CHAPTER 5
TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

5.1 Introduction

Chapter 4, *Facility Requirements*, identified the facilities needed to accommodate current and projected demand over a twenty-year planning period. In this chapter, a series of airport improvement alternatives will be presented for comparison which meet airfield, terminal, commercial, general aviation, and air cargo needs. The chapter will also discuss the potential for other improvements on the airport property which can provide revenue support. Subsequently, a master plan concept will be recommended.

The alternatives presented in this chapter provide options for meeting short- and long-range facility needs. Since the levels of commercial and general aviation activity can vary from forecast levels, flexibility must be considered in the plan. If activity varies by significant levels within a five-year period, BIL should consider updating the plan to reflect the changing conditions.

Alternative concepts were reviewed with BIL staff for further refinement. While the evaluation of airport improvement alternatives may always include the "no action" or "no build" alternative, this alternative will eventually reduce the quality of services provided to the public and potentially affect the Billings area's ability to accrue additional economic growth. However, a final decision with regard to pursuing a particular improvement plan which meets the needs of commercial and general aviation users rests with the City of Billings.

While this study does not deal with the potential relocation of services to other airports, this option also exists. It would be difficult to duplicate the services and convenience of the current facility at a nearby airport. In addition, the economic and environmental costs of new site development are generally far greater than the cost of developing the existing site. It is sometimes possible to relocate or encourage the relocation, of some services. However, most of the services which local users find attractive are not easily met at nearby airports. Therefore, the master planning process must attempt to deal with the facility needs that were identified in the previous chapter, thus providing a logical decision path which BIL can follow in meeting projected needs.

Through coordination with BIL Airport Staff, the Aviation and Transit Board, airport users and the public, the alternatives will be refined and modified as necessary to shape the recommended improvement program. The alternatives presented in this chapter can be considered a beginning point for formulating the updated master plan improvement program, and input will be necessary to define the resulting program.

5.2 Initial Considerations

It is the overall objective of this effort to provide for a balanced airport complex to serve forecast aviation demands. However, prior to defining specific alternatives, improvement objectives should be defined. With this in mind, the following objectives have been defined:

- Develop an attractive, efficient, and safe aviation facility.
- Promote increased use of the airport for transportation of air passengers and air cargo while providing for increased commercial airline competition to stimulate growth.
- Provide the means for the marketing and improvement of the airport and available land as unique business opportunities for both aviation related and non-aviation related commercial businesses.
- Target local economic growth through the improvement of available airport property for industrial and commercial uses.
- Encourage increased general aviation use of the airport by promoting increased business and corporate use of the airport.

In attempting to meet these objectives, improvement of facilities should be undertaken in such a manner as to minimize operational constraints. Flexibility is essential to assure adequate capacity while minimizing financial commitments until market potential is realized.

5.3 Airfield Alternatives

Airfield facilities are, by nature, a focal point of the airport complex. Because of their primary role and the fact that they physically dominate airport land use, airfield facility needs are often the critical factor in the determination of a viable airport improvement program. Analysis in the previous chapter indicated the need to examine the configuration of runways on the airfield with consideration for airfield capacity and landside development.

5.3.1 Runways

The design standards applicable to future development at BIL are based on the ultimate runway classifications developed in previous analyses and summarized in Table 5-1.

Table 5-1: Facility Classifications

	Ultimate Classification
Runway 10L-28R	D-IV
Runway 10R-28L	D-IV
Runway 7-25	B-II

Taxiways designed according to applicable runway and landside facility

Runway 7-25

At 5,501 feet in length, Crosswind Runway 7-25 currently accommodates aircraft under 12,500lbs. As indicated in Chapter 4, Facility Requirements, a length of 7,000 feet would be needed to accommodate the future B-II design for aircraft over 12,500 lbs.

Lengthening of Runway 7-25 to both the east and the west was considered. BIL has ownership control of a significant portion of the approach to Runway 25 from the east, extending approximately 1 mile. The airport's ownership control to the west is much more limited, extending approx. ½ mile from the threshold of Runway 7. For this reason, extending Runway 7-25 to the east is considered the preferred alternative.

Figure 5-1 depicts a 1,499-foot extension of Runway 7-25 to the east to a length of 7,000 feet.

