.

FIGURE 3-3
AIRCRAFT GROUND FLOW DIAGRAM



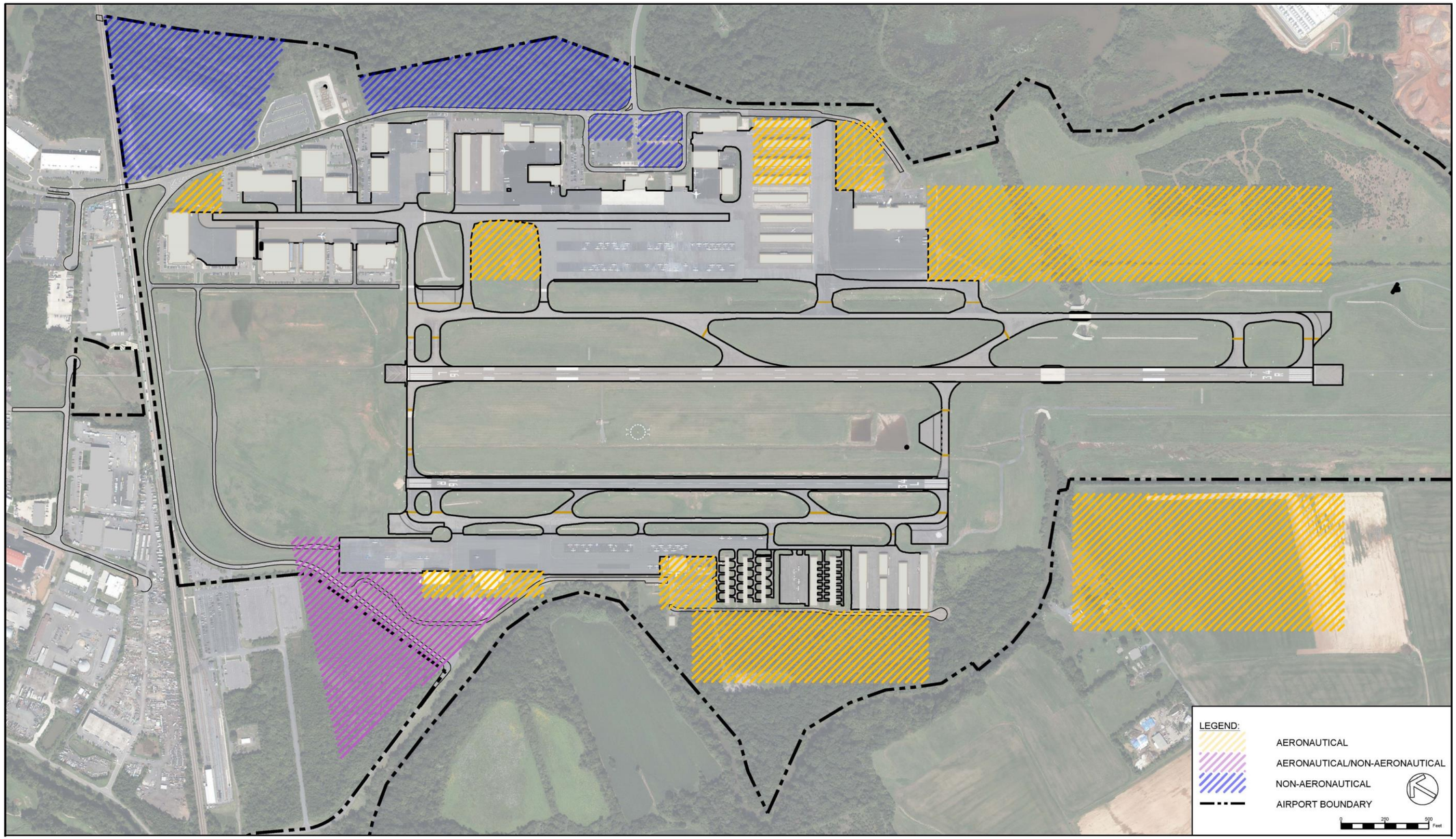
Source: RS&H Analysis, 2023.

As the Airport continues to develop, traffic at the Airport will continue to increase every year. To prevent any conflict arising from this growing congestion, as well as to prepare for the long-term development of the Airport, proper land use must be evaluated, then executed effectively. In order to minimize ground aircraft congestion, as well as to develop and redevelop the Airport in an orderly fashion, large and small aircraft traffic should be separated. To leverage current development, the Airport should focus on developing the west side of the airfield to primarily support single-engine and light twin aircraft while the east side of the field developed to support larger, jet/turbine aircraft. Currently, the majority of smaller aircraft tie-downs and T-hangars are located on the east side, which does not align with the Airport's vision. By catering to the Airport's vision, the land development/ redevelopment can be as efficient and useful as possible. A number of important conclusions were drawn during the facility requirements analysis in relation to land use patterns including:

1. *Development in the NW is most cost efficient compared to SE or SW areas.*

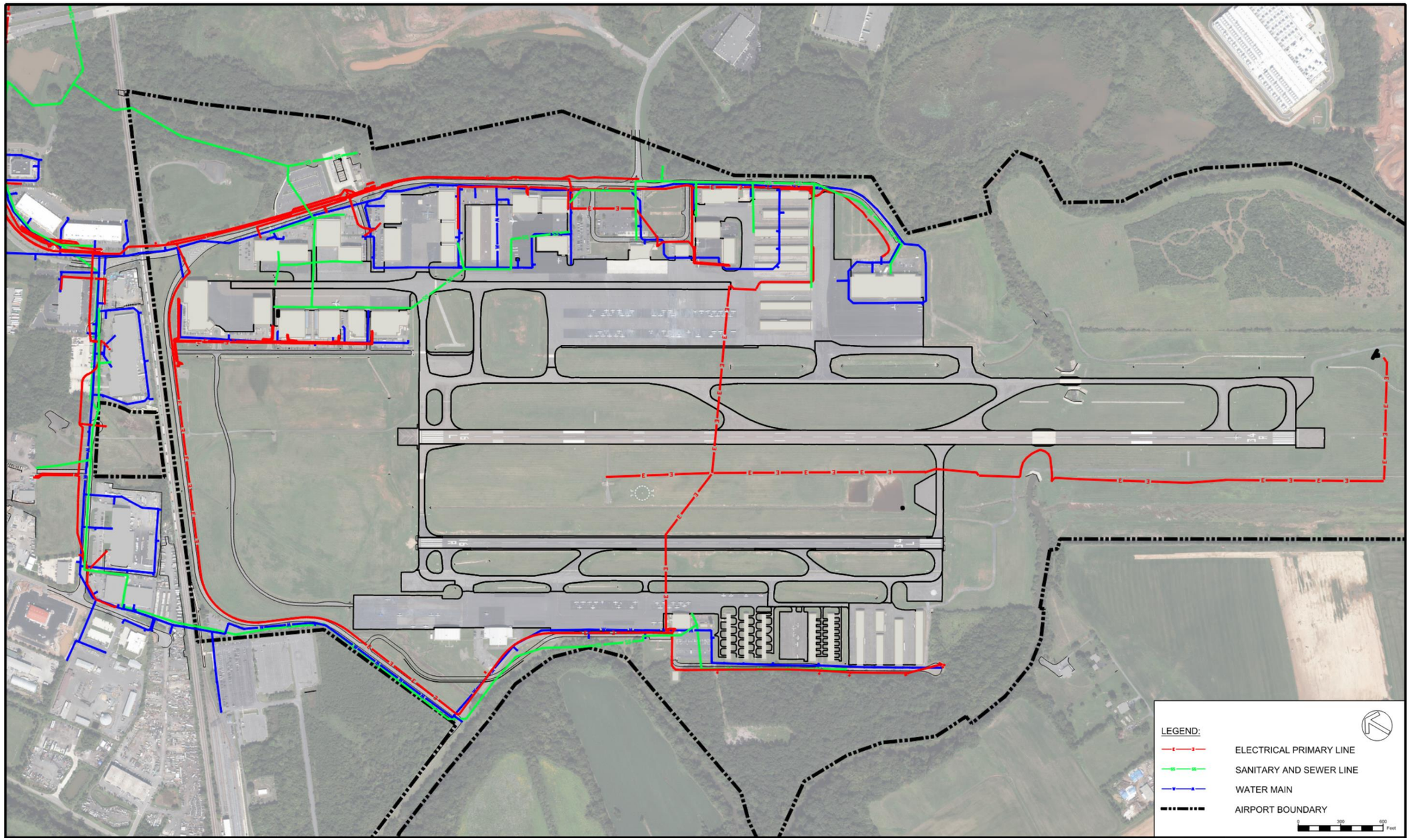
Multiple areas were considered for new development to support future growth. In this consideration, the areas of use are limited to those that follow airport design standards and promote access to the airfield to airport users. Once all areas in consideration met these criteria, the complexity of their construction must be considered. Installing new utility infrastructure, and contending with environmentally sensitive areas, can be an expensive and time-consuming process. By using the advantage of an established utility system, as well as avoiding environmentally sensitive areas, this plan will promote an orderly and effective facility development. **Figure 3-4** depicts all zones in consideration for future development, as well as their use for aeronautical and non-aeronautical development. In order to ensure compliance with environmental regulations and safeguard the ecosystem, it is essential to carefully consider appropriate NEPA triggers. This approach helps to avoid any violations of the law and minimizes the risk of environmental factors that could potentially harm both the on-site facilities and the aircraft utilizing them. Among these factors, utility infrastructure is critical to take into consideration prior to development. **Figure 3-5** depicts the current utility infrastructure at the Airport.

FIGURE 3-4
DEVELOPMENT AND LAND USE OPPORTUNITY ZONES



Source: RS&H Analysis, 2023.

FIGURE 3-5
AIRPORT UTILITIES



Source: RS&H Analysis, 2023.

Considering all airport and environmental development considerations, the most feasible area for future development is the northwest portion identified as aeronautical/non-aeronautical land use in **Figure 3-4**. This area can promote a mix of developments for the Airport and its users, is best integrated with existing utilities, and poses a lesser environmental impact than other undeveloped areas. This area is also in consideration for redevelopment, as the existing Observation Road will likely be realigned and there has been interest in development in this area already. This area is a prime candidate for development, and specific developments in this area will be evaluated in further sections in this and the following chapters.

2. *The west side of the airfield does not have pilot services/amenities which exist on the east side of the airfield.*

In development of the west side of the airport, the current utility of that side's facilities must be evaluated. The west side's biggest unrecognized need is the lack of pilot services and amenities. With no FBO to service fuel, conduct maintenance, provide airfield access to users, or provide restrooms, it is inconvenient for both based and transient aircraft to use the area. In order to incentivize the use of the area, as well as improve the quality of the Airport, facilities with pilot amenities should be implemented on the west side.

3. *Airport ARFF vehicles are located in an operationally inefficient location and does not allow for an adequate emergency response time.*

Currently, the Airport's ARFF vehicles are stored in Hangar C-3 on the East Apron. This is not an optimal long term storage option for the vehicle. From the September 2017 ARFF Feasibility Study, a timely response will require that the ARFF vehicle have its own facility, away from its current location. Regarding Part 139 airport standards, the current emergency response time of seven minutes is unacceptable and requires a new, properly sited ARFF facility.

4. *Runway 16L-34R would best serve larger aircraft operations by extending the runway.*

Majority of the fleet mix operating out of HEF can takeoff and land at the Airport at Maximum Takeoff Weight (MTOW). A growing amount of new users to HEF are using more modern, longer-range business jets that cannot takeoff at MTOW during the highest temperatures experienced at HEF. With monthly highs increasing and the expectation for continued traffic growth, specifically business jet traffic, a runway extension will be able to support the operations during the planning period without limiting payloads.

5. *Appropriately allocate apron and aircraft storage space to meet forecast demand in the planning period.*

The Airport recognizes the need for additional transient apron space and covered aircraft storage facilities in the form of T-hangars, conventional hangars, or corporate hangars. With the costly impact of development on the east side, the west side provides a better opportunity to support aircraft parking and storage. The final alignment of Observation Road will impact the extent and configuration of development. Therefore, this chapter will depict both alignments in consideration to convey the future facility need can be supported with either alignment.

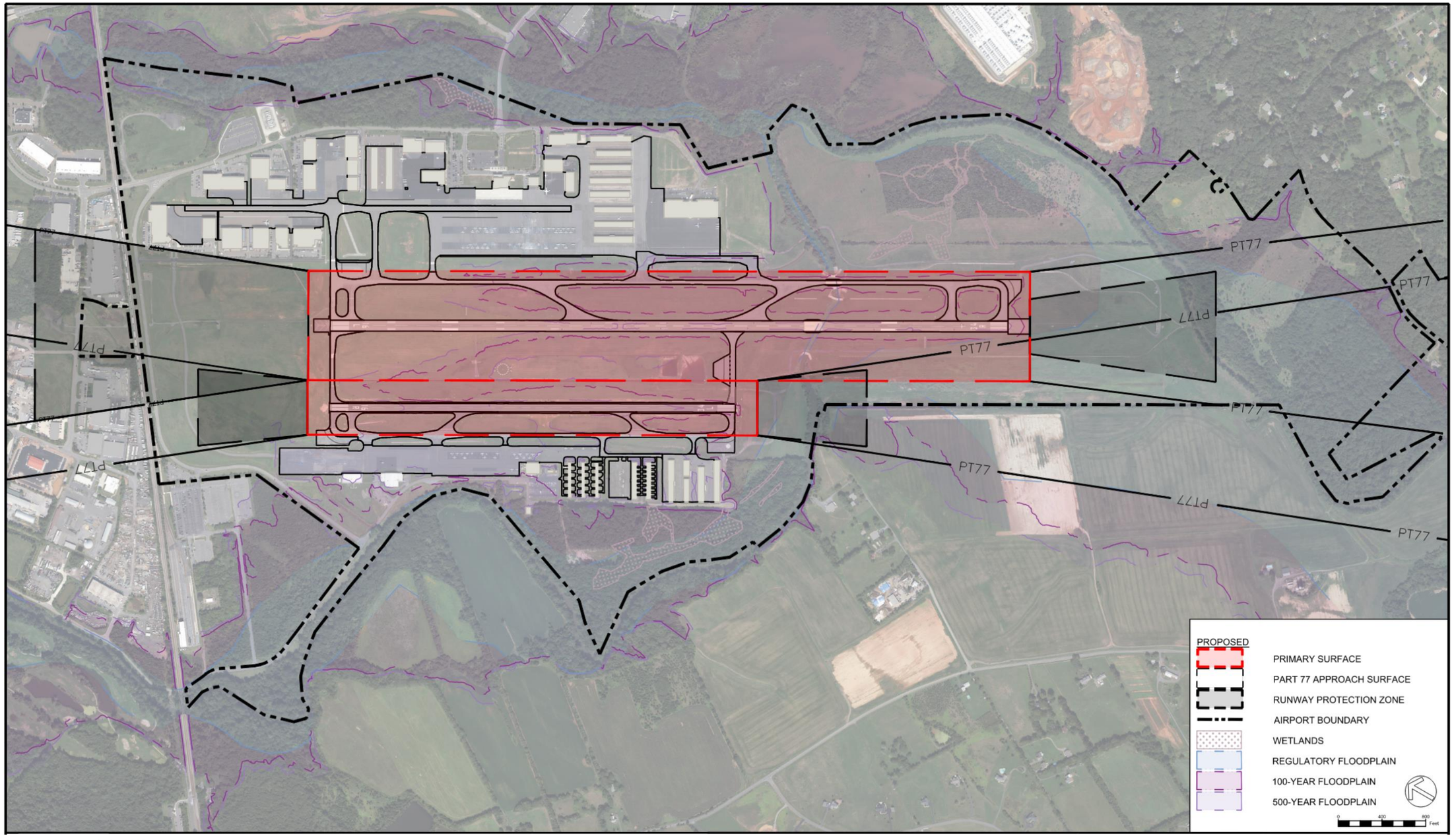
3.2.1 FAA Airspace and Environmental Limitations

Every airport leverages unique advantages, disadvantages, and characteristics regarding its location and local and regional setting. Of these characteristics, the two that both cause and are subject to the greatest impact by the Airport are airspace and the environment.

FAA protected airspace that must be considered for any operations at the Airport include FAR Part 77 airspace and surfaces. These surfaces are also called "imaginary" surfaces. FAR Part 77 surfaces act to protect and promote air safety at and around the airport, as well as promote the efficient use of the facility. At HEF, the most prominent surfaces to impact the facility are the Building Restriction Line (BRL), primary surface, approach surface, and the Runway Protection Zone (RPZ). The BRL defines the area on the airfield where buildings and structures that are 35' tall may be built, to mitigate risk for aircraft collision during normal operation. The primary surface is an imaginary surface that is defined by the runway centerline and expands out beyond the runway thresholds and runway edges to provide more protections from obstruction for aircraft using the runway. The only structures permitted in the primary surface are those which must be located in the area for the airport to function, such as runway lights and runway signs. All other structures, and aircraft not actively taxiing on, off, or across the runway must remain out of the primary surface. The approach surface protects aircraft from on and off airport obstructions and obstacles. Finally, the RPZ is an imaginary surface that resembles a trapezoid expanding away from the runway from the edge of the primary surface. The purpose of this area is to protect the ends of the runway from aircraft overrun or impact prior to the runway during an emergency event. Structures that are allowed in this area are heavily restricted due to the elevated risk of aircraft entering the zone.

The National Environmental Policy Act of 1969 (NEPA) serves as the forefront for environmental protections regarding land in and around airport property. NEPA provides guidelines for responsible development of land, as well as a method to involve public input regarding development decisions for airport projects. At HEF, the largest environmental factors that may impact development and operations would be wetlands and floodplains. The size, location, and proliferation of wetlands (wetland delineation) is critical to understand and document, as wetland can have major environmental impact on any construction site within it. **Figure 3-6** depicts airspace and environmental constraints which can hinder development.

FIGURE 3-6
FAA AND ENVIRONMENTAL LIMITATIONS ON DEVELOPMENT

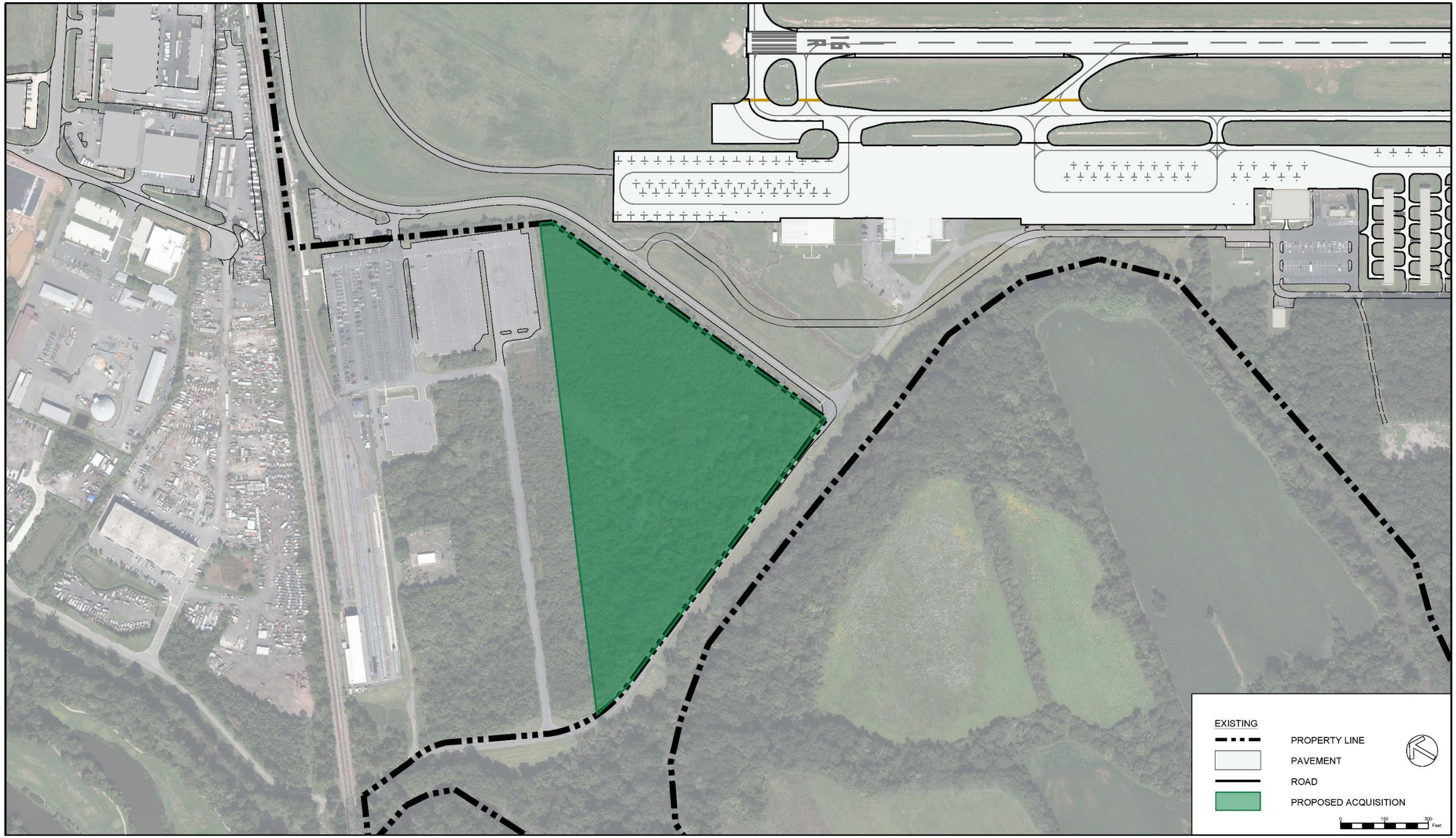


Source: RS&H Analysis, 2023.