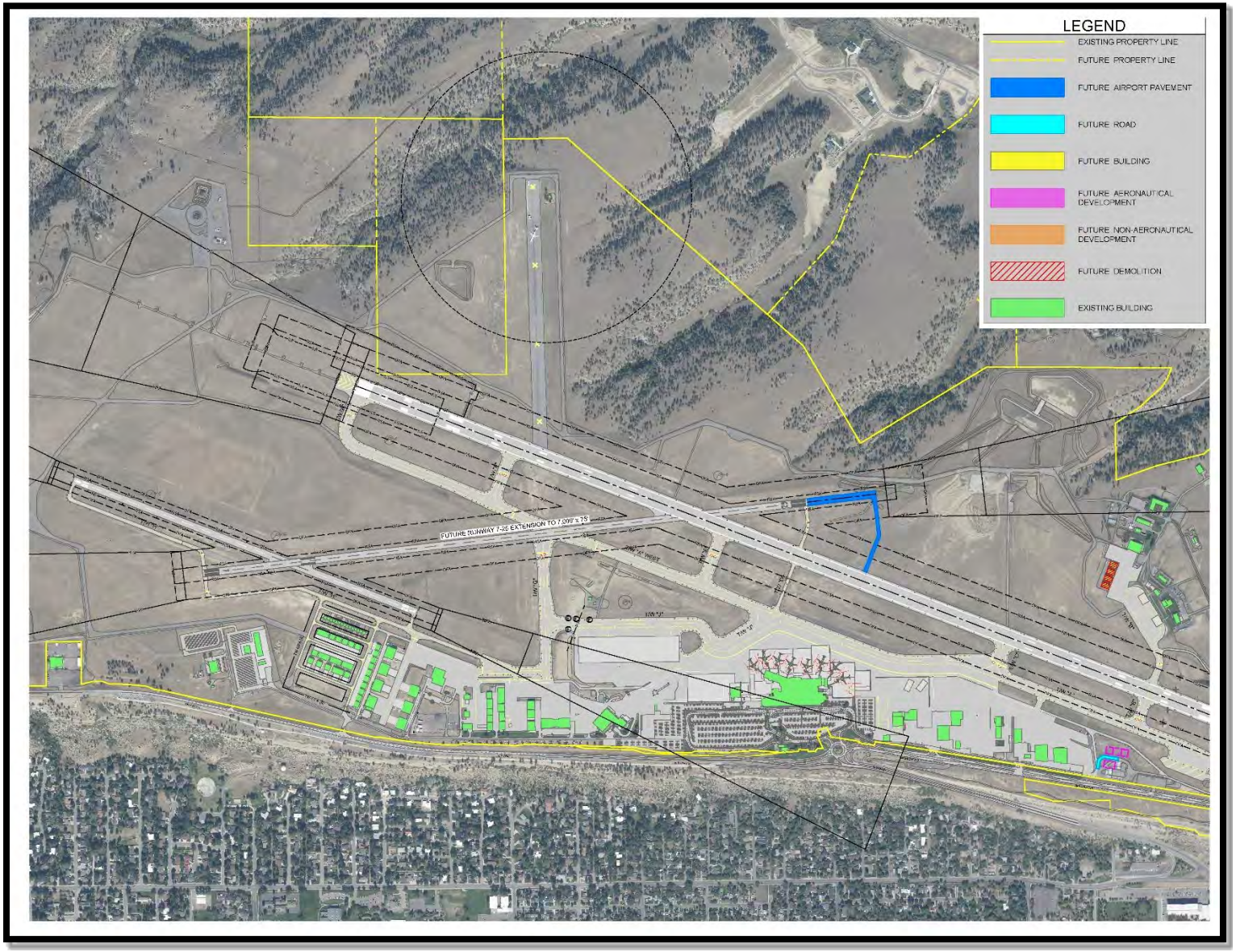


Figure 5-1: Runway 7-25 Extension

Runway 10R-28L – Long Term Planning Horizon: Future D-IV Standards

At 3,800 feet in length, parallel Runway 10R-28L is designed to serve small aircraft under 12,500 lbs exclusively. As discussed in Chapter 4 *Facility Requirements*, Runway 10R-28L is planned as a future D-IV runway to ultimately accommodate the full range of aircraft operating on Primary Runway 10L-28R.