3.3 RECOMMENDED LAND TO ACQUIRE

Alternatives assessed were developed with consideration of the existing airport boundaries and surrounding vacant land ideal for development to show necessary airfield design concepts consistent with that of forecasted demand. Land acquisition is proposed to allow for development opportunities for airport expansion during the planning period and prevent the development of incompatible uses adjacent to existing and planned airport improvements. The airport is located between two streams, Cannon Branch and Broad Run, therefore development opportunities off airport property to the east, west, and south without impacting existing floodplains is challenging. Off-airport property to the north is already developed with rail lines and industrial parks. The master planning team identified a 18-acre parcel of land to the northwest, within Prince William County, which enables development of future aeronautical and/or non-aeronautical facilities that are compatible with airport operations while also providing revenue to support the airport. The Aviation Support facility alternatives will consider this 18-acre parcel, depicted in **Figure 3-7**, to support future demand.

FIGURE 3-7
PROPOSED LAND ACQUISITION



Source: RS&H Analysis, 2023.

3.4 AIRFIELD ALTERNATIVES

The Airport airfield is the leading facility planning element as it serves the primary purpose of the airport, providing safe passage of aircraft transitioning from ground to flight, and vice versa. All facilities are developed around the airfield and how they interface with it. Facilities are influenced by various factors, including terrain, prevailing meteorological conditions, aircraft performance requirements, the mix of aircraft at the airport, FAA design standards, as well as guidance and best practices. These considerations play a crucial role in shaping the design and functionality of the facilities to ensure optimal operations and safety. The runway count and orientation at HEF are adequate to serve forecasted demand over the planning period, however other airfield aspects are being investigated. Taking these impacts into consideration, the four focuses for airfield alternatives are to meet established FAA airfield geometry and design standards, to meet performance requirements for future operations, address known and anticipated operational safety concerns, and to serve future areas of facility development. The focus areas in this section will be development alternatives for the following airfield elements:

- Runway 16L-34R Extension
- Taxiway/Taxilane C Configuration
- HS-1 (Runway Hotspot Intersection)

All airfield solutions will consider peak demand capacity constraints, primary users, and emerging trends. Every development option is always weighed against the option of taking no option as well.

3.4.1 Runway Alternatives

3.4.1.1 Runway 16L-34R Extension

The analysis conducted for the runway extension concluded that the landing length of Runway 16L-34R is sufficient to accommodate the operations of existing and future design aircraft. However, it was determined that the takeoff length is insufficient to serve certain large business jets operating from HEF without imposing significant payload restrictions, particularly during summer conditions. The analysis identifies the need for a runway length providing a takeoff run available (TORA) of 6,500 feet, therefore, only alternatives extending available take off length by 300 feet were evaluated. The following Runway 16L-34R existing conditions and extension alternatives, and the resulting impacts, are evaluated in the following text. In section **3.4.1.2 Runway 16L-34R Extension Alternatives Evaluation**, the evaluation criteria for each alternative is outlined in detail, and section **3.4.1.3 Runway 16L-34R Extension Alternatives Summary** evaluates each alternative to determine a preferred alternative.

- Existing Condition – No Action
- Alternative 1 – 150′ Extension on Each Runway Threshold
- Alternative 2 – 300′ Displaced Threshold (RWY 16L End)
- Alternative 3 – 300′ Extension (RWY 16L End)
- Alternative 4 – 300′ Extension (RWY 34R End)
- Alternative 5 – 300′ Displaced Threshold (RWY 34R End

» **Existing Condition – No Action**

In the existing condition of Runway 16L-34R, there are potential operations that cannot be completed due to runway length being inadequate at MTOW and high temperature conditions, when aircraft takeoff performance is reduced. Maintaining the status quo with no changes to the runway may appear cost-effective initially, but it would come at a significant cost to the airport and its users. By limiting the operations of the largest and longest-range aircraft, the airport would impede its own growth, utility, and overall business. This restriction would have adverse effects on the airport's ability to attract and serve key stakeholders, ultimately hindering its potential for development and success.

» **Alternative 1 – 150′ Extension on Each Runway Threshold**

Implementing 150-foot runway extensions on both runway thresholds would eliminate the need for decision-making regarding which threshold to extend and alleviate the associated challenges of extending the runway from either end. This alternative would involve the challenges of both threshold extensions and would require extensive additional work on surrounding taxiway infrastructure in order to efficiently use the new surface. **Figure 3-8**, **Figure 3-9**, and **Figure 3-10** depict this alternative and each threshold.

» **Alternative 2 – 300′ Displaced Threshold (Runway 16L Threshold)**

A 300-foot extension on the Runway 16L threshold to provide a displaced threshold would provide more space for an aircraft's takeoff roll, while also limiting new airspace impacts of moving the runway. This alternative could also eliminate an existing issue of direct runway access from an aircraft apron via Taxiway/Taxilane C. **Figure 3-11** and **Figure 3-12** depict this alternative and the Runway 16L threshold.

» **Alternative 3 – 300′ Extension (Runway 16L Threshold End)**

A 300-foot extension on the Runway 16L threshold end would provide the airport operational flexibility without introducing an asymmetric airfield using displaced thresholds. This alternative would, as a tradeoff, introduce new airspace considerations for Part 77 and the RPZ. **Figure 3-13** and **Figure 3-14** depict this alternative and the Runway 16L threshold.

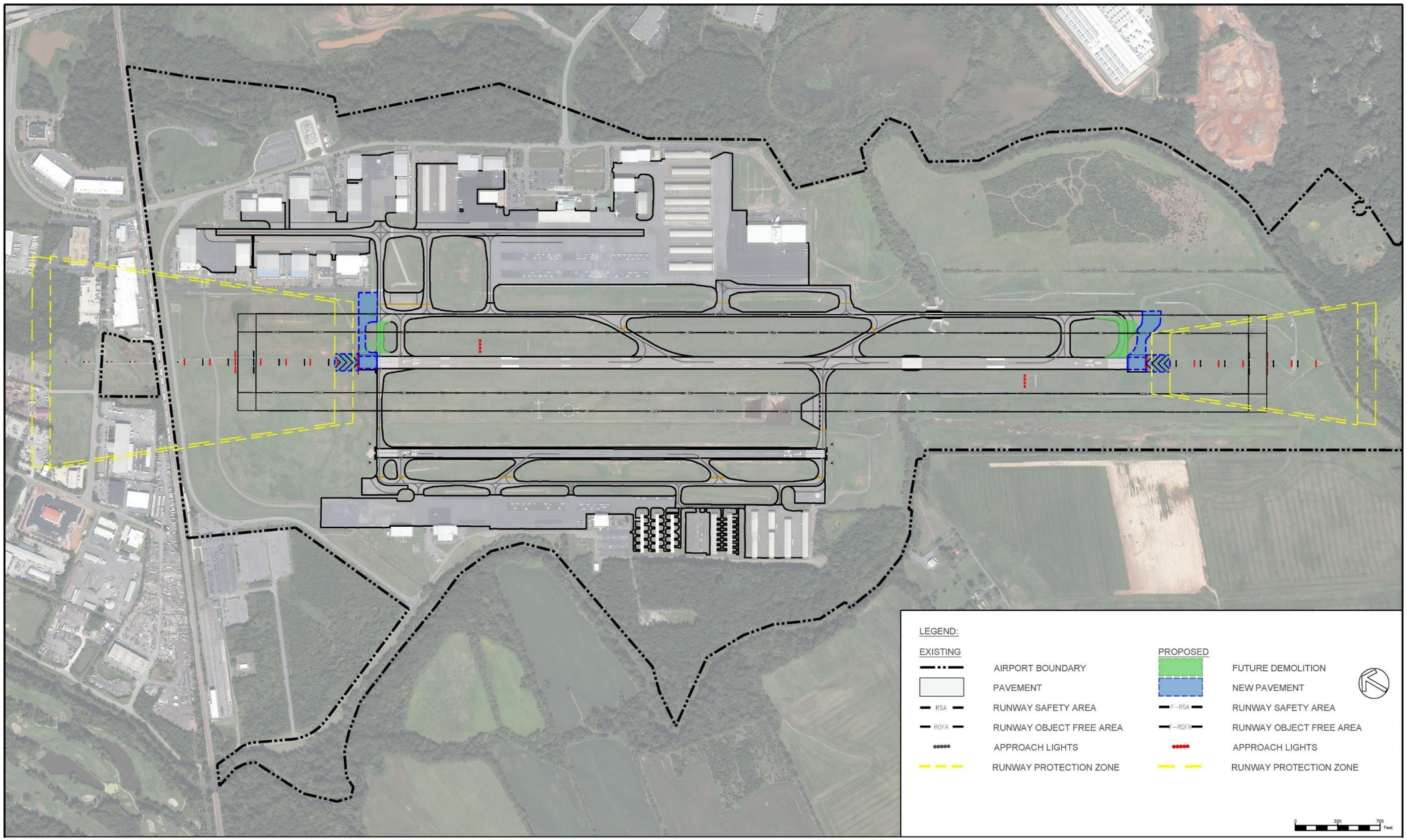
» **Alternative 4 – 300′ Extension (Runway 34R Threshold)**

A 300-foot extension on the on the Runway 34R threshold would provide the airport operational flexibility without introducing an asymmetric airfield using displaced thresholds. This alternative would, as a tradeoff, introduce new land and environmental concerns. **Figure 3-15** and **Figure 3-16** depict this alternative and the Runway 34R threshold.

» **Alternative 5 – 300′ Displaced Threshold (Runway 34R Threshold End)**

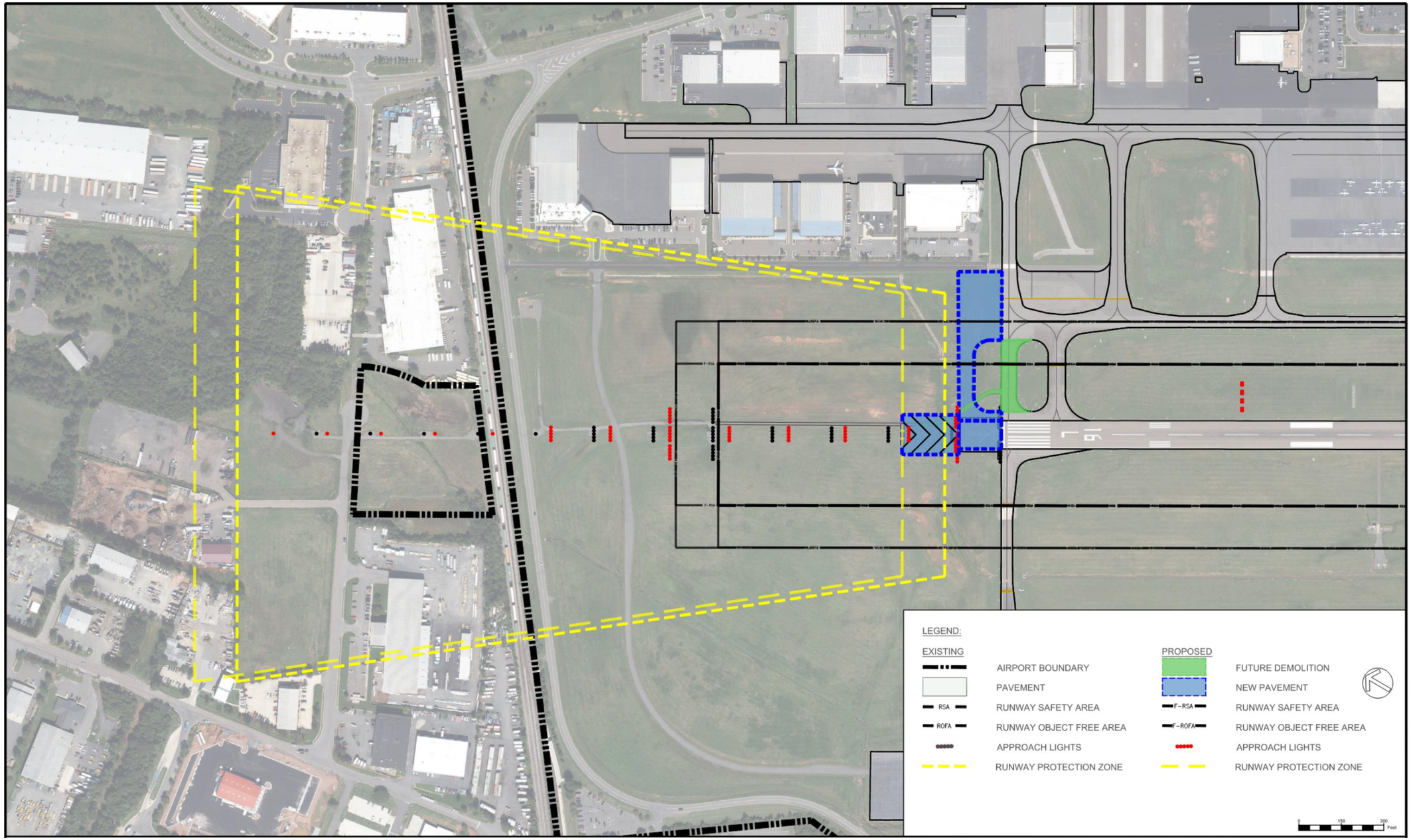
A 300-foot extension on the Runway 34R threshold end to provide a displaced threshold would provide additional more space for aircraft takeoff roll, while also limiting new airspace impacts by moving the runway. This alternative keeps the RPZ of the runway extension within the airport boundary. **Figure 3-17** and **Figure 3-18** depict this alternative and the Runway 34R threshold.

FIGURE 3-8
ALTERNATIVE 1 – 150′ EXTENSION OF BOTH RUNWAY THRESHOLDS



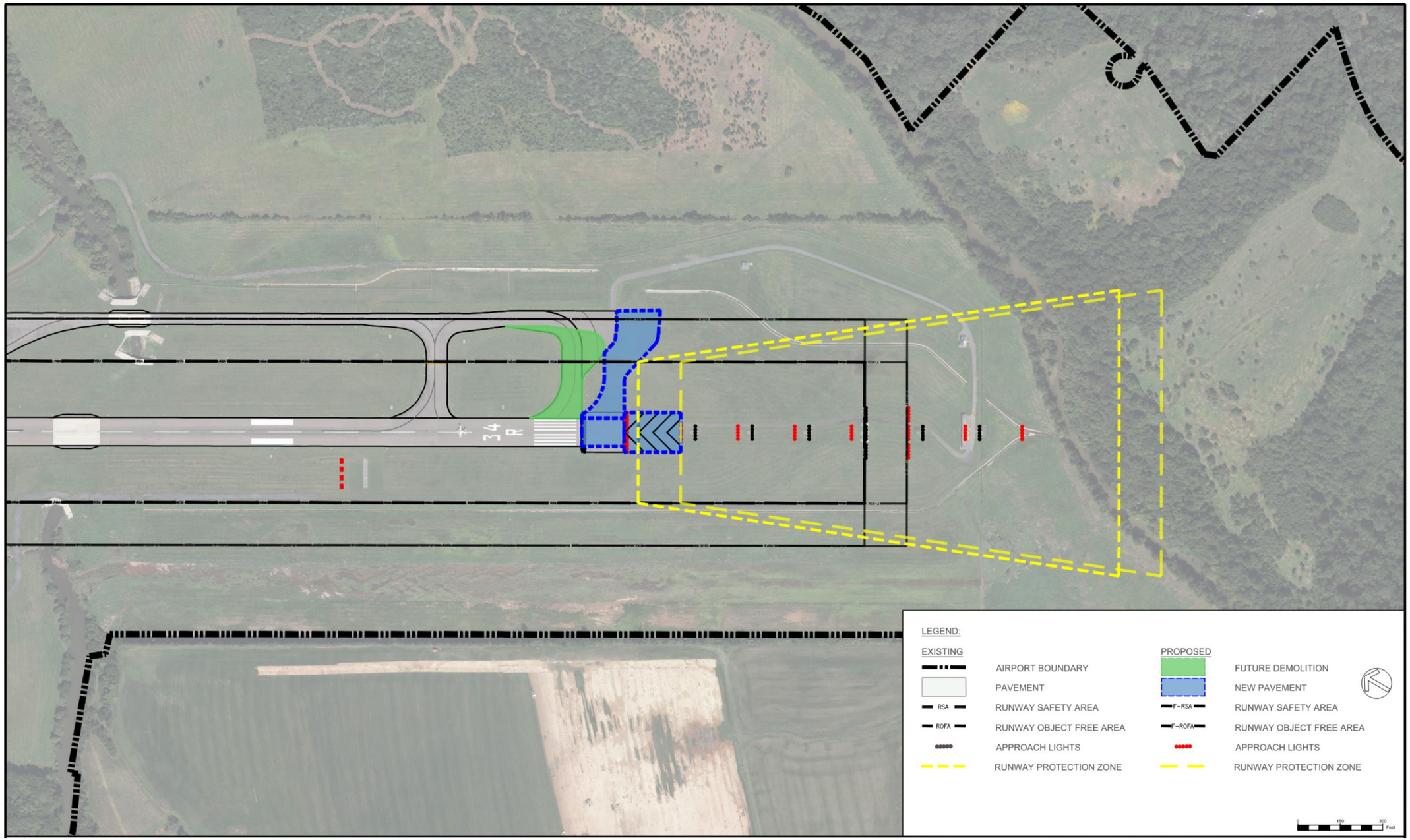
Source: RS&H Analysis, 2023

FIGURE 3-9
ALTERNATIVE 1 – 150′ EXTENSION OF BOTH RUNWAY THRESHOLDS, 16L THRESHOLD VIEW



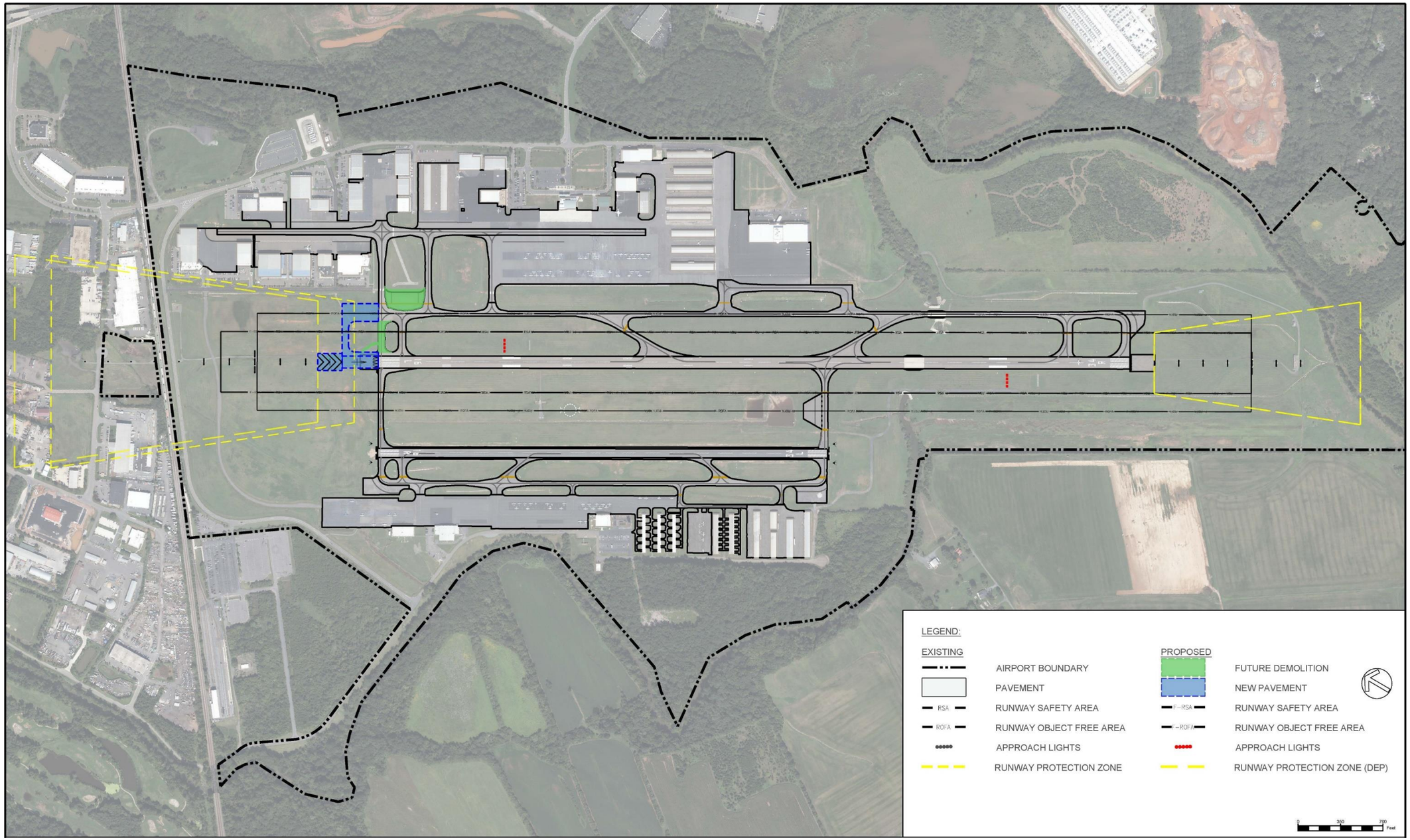
Source: RS&H Analysis, 2023

FIGURE 3-10
ALTERNATIVE 1 – 150′ EXTENSION OF BOTH RUNWAY THRESHOLDS, 34R THRESHOLD VIEW



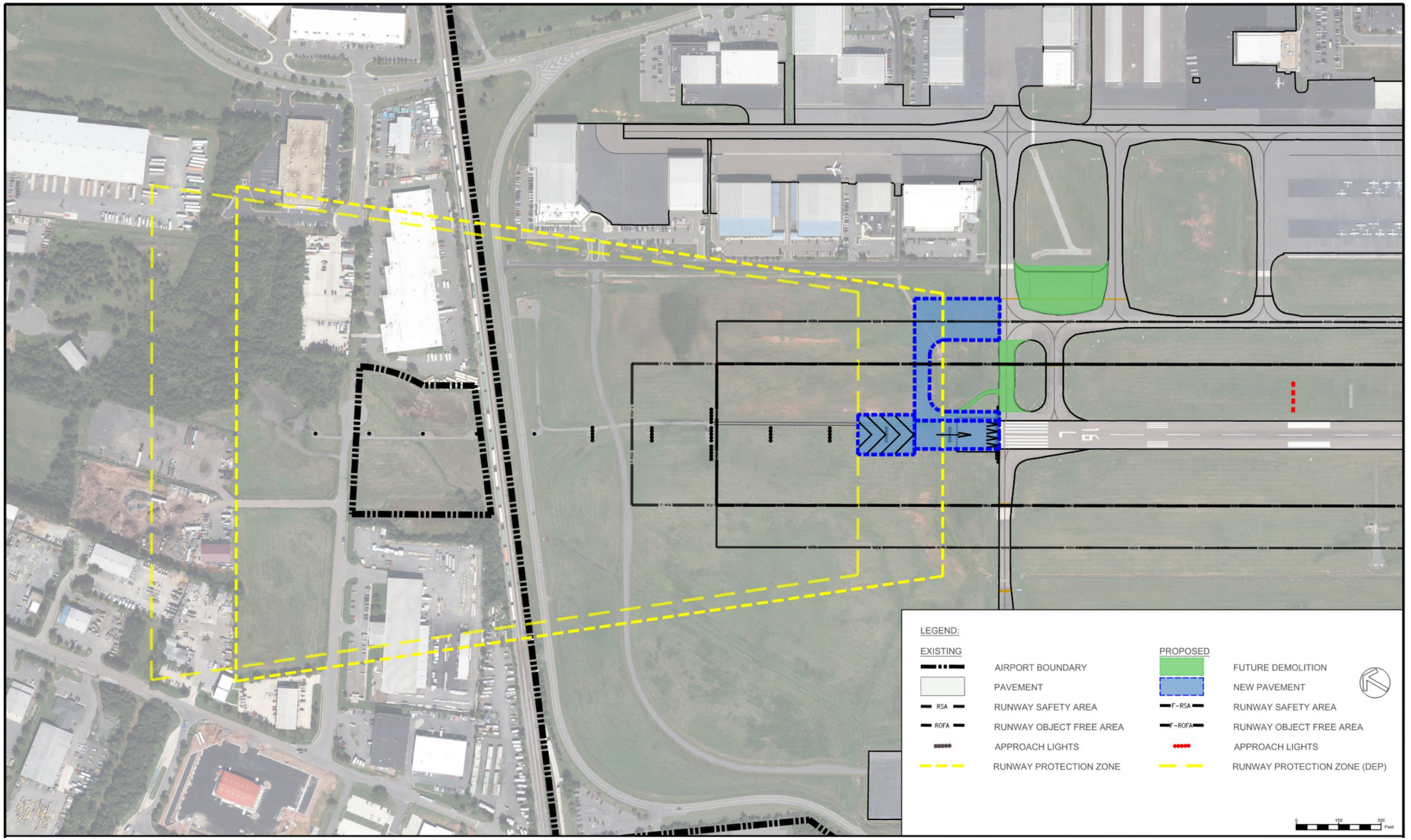
Source: RS&H Analysis, 2023

FIGURE 3-11
ALTERNATIVE 2 – 300′ DISPLACED THRESHOLD (RUNWAY 16L THRESHOLD)



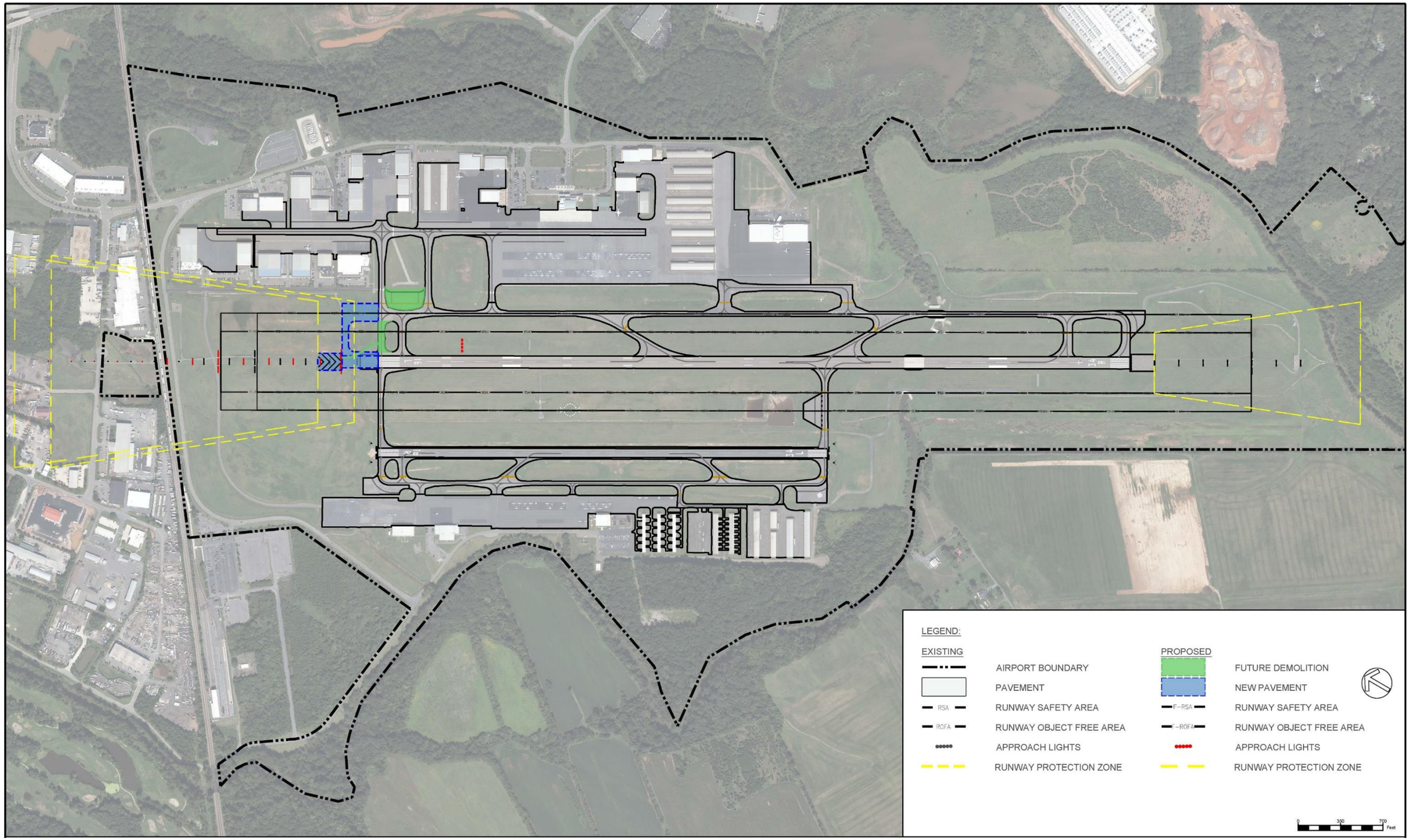
Source: RS&H Analysis, 2023

FIGURE 3-12
ALTERNATIVE 2 – 300′ DISPLACED THRESHOLD (RUNWAY 16 THRESHOLD), 16L THRESHOLD VIEW



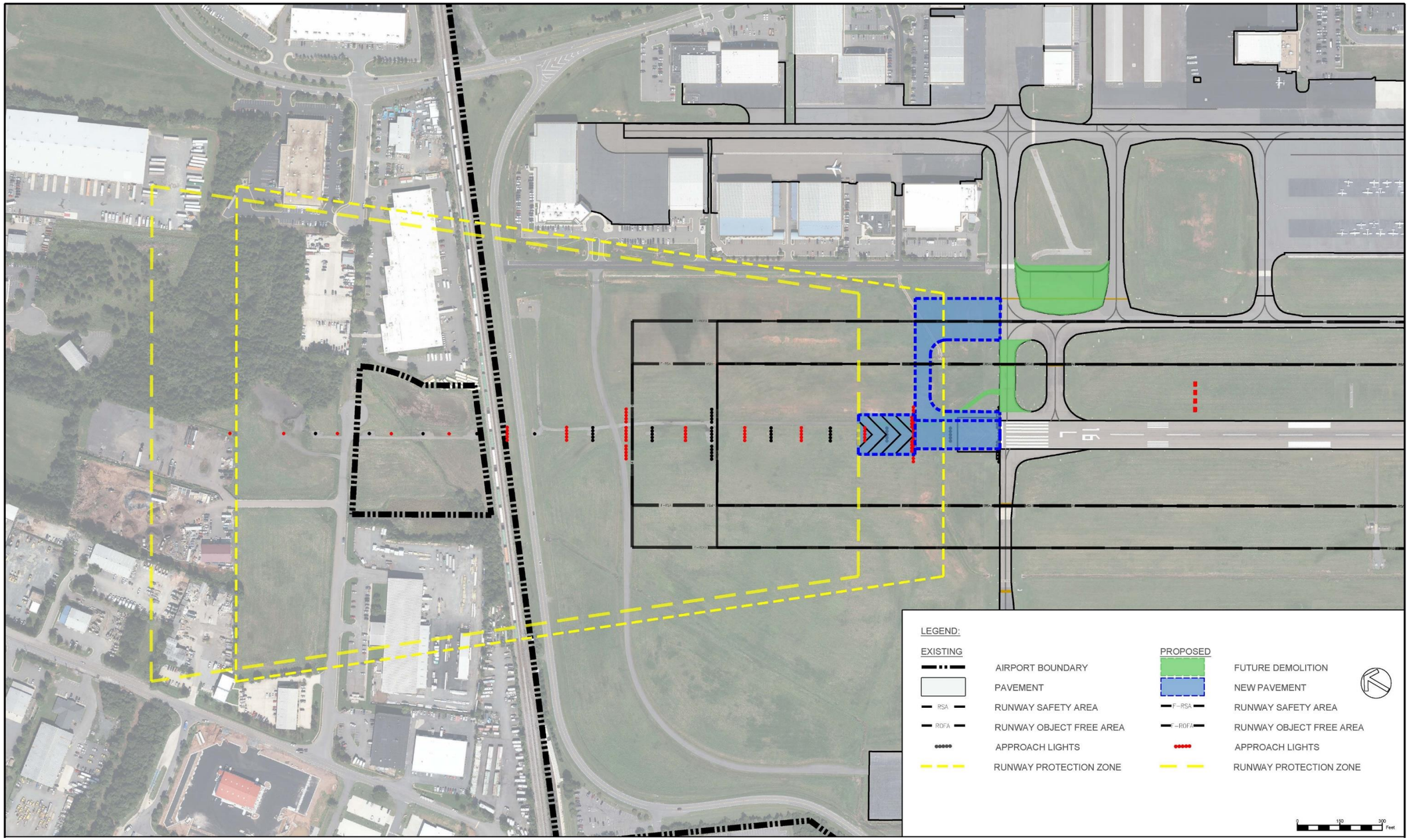
Source: RS&H Analysis, 2023

FIGURE 3-13
ALTERNATIVE 3 – 300′ EXTENSION (RUNWAY 16L THRESHOLD)



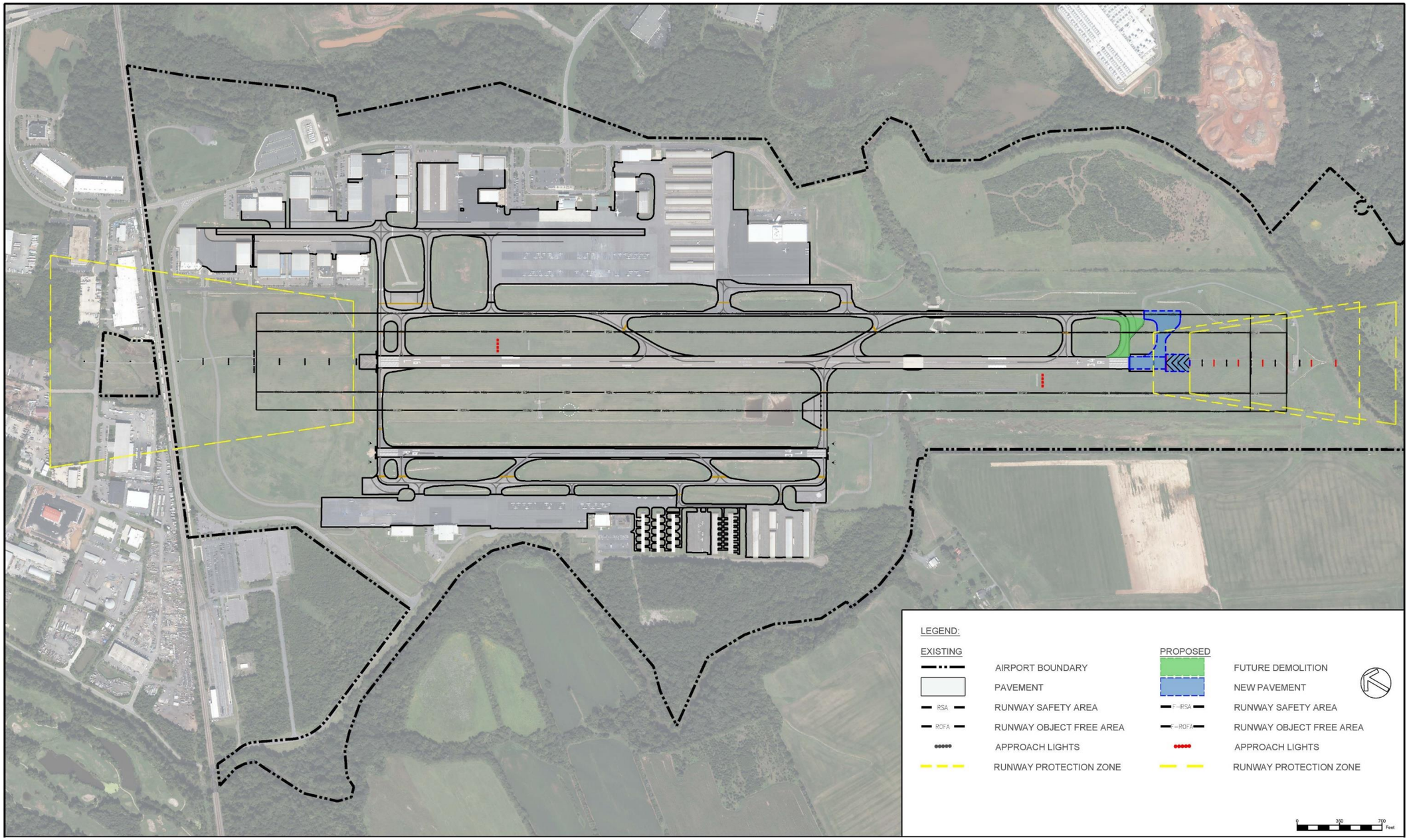
Source: RS&H Analysis, 2023

FIGURE 3-14
ALTERNATIVE 3 – 300′ EXTENSION (RUNWAY 16L THRESHOLD), 16L THRESHOLD VIEW



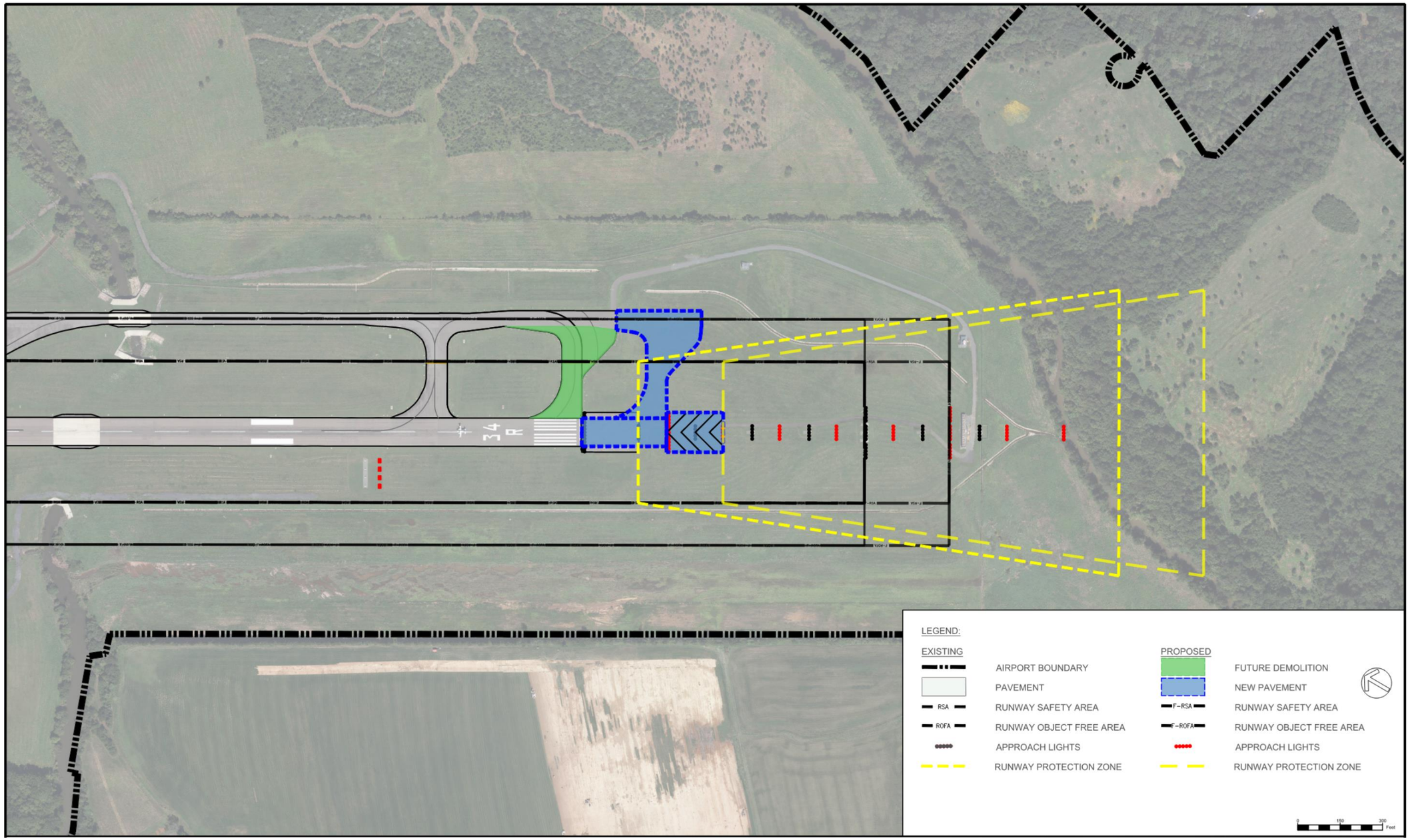
Source: RS&H Analysis, 2023

FIGURE 3-15
ALTERNATIVE 4 – 300′ EXTENSION (RUNWAY 34R THRESHOLD)