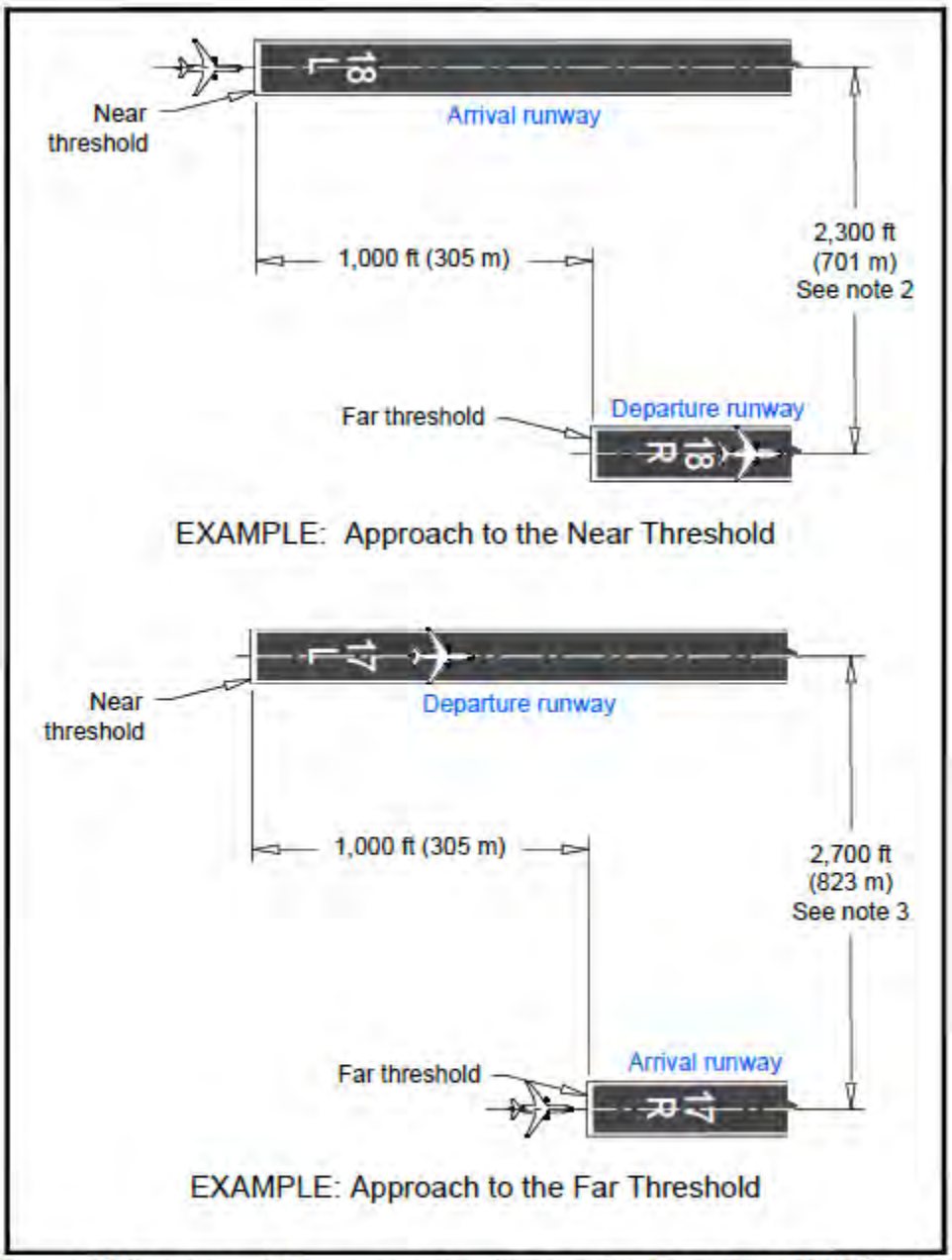
Parallel runway alternatives contemplate the construction of the parallel runway at three lengths. These lengths could correspond to phased construction, with runway extensions over time, or as longstanding alternatives depending upon evolving airport activity. Alternative lengths include:

- 10,500 feet, consistent with existing Runway 10L-28R and suitable for 100 percent of fleet forecasted to operate regularly at BIL at 90 percent of useful load.
- 8,500 feet, suitable for 100 percent of fleet at 60 percent useful load, and
- 7,500 feet, suitable for 75 percent of fleet at 60 percent useful load.