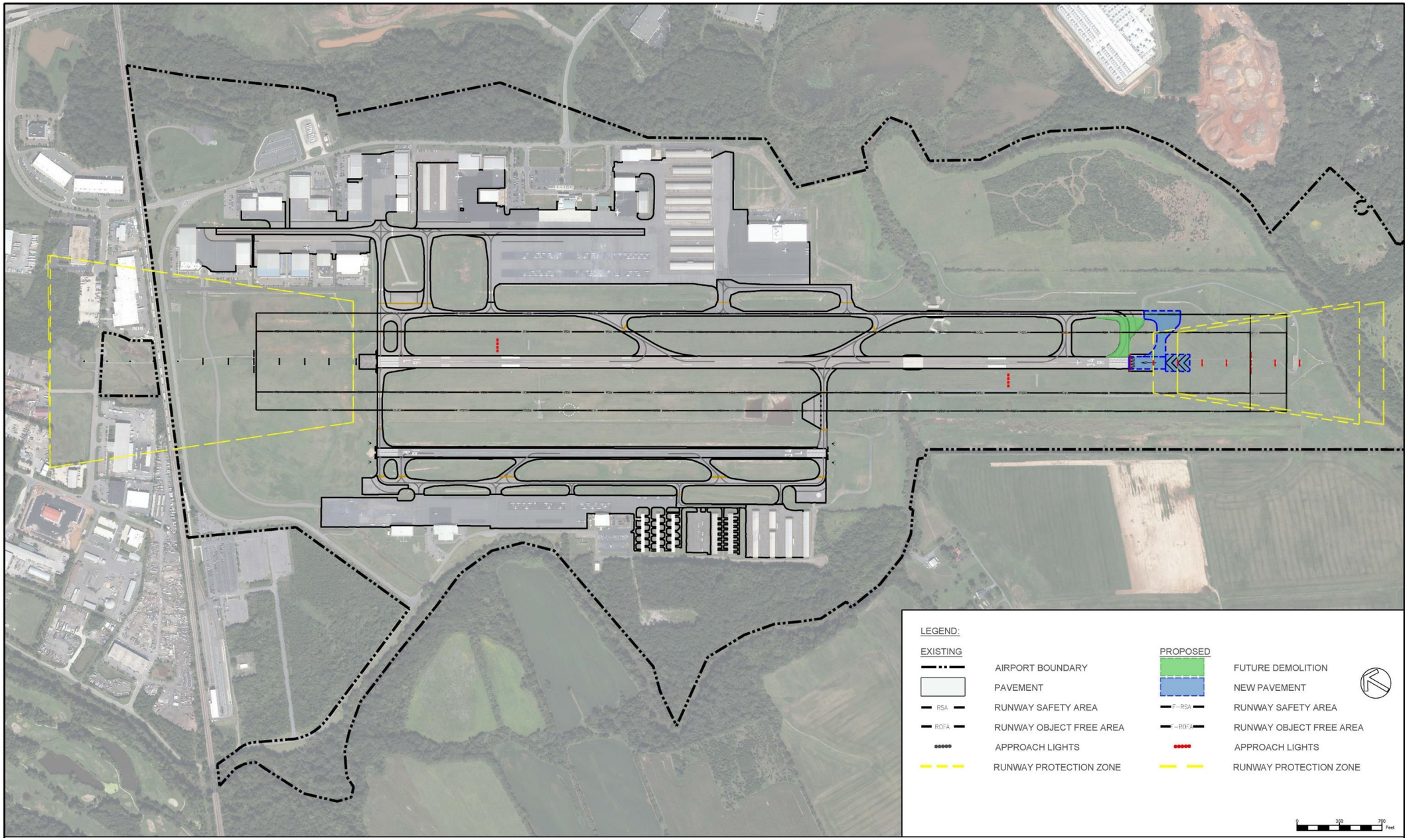
Source: RS&H Analysis, 2023

FIGURE 3-16
ALTERNATIVE 4 – 300′ EXTENSION (RUNWAY 34R THRESHOLD), 34R THRESHOLD VIEW



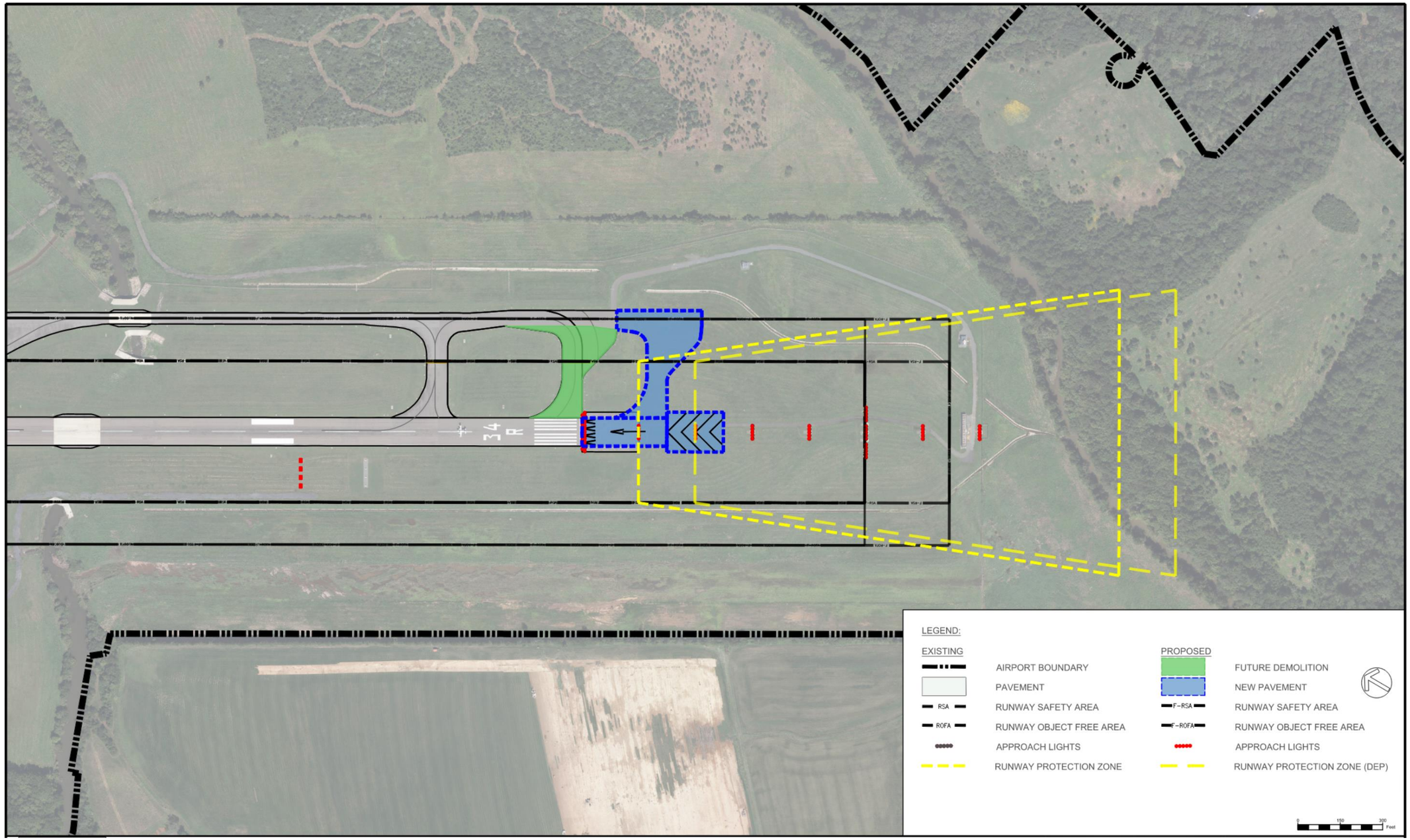
Source: RS&H Analysis, 2023

FIGURE 3-17
ALTERNATIVE 5 – 300′ DISPLACED THRESHOLD (RUNWAY 34R THRESHOLD)



Source: RS&H Analysis, 2023

FIGURE 3-18
ALTERNATIVE 5 – 300′ DISPLACED THRESHOLD (RUNWAY 34R THRESHOLD), 34R THRESHOLD VIEW



Source: RS&H Analysis, 2023

3.4.1.2 Runway 16L-34R Extension Alternatives Evaluation

A 300-foot extension to the Runway 16L threshold end possesses challenging constraints including the presence of off-airport property land in Prince William County which would lie in the approach RPZ. Below the RPZ lies over one-acre of land owned by two separate owners. A 300-foot extension to this end of the runway would require the Airport to pursue control over the approach RPZ by ownership, possessing interest in the area through easements, or attempting to exercise eminent domain. Alternatively, extension of the Runway 34R threshold end, while not without its challenges, would not require such drastic measures to achieve the 6,500-foot runway length since the extended pavement and RPZ fall within airport property. For these reasons, alternatives extending the available takeoff pavement on the 34R threshold end appeared to be the most logical solution. A 150-foot extension on each threshold end, Alternative 1, was evaluated since the alternative met the criteria of extending the runway to 6,500 feet. This alternative ultimately has similar challenges as the 300-foot extension on the Runway 16L threshold end, Alternative 3, with less off-airport property falling under the RPZ.

Extending the allowable takeoff length for Runway 16L-34R south, 34R end, has a number of impacts that need to be addressed from the planning stage through design and implementation. NEPA requires that the Airport undergo an environmental assessment (EA) to understand the full environmental impacts of the development and ensure the public has an opportunity to review and comment on the evaluations. Additional requirements for a 300-foot extension for allowable takeoff length include environmental permitting and wetland mitigation, improvements to the future RSA, and the movement/replacement of existing navigational aids.

Based on available historical data most operations on Runway 16L-34R, approximately 56%, occur during north flow. Therefore, one alternative, Alternative 4, relocated the Runway 34R threshold 300-feet southeast. Another alternative, Alternative 5, extended the allowable takeoff pavement 300-feet southeast while Runway 34R threshold remained in place, resulting in a displaced threshold. The high-speed exit taxiway, Taxiway B3, would not require relocation in either of the alternatives since the taxiway is sited in the middle third of the runway to optimize runway capacity. Additionally, Taxiway B would be extended to reach the new threshold or edge of allowable takeoff run pavement of Runway 34R.

An evaluation of the three Runway 16L-34R extension alternatives and the existing (No Action) condition is provided below and shown in **Table 3-1.**

- **Safety:** The safety of the runway and its users improves with length, especially during the higher temperature days experienced at the Airport.

- **Operational Efficiency:** Extending the runway to a total TORA of 6,500 feet would improve the Airport's operational efficiency by meeting operating aircraft performance demands and limiting weight restrictions and stops at airports with longer length runways to refuel.

- **Meets FAA Design Standards:** FAA design standards can be met when providing a total TORA of 6,500 feet.

- **Effectively Serves Target User:** Currently, the runway effectively serves the majority of business jet traffic operating out of the Airport, however, if the runway were extended it would allow aircraft to operate out of the airport without weight restrictions. Extending the runway offers an additional advantage as it increases the Takeoff Run Available (TORA), which has the potential to attract greater general aviation and commercial air service. This extension could entice new or existing operators with a wider range of aircraft types to serve previously unserved markets, thereby enhancing the airport's overall connectivity and expanding its potential customer base.

- **Resolves Current Issues:** In its current state, the runway does not provide the performance abilities needed by operators of heavier business jets during higher temperature days at the Airport. Extending the runway length TORA to 6,500' resolves this issue.

- **Meets Long-Term Facility Needs:** Extending the runway would meet forecast near-term and long-term facility needs.

- **Appropriate Level of Service**: Level of service is improved by extending the runway as it will limit operators repositioning to an airport with a longer runway to refuel prior to traveling to their final destination. Keeping the runway at its existing length maintains the Airport's existing level of service by maintaining the existing issues with service reliability as well as limiting the potential for increasing general aviation and commercial service traffic and markets available to the community.

- **Ease of Implementation:** Alternative 4 and Alternative 5 can be implemented with generally the same degree of minimal operational impacts compared to Alternative 1, Alternative 2, and Alternative 3.

- **Cost of Implementation:** Implementation costs for any runway extension is manageable when funded through available federal, state, and local financially supportive agencies. Associated costs for a runway extension include advanced planning studies, the NEPA process, land acquisition (for the extended RPZ), design, and construction.

- **Flexible for Future Expansion:** A runway extension of 300' to the southeast maintains flexibility for future expansion of the airfield and runway without causing additional conflicts to previously developed land and roadways to the north.

- **EONS Impact:** Impacts to EONS categories vary by each alternative. No action jeopardizes economic viability, operational efficiency, and community social responsibility factors. Extending the runway has the impact of changing the natural environment.

It is recommended that HEF plan to extend the runway to 6,500' within the near- to mid-term of the planning period. **Table 3-1** shows an evaluation of the runway extension alternatives.

TABLE 3-1
RUNWAY 16L-34R EXTENSION ALTERNATIVES EVALUATION MATRIX

Evaluation Criteria	Runway Extension Alternatives					
	Existing (No Action)	Alt. 1 (150' Ext. Each End)	Alt. 2 (Displaced Threshold)	Alt. 3 (300' Ext. 16L End)	Alt. 4 (300' Ext. 34R End)	Alt. 5 (Displaced Threshold. 34R End)
Safety	Good	Good	Good	Good	Good	Good
Operational Efficiency	Fair	Poor	Poor	Poor	Good	Good
Meets FAA Design Standards	Fair	Good	Fair	Fair	Good	Good
Effectively Serves Target User	Fair	Fair	Poor	Fair	Good	Good
Resolves Current Issues	Poor	Poor	Poor	Fair	Good	Good
Meets Long-Term Facility Needs	Poor	Fair	Fair	Good	Good	Good
Appropriate Level of Service	Fair	Poor	Fair	Fair	Good	Good
Ease of Implementation	Good	Poor	Poor	Poor	Fair	Fair
Cost to Implement	Good	Poor	Fair	Poor	Fair	Fair
Flexible/Future Expansion	Good	Poor	Poor	Poor	Good	Fair
EONS Impact	Good	Poor	Poor	Poor	Fair	Fair

Performance Legend

Good
Fair
Poor

Source: RS&H Analysis, 2022

3.4.1.3 Runway 16L-34R Extension Alternatives Summary

After careful evaluation and comparison between current conditions (no change) and all alternatives, it has been determined that Alternative 4 – 300' extension of the 34R threshold is the preferred alternative. This alternative provides the solution to the required 300' additional runway surface, without restricting the use of this new surface by restricting it's use to a displaced threshold or introducing declared distances. This alternative provides operational efficiency, and provides relative ease of environmental approval, construction, and future improvement.

3.4.2 Taxiway/Taxilane Alternatives

3.4.2.1 Taxiway/Taxilane C Configuration

Taxiways are the most important facility on the airport after runways, as they provide aircraft access to all facilities to and from the runway. **Chapter 2, Inventory and Facility Requirements** identifies some existing taxiway components that do not meet updated FAA design standards. An alternative analysis was prepared for the current site of Taxiway/Taxilane C. Taxiway/Taxilane C is the nearest taxing pavement to the east of Runway 16L threshold connecting operators to/from the primary runway. In between Taxilane C and Taxilane D, there is an aircraft hold pad so aircraft can do final checks before departure. In its current configuration, the taxiway does not meet FAA design standards in two notable ways:

- **Direct Runway Access from Apron –** Taxiway/Taxilane C provides a direct path from an aircraft apron to the runway. This can lead to situations where pilots could lose situational awareness and inadvertently enter the runway, resulting in a runway incursion. This condition does not align with FAA design standards.

- **TLOFA Penetration -** A fenceline and concrete drainage ditch penetrates Taxiway/Taxilane C's taxilane object free area (TLOFA). Per AC 150/5300-13B – *Airport Design* a TLOFA is an area adjacent to the Taxiway Safety Area (TSA) that is clear of objects not fixed-by-function to provide vertical and horizontal wingtip clearance. The TLOFA protects aircraft surfaces, such as wingtips and tails, from damage when taxiing in a taxilane. Objects such as fencelines and concrete drainage ditches should not exist in TLOFAs, as they pose a collision risk to aircraft and does not align with FAA design standards.

Many alternatives were generated in order to address the issues at hand, ranging from no or very little action to rebuilding the entire taxiing pavement. Each alternative gave a unique perspective to solving these issues, while attempting to avoid generating new issues. The existing conditions and the eight alternatives generated are listed below with associated descriptions:

- **No Action**

As mentioned, the current configuration has two major issues regarding direct runway access from the apron and TLOFA penetration. This is not safe for current or future aircraft operations at the airport, and does not meet FAA design standards. By not changing this configuration, there will be no construction costs, but significant safety concerns remain.

» **Alternative 1 – Shift Taxiway/Taxilane C South**

The first alternative considered shifts taxiway/taxilane C south while maintaining all other infrastructure as is. This alternative is the simplest in principle, as it moves the taxilane as to not have direct access to the runway and outside of the TLOFA penetration. This alternative eliminates the run up area for aircraft preparing for departure however, this would pose a major operational impact for aircraft using the Airport. Aircraft will still need to runup and will cause congestion by doing so in taxiways that access the runway, blocking access for users ready to depart.

» **Alternative 2 – Shift Fence and Ditch Outside TLOFA, Install No-Taxi Island**

The second alternative shifts the TLOFA penetration itself, moving the fence and concrete ditch to the north. To fix the direct access from the apron to the runway, a no-taxi island is marked in the pavement area between taxilane C and taxiway C to interrupt the direct access. This alternative will also unfortunately eliminate the runup area due to the no-taxi island eliminating the required space for the runup area.

» **Alternative 3 – Shift Taxiway/Taxilane C South with Additional Runup Area**

The third alternative shifts taxiway/taxilane C to the south similar to Alternative 1, but in addition it incorporates a new portion of pavement to the north of taxiway/taxilane C dedicated to replacing the runup area that is eliminated with the taxiway/taxilane C shift. This eliminates one of the issues regarding Alternative 1, but it introduces additional construction for the surface and requires coordination with the ADO to alleviate risk of impacting the critical areas. This new surface is near many important areas, such as the movement area and the Precision Obstacle Free Zone (POFZ) which it abuts. Due to this level of complexity, it likely will not draw support from the ADO.

» **Alternative 4 – Eliminate Taxiway/Taxilane C and Replace Area with Development**

The fourth alternative would entirely eliminate taxiway/taxilane C, removing any runway access or TLOFA penetration as aircraft would no longer use the surface. This new area would be used for flight facility development for an aeronautical use. This alternative would entirely eliminate any of the major issues, but would also decrease the level of service provided in the area. Taxi times in the area would increase due to congestion, and flexibility for future development would be hampered.

» **Alternative 5 – Shift Fence and Ditch Outside TLOFA**

The fifth alternative shifts the TLOFA penetration itself, moving the fence and concrete ditch to the north. This alternative would not address the direct apron to runway access.

» **Alternative 6 – Shift Taxiway/Taxilane C South Minimum Distance for TLOFA Penetration Clearance**

The sixth alternative shifts taxiway/taxilane C south the minimum distance required to clear it of the TLOFA penetration. This solution does not address the direct access from apron to runway, meaning it does not meet FAA design standards. This also introduces a construction cost for a relatively small change to the airfield, which may be inefficient.