All three parallel runway alternatives assume an offset of 1,514 feet between the runway centerlines and a stagger of 8,500 feet from the east threshold of Runway 28R to the threshold of Runway 28L. The current alignment of Runway 10R-28L is utilized as parallel taxiway and the proposed runway centerline alignment is shown at a 400-foot offset from parallel taxiway. This is the standard runway to taxiway separation for Group IV.

A separation of 1,514 feet between runway centerlines allows simultaneous independent landings and takeoffs under Visual Flight Rule (VFR) conditions. Under Instrument Flight Rule (IFR) conditions, simultaneous radar-controlled mixed operations (aircraft departing on a runway and an aircraft on final approach to another parallel runway) require a 2,500-foot separation. However, with staggered approaches, and the approach to the near threshold, the separation distance required is reduced by 100 feet for each 500 feet of stagger to a minimum separation of 1,000 feet is allowable as described on **Figure 5-2**. Therefore, with a stagger of a minimum of 4,930 feet, operations to Runway 28R and 28L, could have simultaneous mixed operations under IFR, assuming approaches to the near threshold. With stagger lengths of 8,096 feet at a 10,500 foot length, 6,078 feet at an 8,500 foot length and 5,078 feet at 7,500 feet, operations on Runway 10R and Runway 10L would have a sufficient stagger to be operated with simultaneous mixed operations.

Figure 3-18. Parallel Runway Separation – Simultaneous Radar-Controlled Mixed Operations with Staggered Thresholds



Note 1: Figure 3-18 illustrates parallel runway separation adjustments from the standard 2,500 ft (762 m) used with even thresholds for simultaneous radar-controlled mixed operations (arrival to one runway and departure on the other runway).

Note 2: Reduce the standard 2,500 ft (762 m) separation by 100 ft (30.5 m) for each 500 ft (152 m) of threshold stagger.

Note 3: Increase the standard 2,500 ft (762 m) separation by 100 ft (30.5 m) for each 500 ft (152 m) of threshold stagger.

Source: AC 150/5300-13B 3.9.4.2.b

Figure 5-2: Parallel Runway Separation Standards

Because alternatives allow for simultaneous mixed runway operations under IFR conditions, RPZs to accommodate lower than 3/4 mile visibility minimums are shown on both ends. Portions of the RPZ for Runway 10R would fall outside airport property for both alternatives and require purchase of land and/or avigation easement.

Taxiway G establishes the eastern limits of a potential runway. As a D-IV Runway, future Runway 28L's Runway Safety Area (RSA) would extend 1,000 feet beyond the runway end, providing a safety buffer for landing and departing aircraft. To meet RSA requirements, Runway 28L must begin at least 1000 feet to the west of Taxiway G.

Providing a displaced threshold beyond the end of Runway 28L is a way to move the takeoff threshold closer to Taxiway G while meeting RSA requirements. A displaced threshold would result in different published runway lengths being available depending on the type of operation, and the direction of the operation. If the east 960 feet of Runway 28L is identified for takeoffs only and not included in the runway's published landing length, the takeoff threshold of Runway 28L can be moved 960 feet closer to Taxiway G.

Differing published runway lengths associated with displaced thresholds are known as declared distances. Declared distances include the takeoff run available (TORA), takeoff distance available (TODA), accelerate-stop distance available (ASDA), and landing distance available. AC 150/5300-13B defines the TORA as "the runway length declared available and suitable for the ground run of an airplane taking off"; the TODA as "the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA"; the ASDA as "the runway plus stopway length declared available and suitable for the acceleration and deceleration of an airplane aborting a takeoff"; and the LDA as "the runway length declared available and suitable for a landing airplane."

Construction of parallel Runway 10R-28L to a length of 10,500 feet, mirroring the length of existing Runway 10L-28R, is not considered practicable. A runway at this length would necessitate the closure of both Rod and Gun Club Road and Trails End Road as well as the businesses and residences they serve. In addition, the Runway Protection Zone would encompass several residential parcels in the Rehberg Ranch Estates Subdivision. Due to the severity of these impacts, this option is considered not feasible and is eliminated from consideration.

Construction of parallel Runway 10R-28L to a length of 8,500 feet, with a displaced threshold of 960 feet, is shown on **Figure 5-3.** A length of 8,500 feet would be suitable for 100 percent of the fleet over 12,500 pounds at 60 percent useful load and 100 percent of the fleet over 12,500 pounds at 60 percent useful load. At this length, runway pavements would be confined to airport property, however acquisition of approximately 50 acres within the proposed RPZ would be required. In addition, relocation of Trails End Road may be needed to remove it from the RPZ.