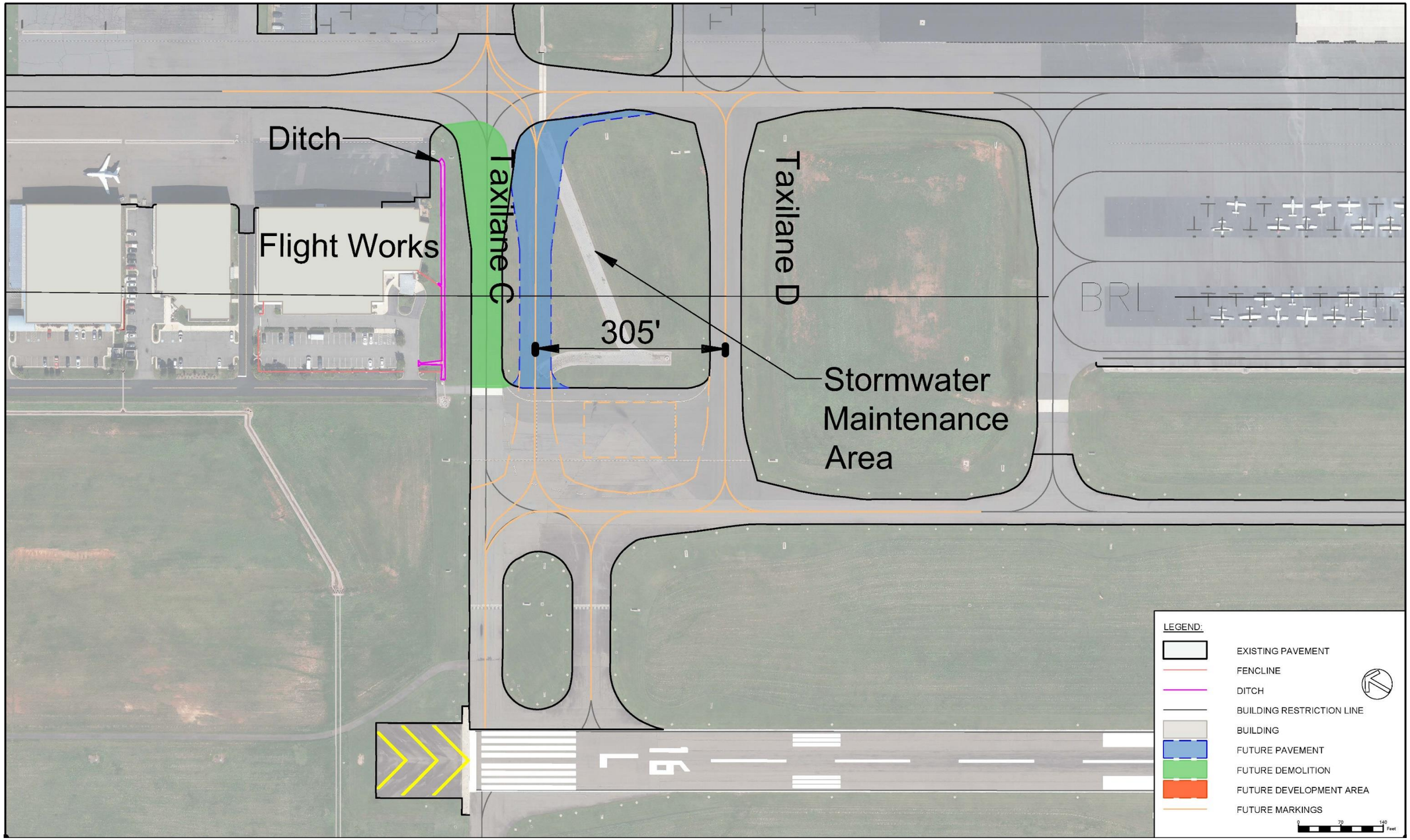
» **Alternative 7 – Redirect Taxiway/Taxilane C South and Shift Taxilane D South with Runup Area**

The seventh alternative introduces a curve on taxilane/taxiway C after it's initial path, as to avoid the TLOFA penetration and to eliminate the direct apron access to the runway. To prevent the runup area from being eliminated as well, it's current size is preserved as it is shifted to the south, and taxiway D is also shifted south the same amount. This solution is more expensive than most others due to taxiway D being shifted as well, and the somewhat abrupt curve may cause operational hiccups or loss of situational awareness for pilots used to the previous configuration.

» **Alternative 8 – Shift Taxiway/Taxilane C and TXL D South with Runup Area**

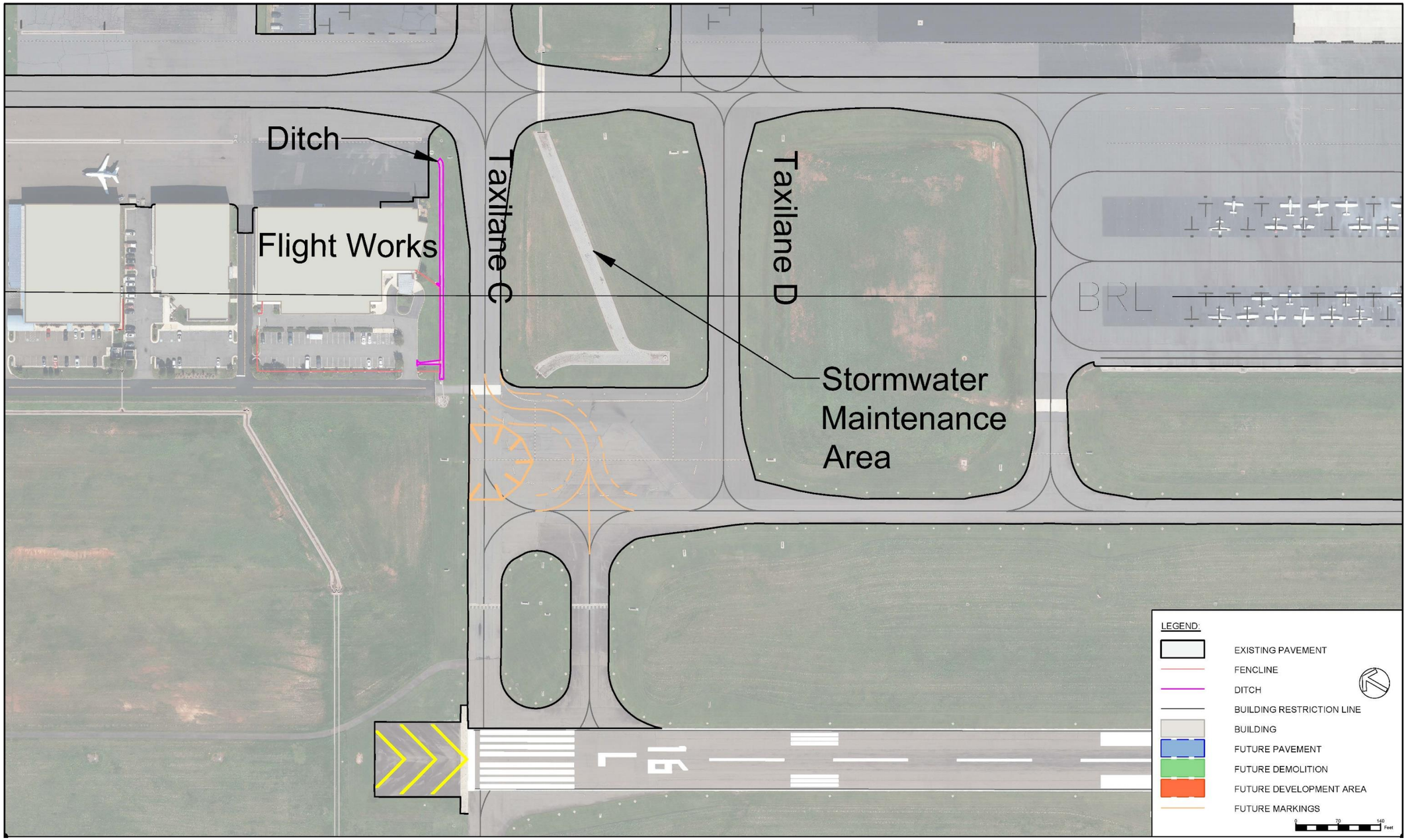
The eight alternative shifts taxiway/taxilane C, the existing runup area, and taxilane D to the south as to avoid the direct access to the runway from the apron, and to eliminate the TLOFA penetration. This will likely be the most expensive of the alternatives, as the entirety of the taxiway/taxilanes will be moved, needing extensive construction.