Figure 5-4 depicts an alternative construction of parallel Runway 10R-28L to a length of 7,500 feet. This length would be suitable for 75 percent of fleet over 12,500 pounds at 60 percent useful

load. As shown, a runway at this length could be achieved with less land acquisition, approximately 25 acres, for the Runway Protection Zone.

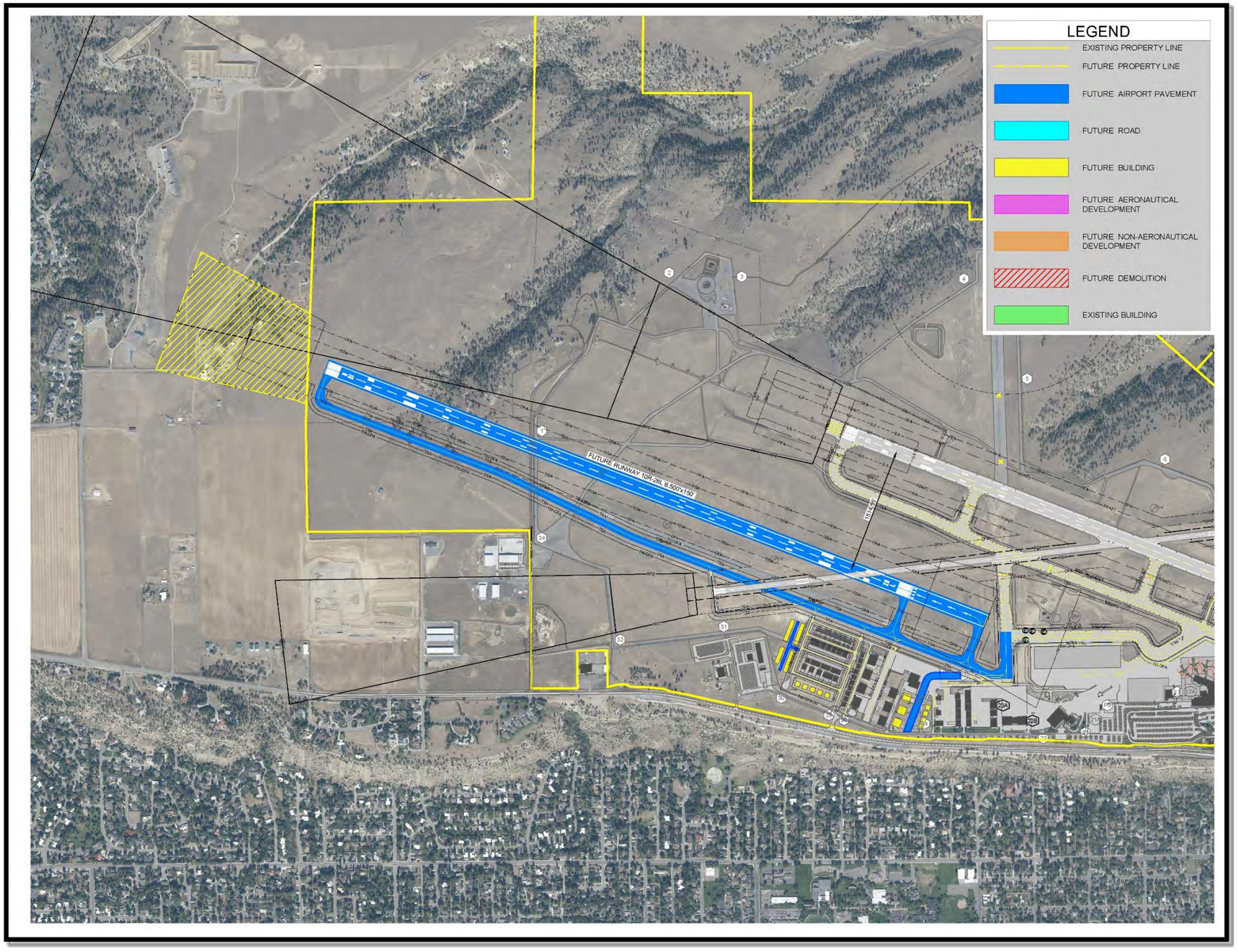


Figure 5-3: Parallel Runway Alternative B: 8,500 Feet Long

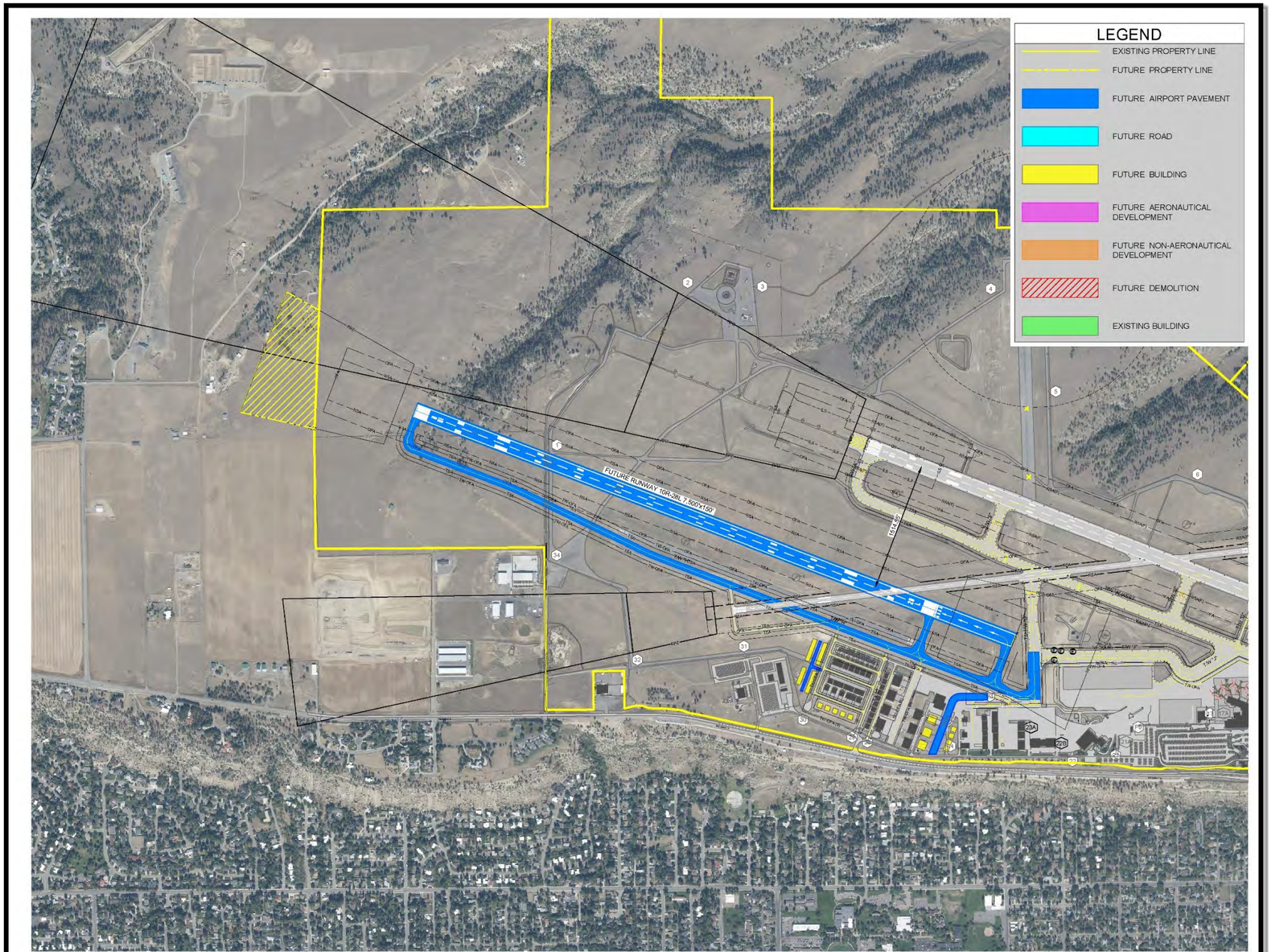


Figure 5-4: Parallel Runway Alternative C: 7,500 Feet Long with 960 Foot Displaced Threshold

5.3.2 Taxiways

This section evaluates the taxiway system and recommends improvements to develop taxiway layouts that are operationally efficient, and that enhance safety, circulation, and capacity.