FIGURE 3-19
ALTERNATIVE 1 – SHIFT TAXIWAY/TAXILANE SOUTH W/ NO RUNUP AREA



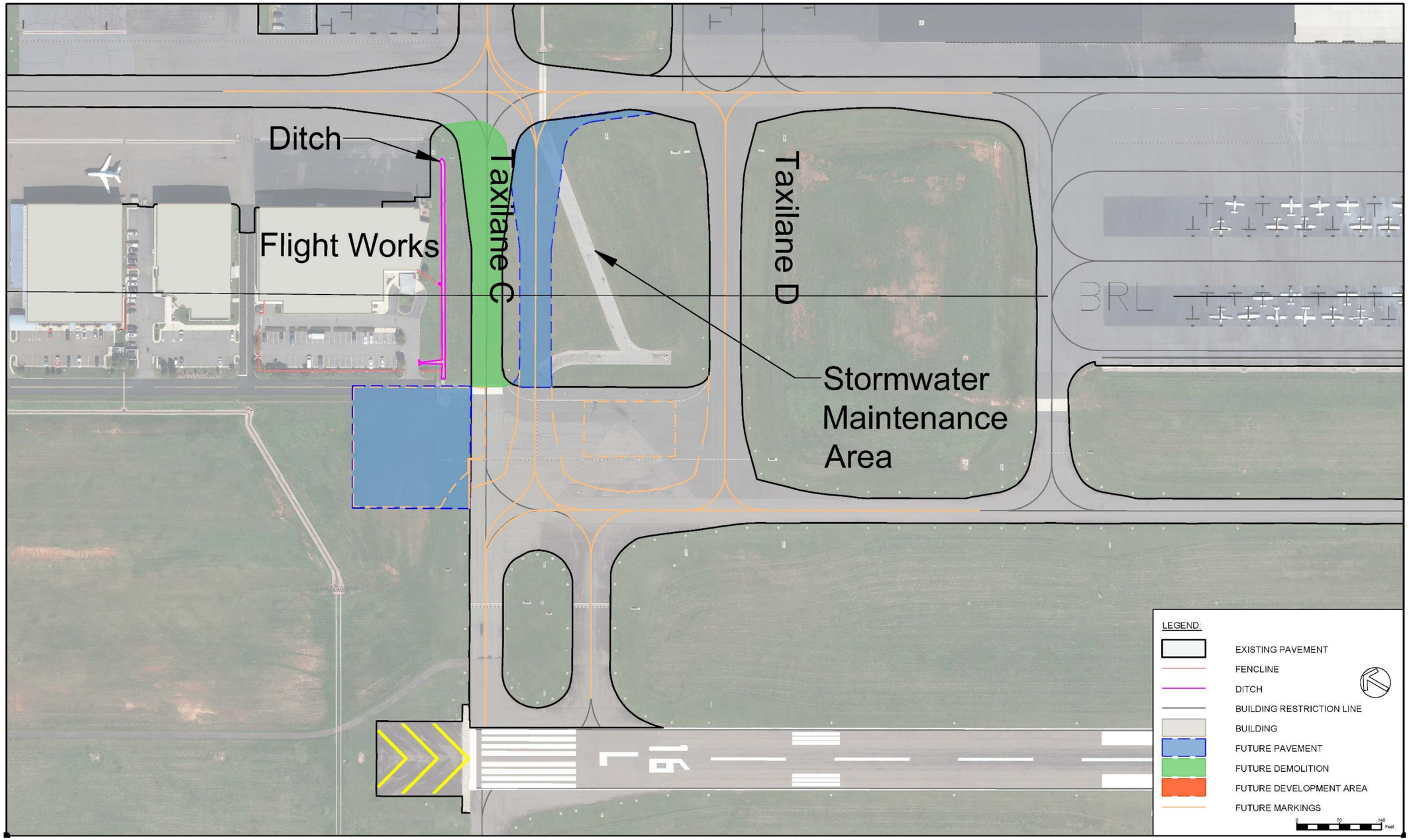
Source: RS&H Analysis, 2023

FIGURE 3-20
ALTERNATIVE 2 – SHIFT FENCE AND NO TAXI ISLAND W/ NO RUNUP AREA



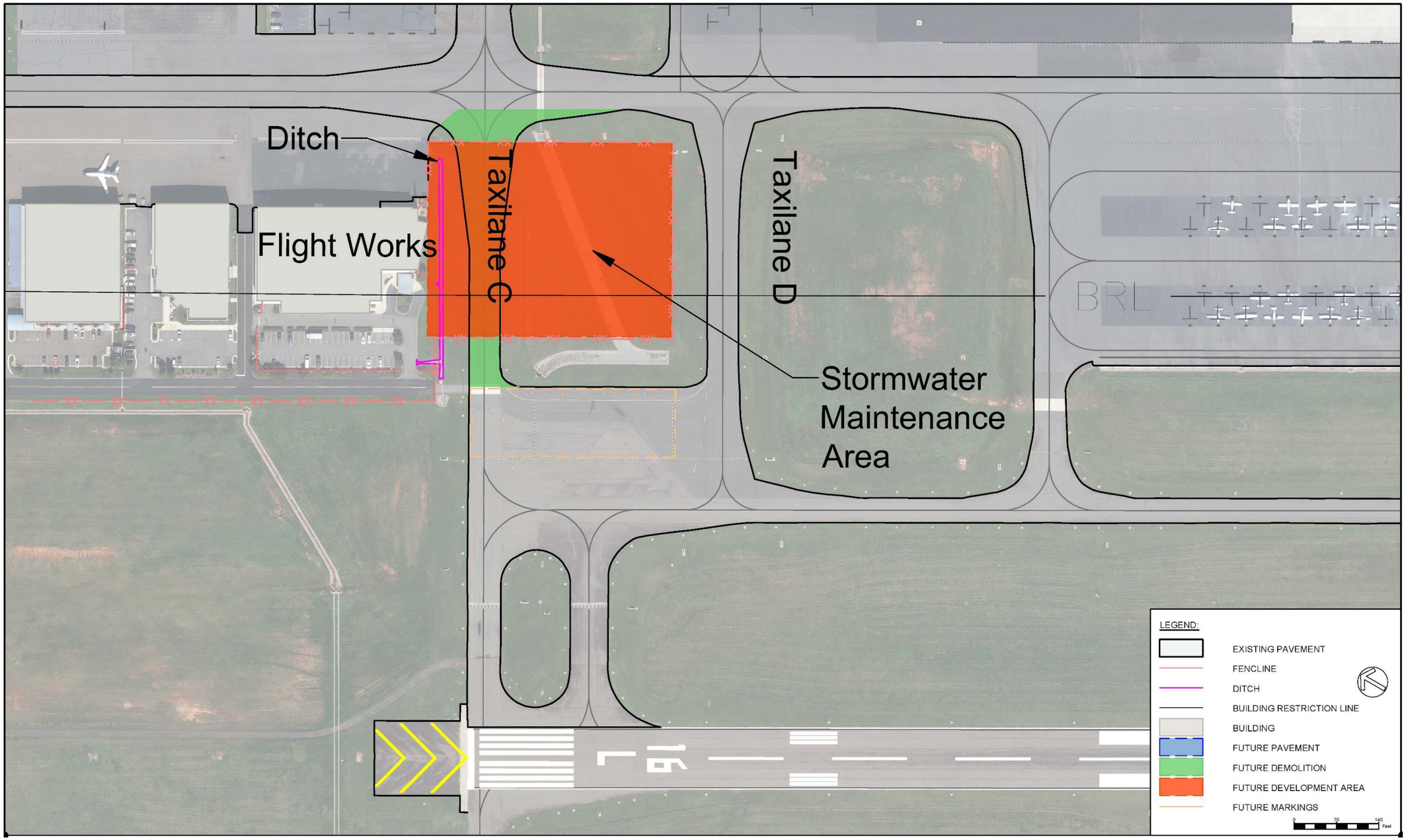
Source: RS&H Analysis, 2023

FIGURE 3-21
ALTERNATIVE 3 – SHIFT TAXIWAY/TAXILANE SOUTH W/ RUNUP AREA



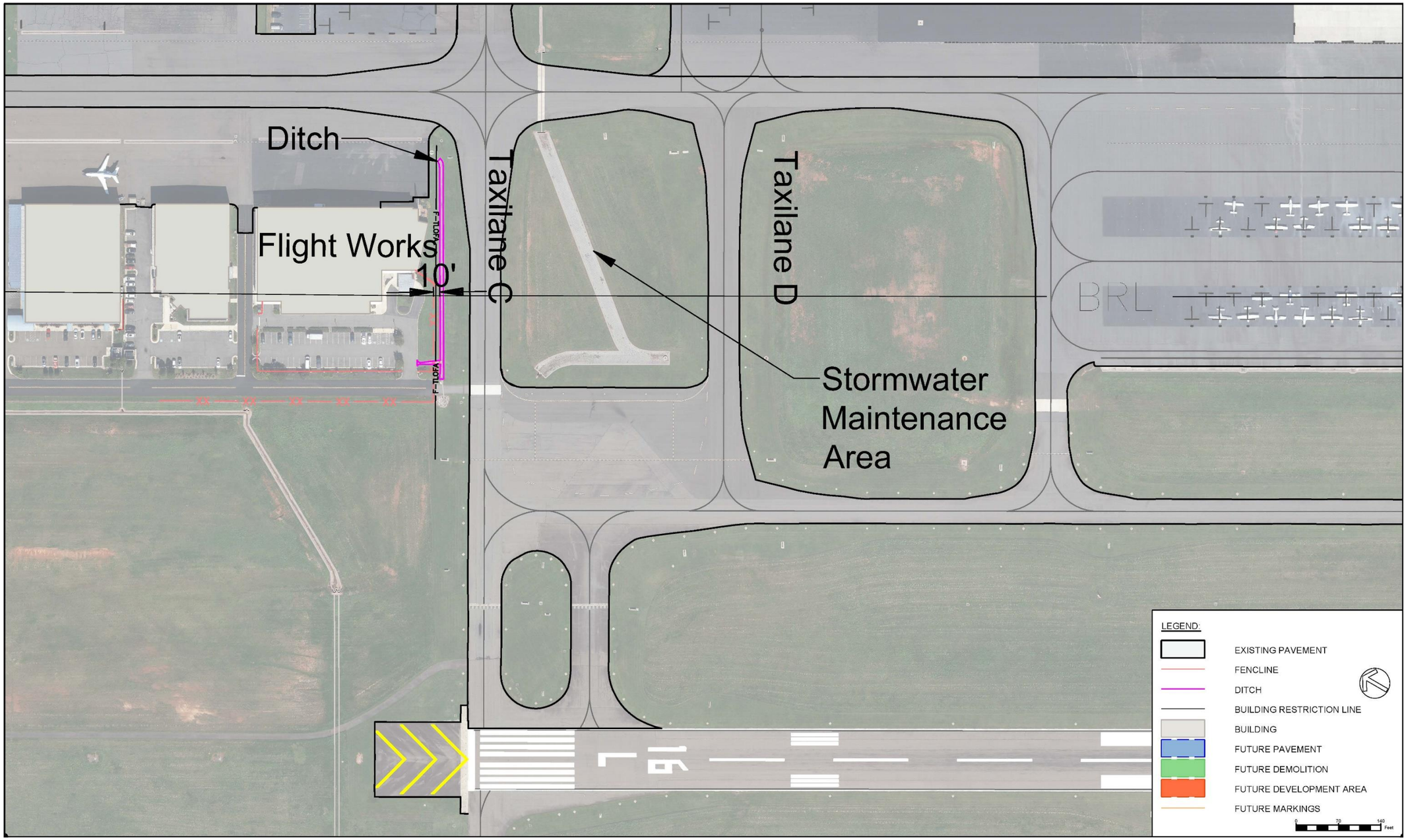
Source: RS&H Analysis, 2023

FIGURE 3-22
ALTERNATIVE 4 – DEMO TAXIWAY/TAXILANE & REPLACE WITH DEVELOPMENT



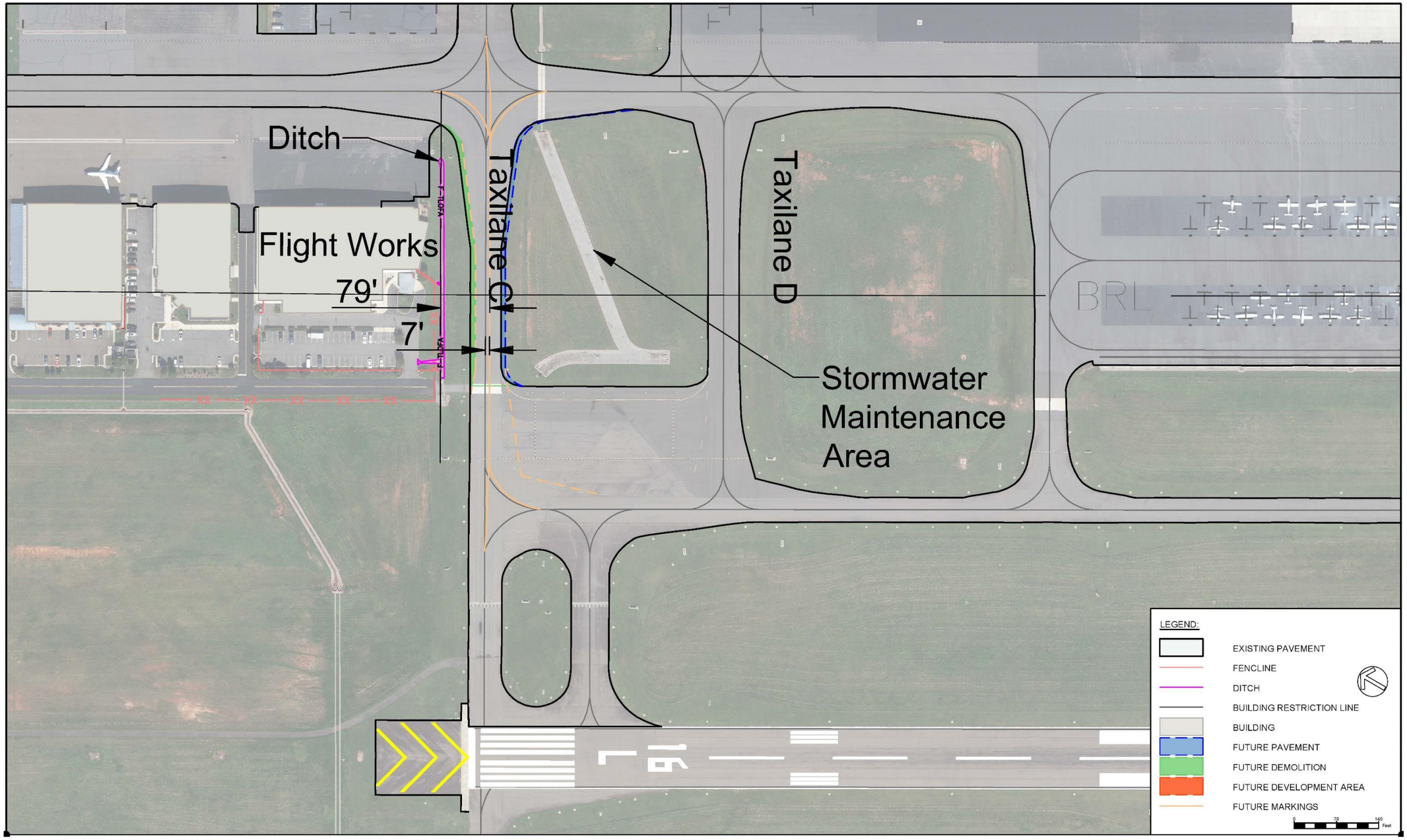
Source: RS&H Analysis, 2023

FIGURE 3-23
ALTERNATIVE 5 – SHIFT FENCE AND DITCH REMEDIATION



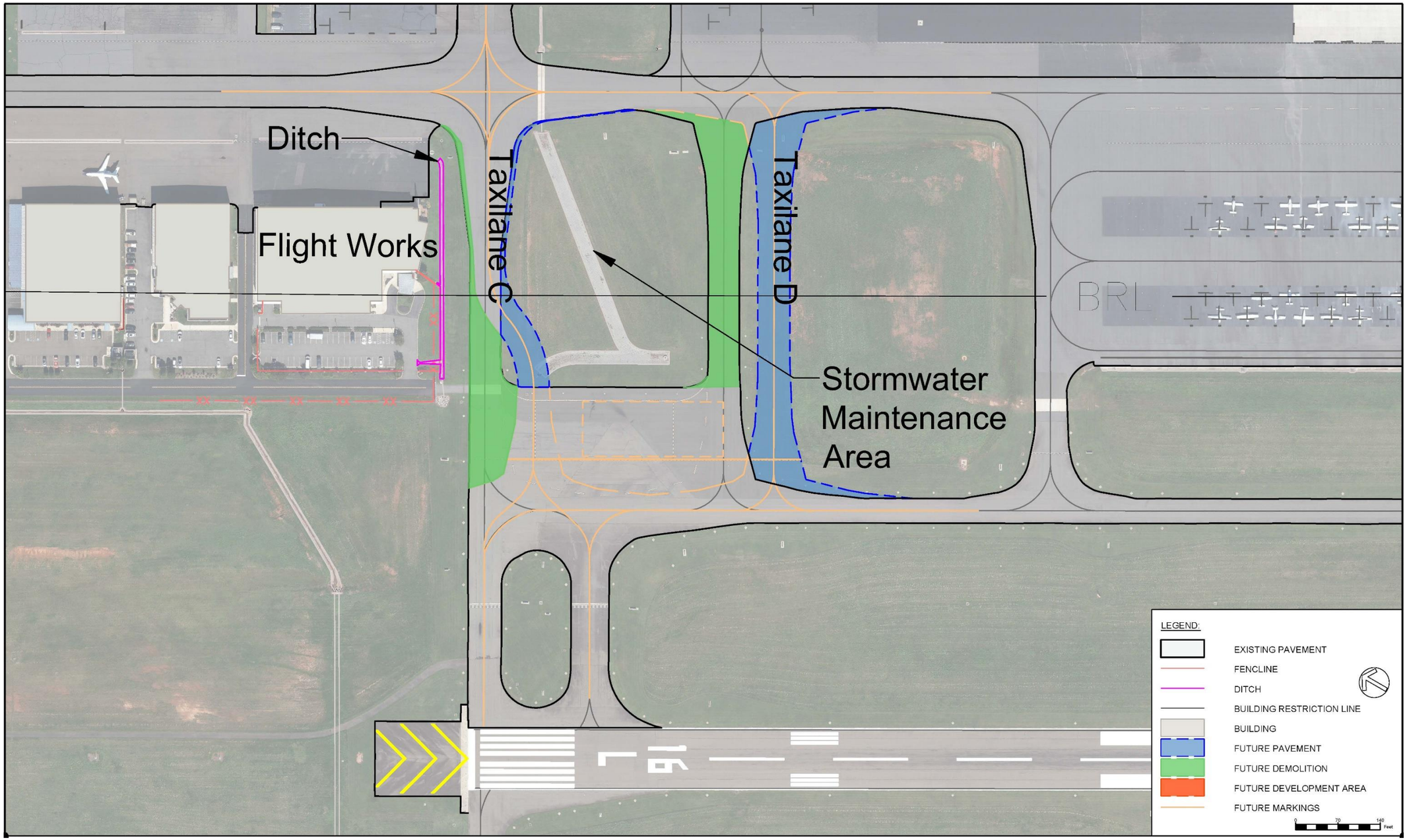
Source: RS&H Analysis, 2023

FIGURE 3-24
ALTERNATIVE 6 – SLIGHTLY SHIFT TAXIWAY/TAXILANE SOUTH



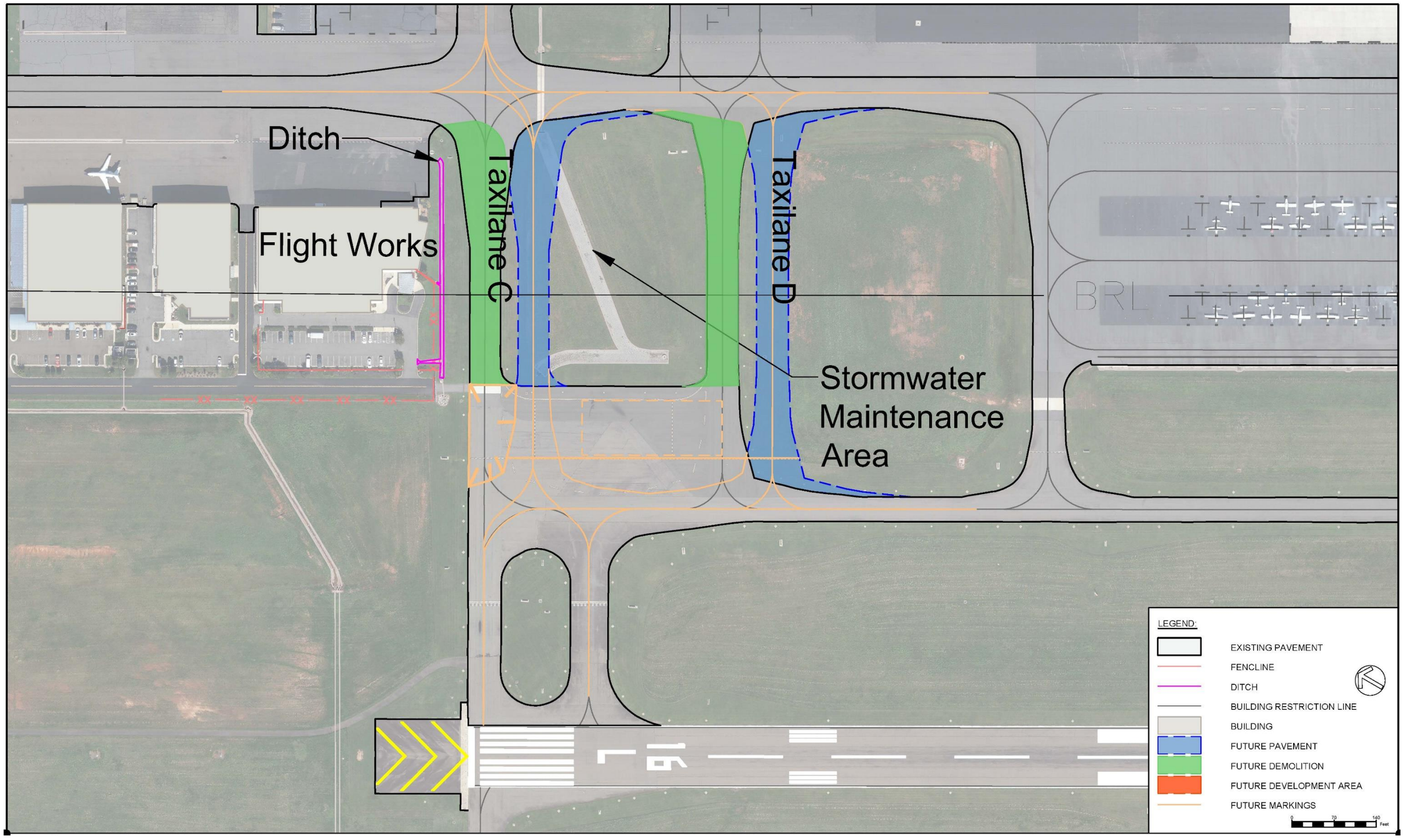
Source: RS&H Analysis, 2023

FIGURE 3-25
ALTERNATIVE 7 – SHIFT TXL C SOUTH OUT OF TLOFA AND TAXILANE D SOUTH WITH RUNUP AREA



Source: RS&H Analysis, 2023

FIGURE 3-26
ALTERNATIVE 8 – SHIFT TAXILANE C SOUTH AND SHIFT TAXILANE D SOUTH WITH RUNUP AREA



Source: RS&H Analysis, 2023

TABLE 3-2
TAXIWAY/TAXILANE C & DIRECT RUNWAY ACCESS ALTERNATIVES EVALUATION MATRIX

Evaluation Criteria	Taxiway/Taxilane C & Direct RWY Access Alternatives								
	Existing (No Action)	Alt. 1 (Shift TWY/TXL South w/ no runup area)	Alt. 2 (Shift Fence and No Taxi Island w/ no runup area)	Alt. 3 (Shift TWY/TXL South w/ runup area)	Alt. 4 (Demo TWY/TXL & replace with development)	Alt. 5 (Shift Fence and ditch remediation)	Alt. 6 (Slightly Shift TWY/TXL South)	Alt. 7 (Shift TXL C South out of TLOFA and TXL D with runup area)	Alt. 8 (Shift TXL C South and shift TXL D South with runup area)
Safety									
Operational Efficiency									
Meets FAA Design Standards									
Effectively Serves Target User									
Resolves Current Issues									
Meets Long-Term Facility Needs									
Appropriate Level of Service									
Ease of Implementation									
Cost to Implement									
Flexible/Future Expansion									
EONS Impact									

Performance Legend

Good

Fair

Poor

Source: RS&H Analysis, 2023

3.4.2.2 Taxiway/Taxilane C Alternatives Summary

After careful consideration of safety, efficiency, cost, and feasibility for the Airport's current and future development, the preferred alternative selected was Alternative 8. This alternative was found to effectively serve target users on the east side by still providing a hold bay on the approach end of Runway 16L while eliminating the non-standard issues presented in the area. This alternative also allows for use of the island between Taxilane D and the tie-down apron as noted later in this chapter.

3.4.3 HS-1 (Hotspot Intersection)

The FAA defines hot spots as a location on an airport movement area with a history of potential risk of a collision or runway incursion. The Airport has one hotspot, HS 1, located at the intersection of Runway 16L-34R, Taxiway K, and Taxiway B3. This intersection meets the definition of a hot spot due to pilots' ability to locate Taxiway B3 being reduced as a result of the crown of Runway 16L-34R. To better delineate the hotspot area the Airport has installed elevated signage and ATC routinely provides notice to pilots operating on associated intersections.

A line-of-sight analysis was completed at the Taxiway K, Runway 16L-34R, and Taxiway B3 intersection. While FAA AC 150/5300-13B does not provide specific guidance on line-of-sight at taxiway/runway intersections, it is reasonable to use some of the guidance on runway line-of-sight for this scenario. Section 3.8.1.1 states, "for runways…., ensure any point five (5) feet (1.5 m) above the runway centerline is mutually visible with any other point five (5) feet (1.5 m) above the runway centerline." Five (5) feet is considered to be the typical eye height of the pilot above the ground.

Using this eye height, a line is drawn from either end of the runway safety area (RSA). The line does not intersect the ground and clears any existing ground by just over two feet, meaning that a pilot at the Taxiway K runway hold line should be able to see a pilot on the opposite side of the runway at the Taxiway B3 hold line. The same analysis was completed using an eye height of 3.5 feet. This is the typical eye height used by the Federal Highway Administration (FHWA) in similar analyses. This line-of-sight analysis also does not intersect the ground, but only clears it by 0.55 feet. This also means that the lowest eye height that still clears the terrain is 2.95 feet. Any aircraft or vehicle with a pilot/driver eye height of less than 2.95 feet will not be able to see a vehicle/aircraft of the same eye height holding at Taxiway B3.

Additionally, due to the orientation of the intersection, a pilot holding on Taxiway K which is roughly perpendicular to Runway 16L-34R may have trouble seeing aircraft holding on Taxiway B3 as it is 39 degrees to the right of the Taxiway K centerline.

This analysis accounts for terrain and does not account for any other objects that could be obstacles to pilot's vision. As the intersection meets line-of-sight requirements outlined for a runway in the advisory circular, no changes to the pavement elevations or orientation will be depicted in the preferred development alternative. A comprehensive study of the hotspot is recommended for the Airport.

3.5 AVIATION SUPPORT FACILITIES

The configuration of airport support facilities is dependent upon the airfield layout and available land for airport development. After these considerations have been made, these facilities must be able to meet current and forecasted demand of Airport users. Most of the existing GA and Airport support (or Support) facilities are expected to meet the Airport's demand over the short-term (estimated at five years). However, at some point during the Master Plan 20-year horizon many are anticipated to need expansion, reconfiguration, and/or updates.

Airport support facility requirements demonstrated the current space allocated for ARFF equipment, airfield maintenance/snow removal equipment (SRE) facility, and administrative spaces are generally inadequate, but some inadequacies are present with the need for update in the near future.

As mentioned in **Section 3.2, Existing Land Use and Future Land Use,** the existing land use on the airport promotes that large, jet/turbine aircraft use the east side of the airfield and small, single-engine aircraft use the west side of the airfield. This is primarily due to existing facility location on the airfield; the two FBOs, the terminal, and the corporate hangars are primarily on the east side, while the lion share of small, single-engine operations are on the west side.

This section will focus its evaluation on these key support facilities:

- Transient Parking Apron
- Aircraft Hangars
- ARFF/Safety Center
- Electric Aircraft Charging
- Airfield Maintenance/ Snow Removal Equipment (SRE) Facility

3.5.1 Transient Parking Apron

All of the land available for aeronautical development without significant environmental impact at Manassas Regional Airport is currently under lease with a tenant, with the exception of two facilities on the west side, previously leased by Dulles Aviation. However, there are areas of land with access to the airfield that are currently developed, and the oldest areas of the airport contain buildings that are nearing, or exceeding, their useful lives. The East Apron contains many older T-hangars and tie-downs which present opportunities for redevelopment under current and forecast market conditions. The West Apron contains the old Dulles Aviation facilities which are scheduled for demolition, old GA hangars, an air traffic control tower which has exceeded its useful life, and Observation Road which allow opportunities for development with the proposed realignment design in consideration. Previously in this chapter, **Figure 3-4** revealed general areas of the airport considered as either aeronautical use, non-aeronautical use, and both aeronautical and non-aeronautical uses .Only a few areas present opportunities during the planning period for development or redevelopment of aircraft hangars and transient apron space without being restricted by environmental factors.

Table 3-3 shows calculation of the transient apron requirement provided within the Inventory and Facility Requirements chapter.

TABLE 3-3
TRANSIENT APRON REQUIREMENT

Transient Apron	Existing	Planning Activity Level 3
Transient Apron Requirement	340,000	370,400
Surplus / (Deficit)		(30,400)

Source: RS&H Analysis, 2023

The facility requirements indicate that the transient apron space will not meet the demand of the Airport's general aviation community and visitors during the planning period. Analysis of the transient apron showed a deficiency of 30,400 square feet by the end of the planning period. Non-inclusive of the No Action alternative, three alternative sites were generated in order to address the deficiency of transient apron space. Each alternative gave a distinctive viewpoint to solving the transient apron deficiency.

- **No Action**

  In order to accommodate additional transient aircraft activity, particularly by corporate aircraft, an additional transient parking apron is needed. No action to support future aircraft activity can result in a diminished level of service and will not effectively serve users of the Airport. A cascading effect of no action may result in transient aircraft deferring to a nearby airport rather than HEF since HEF will lack the facilities to support transient aircraft, thus impacting airport revenue.

- **Alternative 1 – East Apron: Between Taxilane D and Taxilane E**

  The first alternative took into account the preferred realignment of Taxilane C and Taxilane D to resolve the issue of the direct access to the runway and TLOFA intrusion as noted in **Section 3.3.2**. This alternative takes advantage of the island between Taxilane D and Taxilane E and converts the unused space to transient aircraft parking. The alternative is located at an ideal location near the vicinity of the primary transient parking apron identified in the AFD, close proximity to APP Jet Center FBO, and a perimeter gate for ease of access on and off the airfield.

- **Alternative 2 – West Apron: North Site**

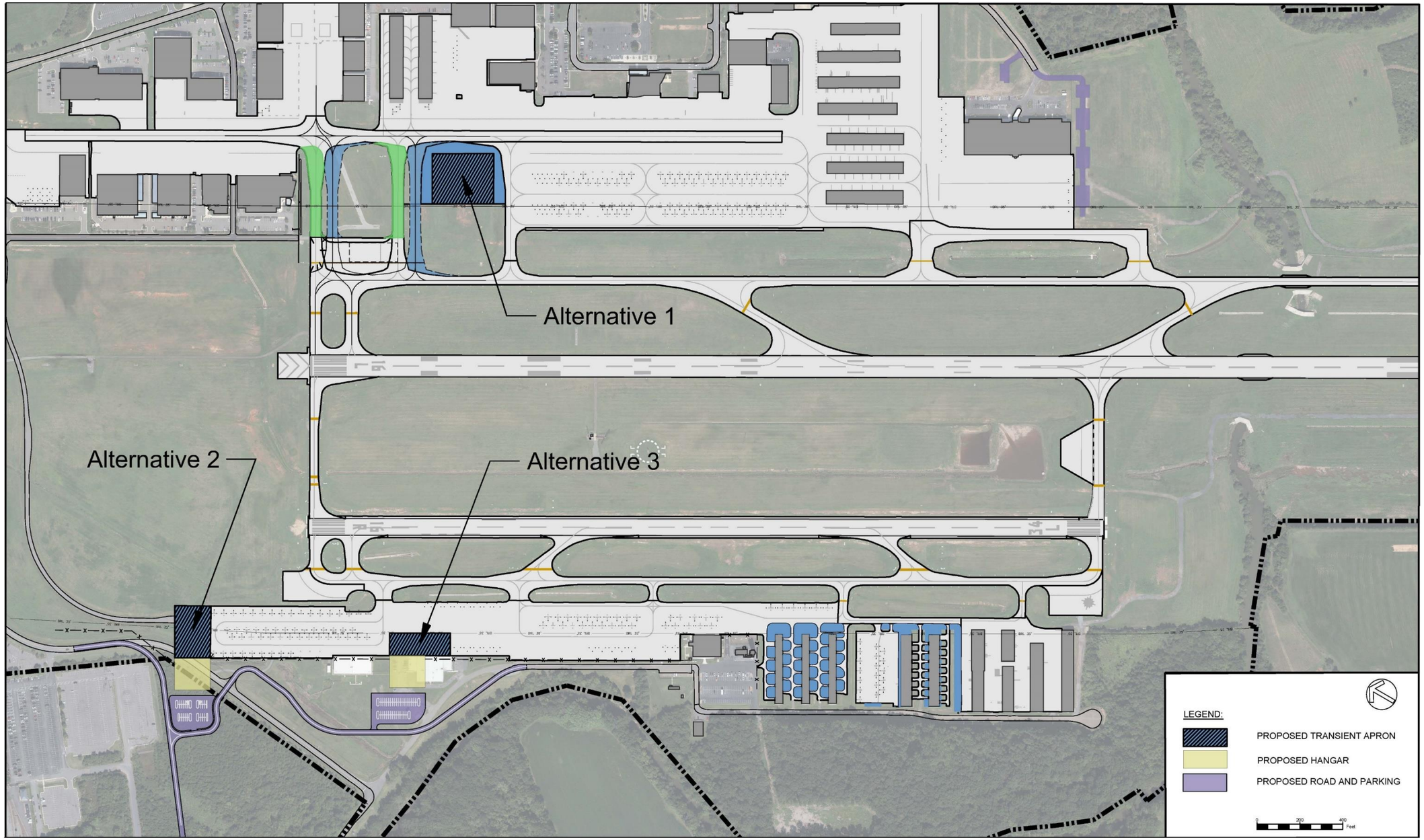
  The second alternative assumes the West Apron is expanded north to meet the planning period deficiency. The alternative could occur with the standalone apron expansion or coincide with the development of new FBO space or satellite space on the West Apron to provide the requested pilot amenities missing on the west side. The latter option could require further realignment of Observation Road to provide space for a vertical facility and a parking lot.

- **Alternative 3 – West Apron: Central Site**

  The final alternative assumes transient apron parking on the West Apron would be located in front of the previous Dulles Aviation facility. Similar to Alternative 2, this alternative can be a standalone

option, or it can coincide with development of new FBO space which provides needed pilot amenities. The latter option would not require further realignment of Observation Road as the proposed alignment of the road routes around the existing Dulles Aviation facilities and a proposed vertical facility.

FIGURE 3-27
TRANSIENT APRON PARKING ALTERNATIVES



Source: RS&H Analysis, 2023

An evaluation of the three transient parking apron alternatives and the existing (No Action) condition is provided below and show in **Table 3-4**.

- **Safety:** Safety to aviation operations falls to fair for the Alternative 1 due to its location between two Taxilanes. The latter alternatives were deemed safe as the transient parking apron were located on the perimeter or adjacent to taxiing aircraft and bears the same risk as the existing transient parking aprons.

- **Operational Efficiency:** Majority of transient aircraft activity stage their aircraft on the East Apron due to its proximity to the two FBOs, terminal, and rental car facility. Ideally, the preferred site will provide similar access to amenities and services regularly used by transient customers.

- **Meets FAA Design Standards:** All alternatives will meet FAA Design Standards.

- **Effectively Serves Target User:** The target users are transient aircraft, in which HEF's case are currently and projected to continue be business jets. The greater part of business jet operation occur on the east airfield and the East Apron; therefore, the most effective site for a transient aircraft parking apron would be on the east side.

- **Resolves Current Issues:** Each alternative will expand or modify the airfield to resolve the deficient transient parking apron need during the planning period.

- **Meets Long-Term Facility Needs:** Alternative 1 exceeds the area needed during the planning period and provides additional support for transient traffic should the Airport and the flying public need it. The latter alternatives limits the transient parking to balance the deficiency in the planning period.

- **Appropriate Level of Service**: No action diminishes the level of service the Airport intends to provide to the flying public due to the limitation in parking options. While each alternative should provide the appropriate level of parking needed, taxi time to each alternative site was factored into this assessment. Transient aircraft operators would prefer a short taxi time to park their aircraft. The two alternatives located centrally on the East and West Apron were graded fair while the alternative on the north end of the West Apron (longer taxi time) was graded as poor.

- **Ease of Implementation:** Construction to resolve the non-standard issues on Taxilane C provides an opportunity for the addition of Alternative 1. Alternative 2 would require additional alignment of Observation Road and FBO facilities to support the transient parking apron.

- **Cost of Implementation:** Implementation costs for any parking apron extension is manageable when funded through available federal, state, and local financially supportive agencies. There will likely be an economies of scale when including Alternative 1 into realignment of Taxilane C and Taxilane D construction scope.

- **Flexible for Future Expansion:** Siting of an FBO facility at Alternatives 2 and 3 provides less flexibility for development in the case the Airport decides to develop new hangar facilities in the area. Alternative 1 simply transforms the grass between taxilanes to parking pavement which can be more easily repurposed if needed.

- **EONS Impact:** Impacts to EONS categories vary by each alternative. Alternatives 1, 2, and 3 were rated fair as each action would have similar environmental and socioeconomic impacts. An FBO sited at Alternative 3 would require demolition of the vacant Dulles Aviation facility and potentially harmful substance remediation prior to construction.

TABLE 3-4
TRANSIENT APRON ALTERNATIVES EVALUATION MATRIX

Evaluation Criteria	Transient Apron Alternatives			
	Existing (No Action)	Alt. 1 (East Apron: Between TXL D and TXL E)	Alt. 2 (West Apron: North Site)	Alt. 3 (West Apron: Central Site)
Safety				
Operational Efficiency				
Meets FAA Design Standards				
Effectively Serves Target User				
Resolves Current Issues				
Meets Long-Term Facility Needs				
Appropriate Level of Service				
Ease of Implementation				
Cost to Implement				
Flexible/Future Expansion				
EONS Impact				

Performance Legend

Good
Fair
Poor

Source: RS&H Analysis, 2023

3.5.2 ARFF Facility

Manassas Regional Airport is not certified as a 14 CFR Part 139 compliant airport and therefore is not required to have ARFF services onsite. The Airport does receive and is capable of receiving large aircraft which include the 30-seat Jetstream 41, 19-seat Gulfstream V, and 58-seat Q-400, and C-130 military aircraft. Currently the City of Manassas Fire and Rescue Department (The Department) is the lead agency in charge of providing ARFF services in the event of an incident or accident anywhere on airport property. Through established agreements, the Manassas Volunteer Fire Company, the Greater Manassas Volunteer Rescue Squad, and the Prince William County Department of Fire and Rescue supplements the Department's response to an emergency if needed.

The Department's primary response station, Station 21, is 2.9 miles away from the Airport's main response east gate. The Airport currently owns ARFF equipment which is located on airport property. One ARFF Unit, an E-One, capable of holding 3,000 gallons of water, 400 gallons of foam, and 460 pounds of Halotron. This unit is located in T-hangar C-3 on East Apron. The second ARFF apparatus is a quick response unit, a Ford F-550. With existing resources, it is reasonable to expect a total response time of seven minutes from the time of notification. The 2017 ARFF Feasibility Study determined with existing agreements and apparatus equipment on-site, the Airport's emergency personnel would not be able to respond to an accident within the desired time of 2-3 minutes. The Airport intends to meet the Index B requirements and response times from the proposed location.

The Airport has expressed interest in the proposed ARFF facility being a multi-use facility. The siting options take into consideration a standalone ARFF facility, an ARFF/Maintenance facility, ARFF/airport safety officer facility, and a safety center meeting room. Four alternative sites were generated in order to address the need for an on-site ARFF facility. Each alternative attempted to enhance response times by siting the proposed facility on the perimeter of the airfield or near a perimeter gate. The No Action option and the four alternatives generated are listed below with associated descriptions:

- **No Action**

  While not a requirement, having on-site ARFF service provides a safer airport for the flying community. The current agreements and emergency personnel responding to an accident at the Airport would not meet the desired emergency response time for an Index B airport. Therefore, no action by the Airport does not align with its strategic vision.

- **Alternative 1 – East Apron: Corner of Wakeman Drive and Observation Road**

  This alternative places the proposed ARFF facility in the northeast corner of airport property. The location sited between two corporate hangars and the corner of Wakeman Drive and Observation Road provides an opportunity for rapid response to an accident on the airfield or an incident off the airfield. While the location is a corporate pad site, the size and location of the parcel limits the extent of hangar development should a developer require a hangar over 15,000 square feet.

» **Alternative 2 – East Apron: West of Flightworks**

The second alternative positions the proposed ARFF facility just off the pavement of Taxiway B and Taxilane C at the end of James Payne Court and west of Flightworks. The proposed location is just out of the 16L Approach RPZ. Due to its proximity to Runway 16L-34R the design of the proposed ARFF facility will have significant height limitations which will need to be taken into consideration when positioning apparatus hold bay doors. Alternative Site 2 site would provide the quickest response to airfield accidents as it sits just off the north end of Taxiway B.

» **Alternative 3 – East Airfield: South of Flightworks**

The third alternative sits just south of Flightworks and north of Taxilane C. Given its location this site would provide a quick response time an airfield accident comparable to Alternative 2. This alternative is dependent on Taxilane C shifting south as assessed in Section 3.3.2 as the existing location would protrude into the TLOFA for Taxilane C. Since the preferred alternative for Taxilane C entails shifting the pavement, this alternative is a viable option for consideration.

» **Alternative 4 – West Apron: South End of Apron**

The final alternative is the only alternative which places the proposed ARFF facility on the west airfield. The proposed site sits towards the south end of the West Apron on pavement which currently holds unused tiedowns. This location should allow emergency response to meet the desired response time for accidents on the airfield; however, a majority of traffic uses the east side of the airport so the responding unit may have difficulty with traveling across both runways. This location may not be as effective as other alternatives when responding to off-airfield accidents due to its position on the West Apron. Future expansion may also be limited if T-hangars are constructed in the vicinity.

TABLE 3-5
ARFF FACILITY EVALUATION MATRIX

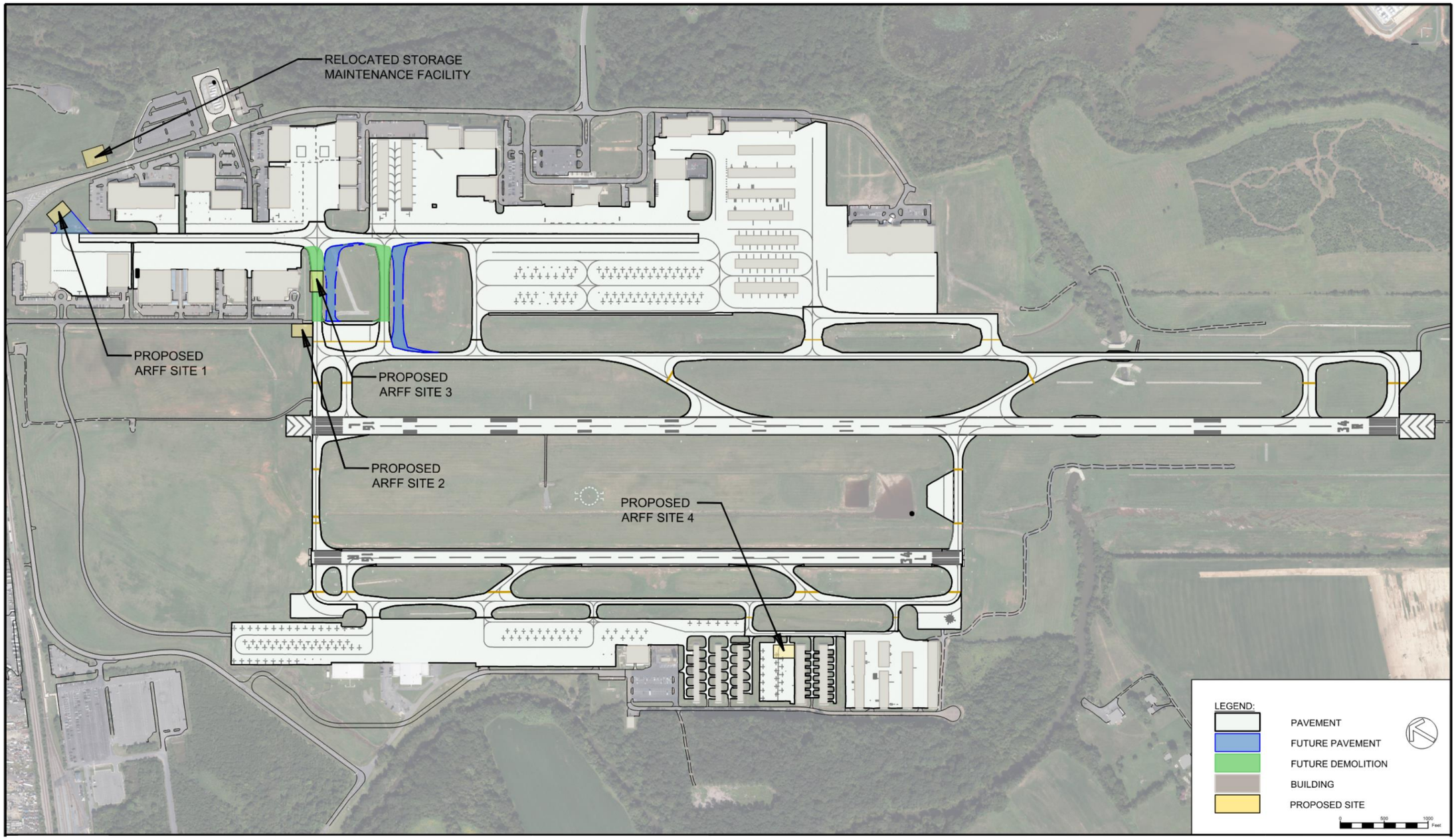
Evaluation Criteria	ARFF Alternatives				
	Existing (No Action)	Alt. 1 (Wakeman Dr. and Observation Rd.)	Alt. 2 (West of Flightworks)	Alt. 3 (South of Flightworks)	Alt. 4 (South end of West Apron – between T-hangars)
Safety	Fair	Poor	Good	Good	Good
Operational Efficiency	Fair	Poor	Good	Good	Fair
Meets FAA Design Standards	Good	Good	Good	Good	Good
Effectively Serves Target User	Poor	Good	Good	Good	Fair
Resolves Current Issues	Poor	Good	Good	Good	Good
Meets Long-Term Facility Needs	Poor	Good	Good	Good	Fair
Appropriate Level of Service	Poor	Good	Good	Fair	Fair
Ease of Implementation	Good	Good	Fair	Fair	Fair
Cost to Implement	Good	Fair	Good	Good	Fair
Flexible/Future Expansion	Good	Good	Fair	Fair	Fair
EONS Impact	Good	Good	Good	Good	Good

Performance Legend

Good
Fair
Poor

Source: RS&H Analysis, 2023

FIGURE 3-28
ARFF ALTERNATIVES / PREFERRED MES SITE



Source: RS&H Analysis, 2023

3.5.3 Airfield Maintenance Equipment Storage (MES) / Snow Removal Equipment (SRE) Facility

There is one facility used for Airport maintenance equipment storage (MES) and repairs. The Airport's maintenance and equipment storage facility was constructed in 2006 and is approximately 8,000 square feet. The MES facility is located on the East apron just south of the passenger terminal. The MES is a two-level facility with an office, restrooms, and equipment on the lower level while additional storage is located on the upper level. The Airport intends to purchase new snow removal equipment (SRE) to efficiently combat the adverse conditions seen at the Airport during the snow season. The building is in good condition. However, as SRE equipment sizes continue to trend larger, the layout and orientation of the building create challenges to accommodate future needs. These challenges include providing adequate storage space and equipment maneuverability in the building. As well as pavement away from the movement area for snow and ice training and pavement marking training, a cost-effective consideration for the Airport and its maintenance staff. A parcel of land in the northeast corner of the airport property has been identified as the preferred site for future Airport maintenance facilities. This site allows efficient access to the airfield to respond to maintenance issues or snow and ice operations while allowing the opportunity to expand a maintenance facility to support future growth. **Figure 3-28** depicts the preferred site for the maintenance equipment storage facility.

- **No Action**

  With current site of the MES facility the maintenance operations have no room for growth and introduction of new multi-function SRE, which are larger and longer than single function pieces of equipment, would be difficult to contain with the facility. The existing facility is not configured to accommodate pull through bays using drive-through design building configuration.

- **Northeast pad site**

  The airport needs a larger MES/SRE facility that has room to safely park and maneuver existing and future multi-function snow removal equipment, pickup trucks, mowers, and other maintenance vehicles. The site is ideal to accommodate potential future expansion needs ranging from warehouse space, loading dock capabilities, concrete/asphalt pad for pavement marking testing and snow operations training. A future MES/SRE facility located at this site takes advantage of this strategic location as it provides quick access to perimeter roadway surrounding the airport and maintenance staff can quickly access the airfield by nearby airfield access points.

3.5.4 Hangars

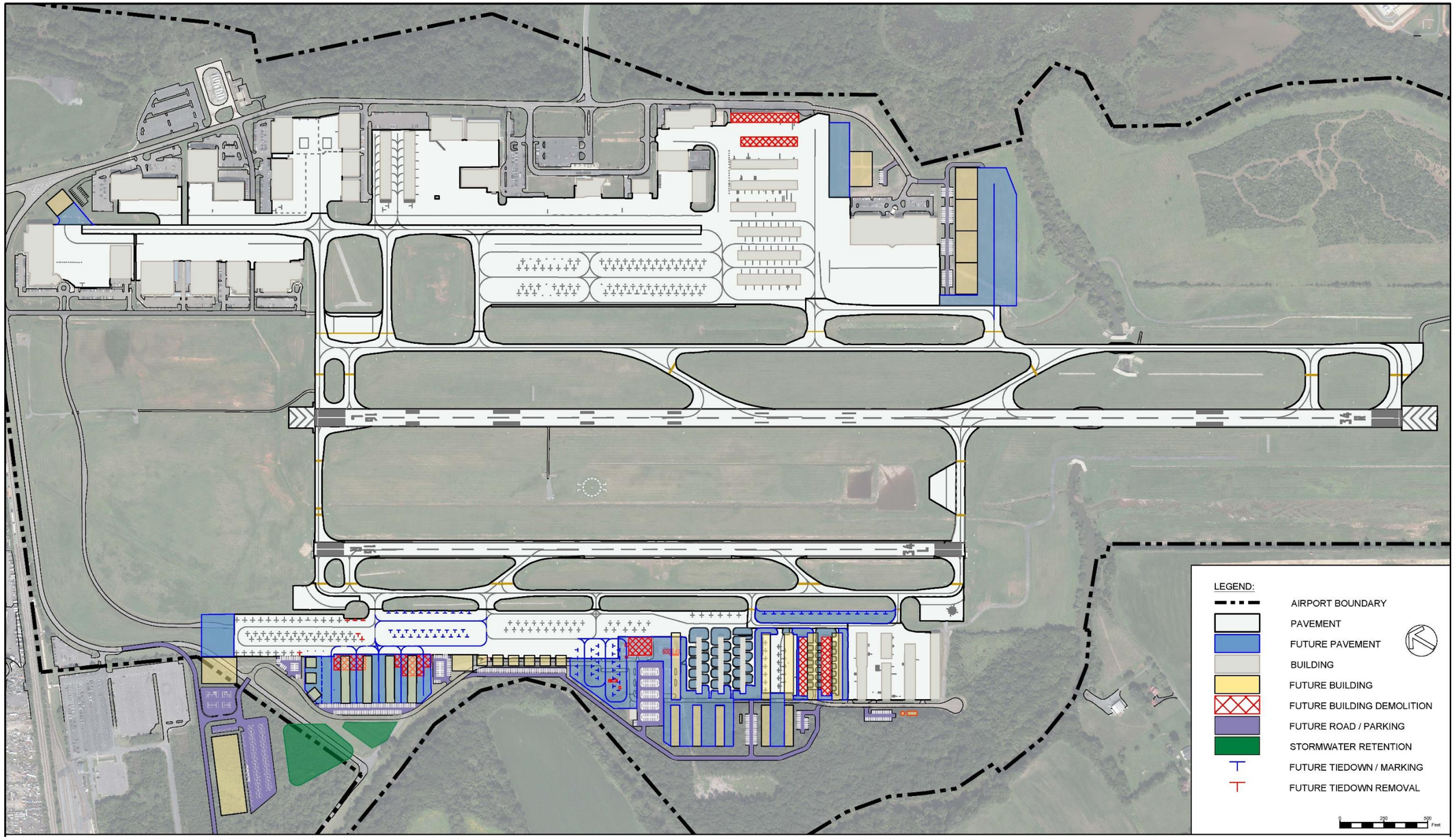
Manassas Regional Airport needs 56 additional T-hangar bays and three conventional hangars to accommodate PAL 3 forecast demand. However, given the available development areas and the Airport's vision the final breakdown of T-hangars, conventional hangars, and corporate may differ from the split noted in the previous chapter. The hangar development is ultimately triggered by demand.

Hangar designs can vary depending on developer/owner preferences, Airport minimum standards and

development requirements, and the size(s) of aircraft being stored. ACRP Report 113 describes the nested T-hangar configuration as one that is shorter and wider than the standard T-hangar. This type of configuration helps optimize the developable space and reduce the required taxilane pavements. The nested T-hangar design is common at HEF and airports across the nation. T-hangars can be standard size or customized based on hangar manufacturers. The standard T-hangar dimensions include 42 ft. on its widest side, down to 21 ft. on its shortest side, and 33 ft. deep.

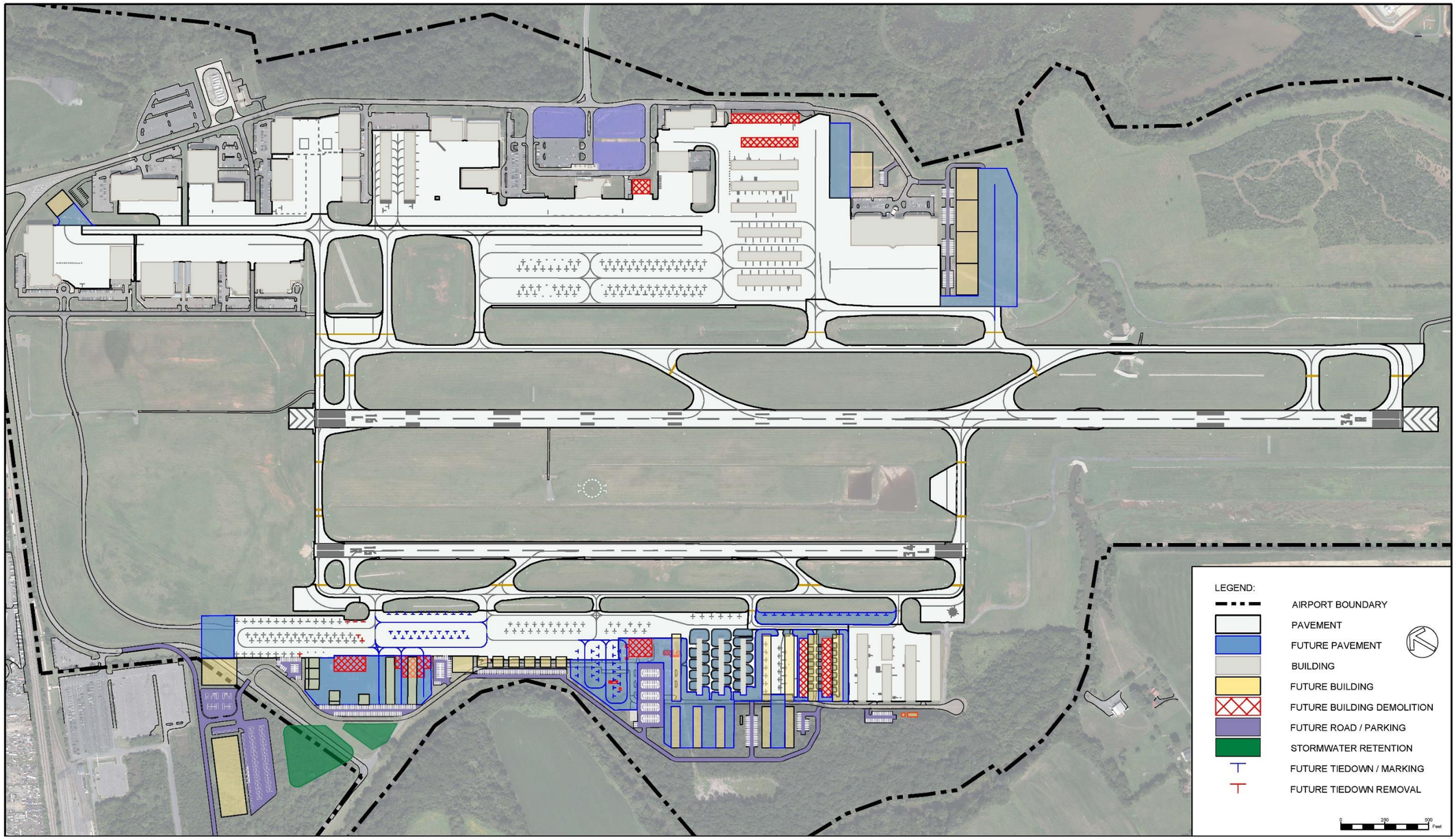
Overall, the footprints for all hangar facilities are much larger than just the building, as additional space is needed for airside and landside purposes. This includes protecting for taxilane object free areas. A building with 10 nested T-hangars would require approximately 65,000 sq. ft. of land. To be conservative and allow flexibility in hangar site design, a conventional hangar footprint would require approximately. 50,000 sq. ft. of land and a corporate hangar would require approximately 90,000 sq. ft. As a result, large amounts of continuous acreage are highly desirable for GA development. **Figure 3-29** depicts significant development on the west side which primarily support general aviation storage. **Figure 3-30** depicts additional development opportunities with a realignment of Observation Road if the Airport and the City of Manassas were to agree to adjust the road geometry again to support general aviation and corporate hangars on the west side. Both exhibits assume acquisition of property in Prince William County discussed in **Section 3.3** to support forecasted growth at the airport.

FIGURE 3-29
HANGAR DEVELOPMENT CONCEPT WITH FOCUS ON GA SUPPORT



Source: RS&H Analysis, 2023

FIGURE 3-30
HANGAR DEVELOPMENT CONCEPT WITH ADDITIONAL DEVELOPMENT OPPORTUNITY



Source: RS&H Analysis, 2023

3.5.5 Electric Aircraft Charging

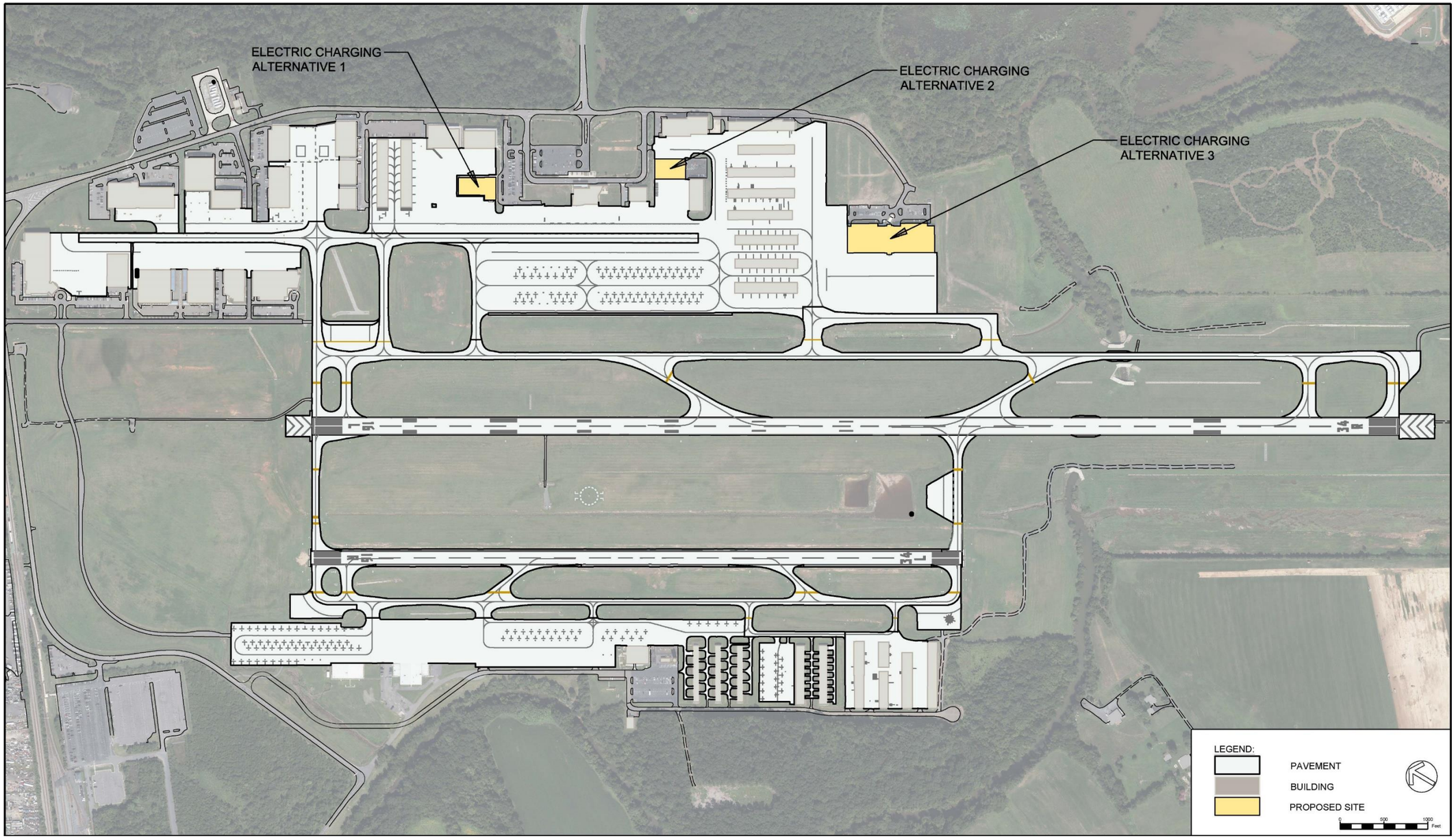
The advent of Advanced Air Mobility (AAM) and Urban Air Mobility (UAM) electric aircraft presents potential near-term need to integrate new charging facilities into airport facilities. This creates a need to understand the degree of impact as it relates to:

- Ownership models
- Impacts to airport financial policies
- Early adopters and forecast demand
- Size and location of charging infrastructure
- Demand on existing utility infrastructure (transmission lines, transformers, substations, etc.)
- Aircraft fleet, battery types, charge rates, and design (charge station versus battery swap)
- Impacts to the economy and the environment
- Impacts to airfield infrastructure

Preliminary review of HEF electrical utility infrastructure shows it to be sufficient to handle, at minimum, any potential small-scale near-term increase in electrical demand as result of aircraft charging stations.

There are two options for airports providing aircraft charging facilities. The investment can be made by the Airport or its tenants. In line with preferred Airport financial policies, the preferred HEF position is to allow FBOs or tenants to implement and provide this service on leaseholds. In this case, the most advantageous locations to service early adopters would be Chantilly Jet Center, APP Jet Center, and Electra Aero, as shown in **Figure 3-31**.

FIGURE 3-31
POTENTIAL ELECTRIC AIRCRAFT CHARGING LOCATIONS



Source: RS&H Analysis, 2023

Under the preferred airport alternative, it is prudent to understand best practices when implementing aircraft charging stations. Some of the lessons learned from electric automobiles also translate into the aviation industry. The following sections will discuss best practices and implementation strategies to consider. These best practices will focus less on specific details of implementation such as types of charging stations, and more on overarching policies to ensure a variety of charging stations can be successfully implemented.

3.5.5.1 Implementation and Best Practices

- Determine the target user at the airport and focus on customer level of service. This will help determine placement and proximity to desirable amenities by the targeted user. For example, if the charging station were placed immediately adjacent to App Jet Center and Chantilly Jet Center, the targeted user would most likely be transient aircraft. If the station were placed near Electra Aero, the targeted user would most likely be for based aircraft. Understanding what drives user behavior will help ensure investment in charging stations are maximized.

- Make charging stations highly visible to promote them and protect them. Signing and marking electric charging stations helps promote their use while also protecting them from damage. If stationary, consider physical barriers such as bollards around the stations to ensure aircraft cannot accidentally hit them. Placing stations at the edges of apron and buildings is much safer than in open spans of pavement.

- Seek out and join partnership networks to stay involved and current with electric aircraft trends. Electric aircraft and battery technology are burgeoning and remaining current with new information allows the Airport to promote the technology among those who may be early adopters such as airport tenants. Coordinating with DOAV, local economic development groups, and tenant stakeholder groups can provide avenues to technology information as well as supplemental funding opportunities.

- Review and update airport policies as electric aircraft charging gains favor to ensure the Airport remains self-sufficient and meets federal grant assurances. This will require information about charging kilowatt-hours to accurately account for the impacts on Airport revenues. It would benefit the Airport greatly to require tenants to collect and provide that information, just as fuel sales information would be provided, so as the Airport may monitor and track overall use. At some point, the Airport may need to review and amend minimum standards, lease guidelines, development review guidelines, and/or Airport rates and charges fee structure.

- Educate tenants and airport users about resources and opportunities. The EPA, peer airports, and industry leading charging station providers which are all excellent sources of information. The Airport can research and consider techniques for how to incentivize use, get ideas for implementing cost-savings measures (such as off-peak charging), and promoting airport sustainability practices. Having electric charging stations creates potential for FBOs to begin

integrating new ground electric handling equipment into the fleet as older equipment is removed from service.

When planning for electric aircraft, it's important to consider the effects on power for current airport operations, Strategic Plans, and long-term airport master plans. For the individual airport, the primary impact will stem from the increased electrical demand necessary to charge electric aircraft. The effects and necessary considerations will vary between airports of various sizes based on the type and density of traffic. During the planning process, along with the aviation facility requirements, aircraft-specific power supply requirements should be developed. Based on individual charging requirements, and assuming that future chargers will take 45 minutes for a full-charging cycle, the demand could grow to several megawatts.

Smaller all-electric general aviation aircraft can be charged in about 45 minutes with 40 to 60 kW chargers. Twenty of those aircraft charging simultaneously would have an electric demand of about 1 megawatt (MW: 800 to 1,200 kW). Small commuter aircraft demand an additional order of magnitude. An individual aircraft might need 400 to 600 kW to ensure charging times compatible with the typical aircraft turnaround time. At busy regional airports, power requirements might reach about 10 MW.

Currently, terminals consume 60 percent of the electricity at a typical airport, and airfields consume the remaining 40 percent. This balance could be significantly shifted with the emergence of electric aircraft, especially beyond the 2041 horizon.

Airport electric infrastructure is likely to be affected by the integration of electric aviation into the existing airport ecosystem. Increasing electrification across airport technology and infra-structure, coupled with the introduction of high-power fast charging for electric aircraft, could place a significant strain on the existing airport power grid. The Airport could experience one of two scenarios as it relates to integration of electric aircraft into its operations. The Airport's electrical infrastructure would be sufficient and not require an upgrade to its main electrical connection to the greater power grid. In this scenario the leaseholder would simply add the necessary airside equipment to support electric aircraft. The second scenario would result in the airport electrical infrastructure being insufficient to support the added equipment necessary to support electric aircraft operations. The following options would aid in addressing this issue:

- Smart power management at the airport to share the available capacity with other resources, which would include sharing existing power supply with other airside equipment (e.g., jet bridges) and defining prioritization rules.

- Working with energy providers to upgrade their electrical power supply.

- Developing local electric production at the airport, which could include a microgrid strategy to increase resiliency.

3.6 LANDSIDE

The landside component of the Airport and its associated road system are driven by the operation, design, and traffic of the terminal building it serves. As documented in **Chapter 2, Inventory and Facility Requirements**, the consistent growth expected at HEF will require additional landside resources to adequately serve the Airport's future needs. Development that must be considered landside will be in the terminal area, and specifically relates to the vacant quadrants in front of the terminal facility. The following section will review the terminal area improvements.

3.6.1 Terminal Area

The process of forming alternative landside concepts resulted in the creation of one alternative development option as the Airport plans for continued growth and the possibility of introducing scheduled air carrier service. This option has the ability to be refined or reorganized (as best as possible) from how development in shown in the alternative graphic. The terminal curb road has two lanes, one for loading/unloading vehicles and the other for through vehicles. The traffic in front of the terminal is in one direction in a counterclockwise movement. The terminal area lot has 119 parking spaces which includes 5 accessible parking spaces.

Currently, the parking area for the terminal is one portion of a lot divided into four sections. The other three sections in this lot are currently undeveloped. This presents a great opportunity to reserve this area for future landside parking, as the need for this area will likely arise soon. Pursuing development in any of the vacant parcels which does not involve increasing parking capacity will impact facility modifications to support expected growth. If the Airport receives scheduled air carrier service parking modifications will be needed to eliminate bottlenecking at the curb front which will occur. The parking lot will need modifications to accommodate for short-term parking, long-term parking, tenant and employee parking while considering expansion of rental ready-return and service area lots.

Expand on highest and best land use of the three vacant quadrants in terminal area. Currently, there is one parking area in the terminal area for the current terminal building. This parking lot is generally large enough for current traffic; however, the Airport will experience increased traffic, so will need the ability to expand in the near future.

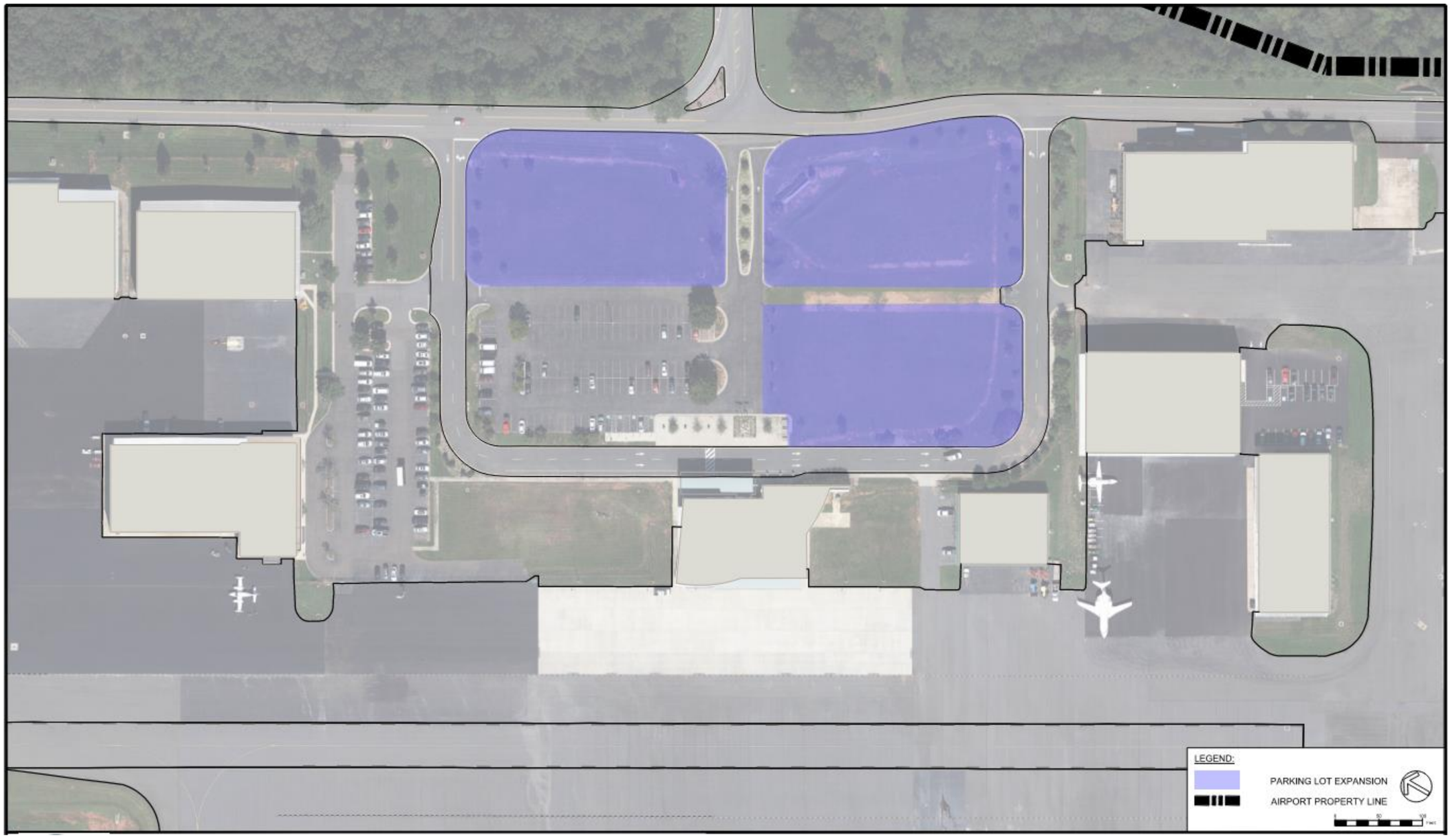
- **No Action**

  With current landside use and access, there is no pressing capacity or congestion issue. This will become an issue with growth, or the introduction of air carrier operations, but keeping the surrounding areas undeveloped will allow for financial and construction flexibility for when the need becomes pressing.

- **Expand Parking Lot**

  Taking proactive action, rather than reactive, to the approaching capacity limitation will facilitate seamless expansion and growth for the Airport, preventing an unnecessary "bottleneck" to the Airport's capacity growth. Each lot would be developed as the capacity need arises, as to not introduce undue construction and maintenance cost for unused lots.

FIGURE 3-32
TERMINAL PARKING LOT EXPANSION



Source: RS&H Analysis, 2023

3.7 COMPREHENSIVE PREFERRED DEVELOPMENT

- Combination of all preferred facility development concepts over the planning period and beyond
- Graphic representation