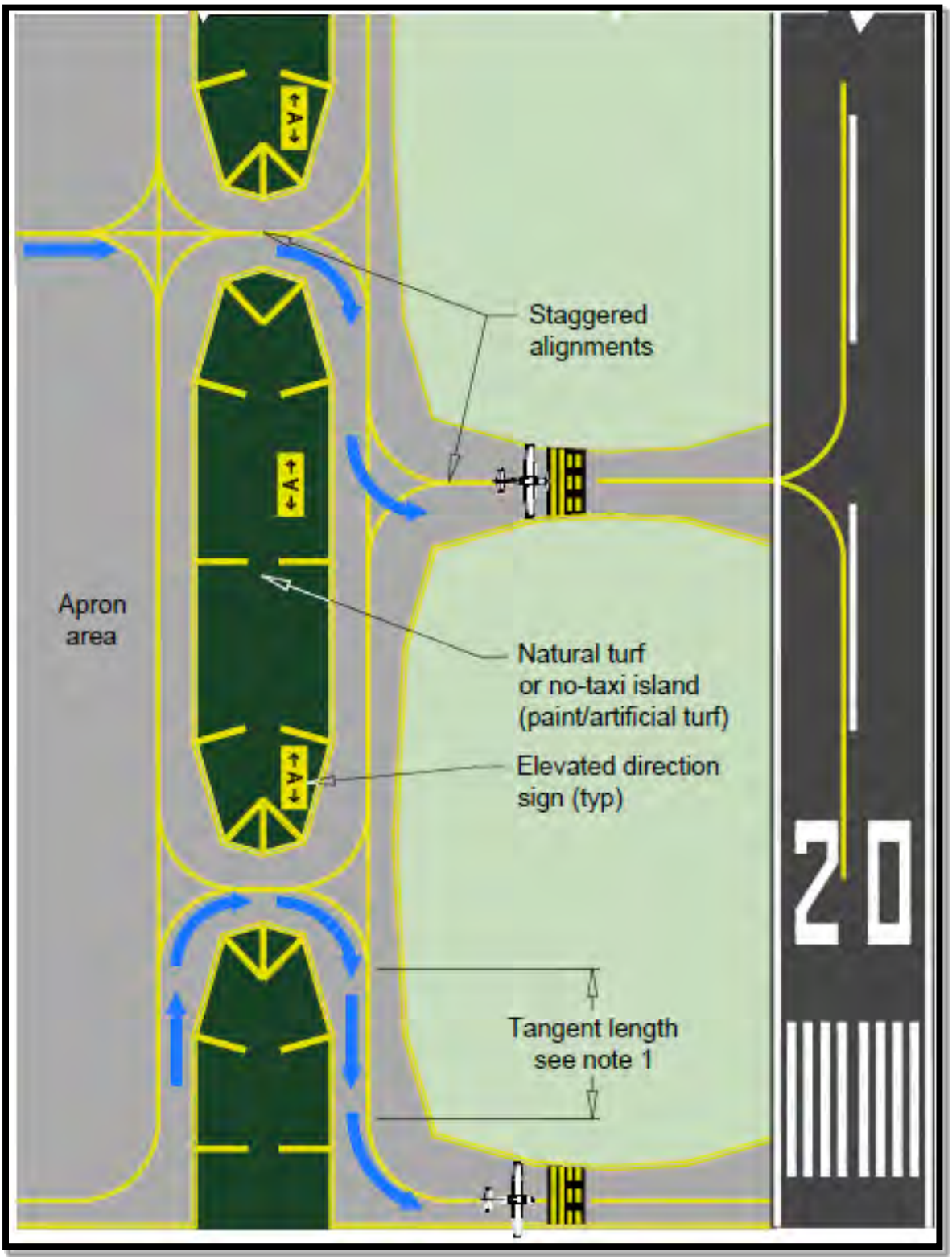
A number of targeted upgrades for taxiways are recommended to improve operational efficiency and help increase airfield capacity by maximizing the efficient movement of aircraft to and from the runway environment. Taxiway improvements generally have limited alternatives beyond build or "no build".

Any future planned parallel taxiways, as discussed in previous parallel runway discussion, must be offset a minimum of 400 feet from Runway 10L-28R and from the future planned parallel runway to meet design standards for ADG IV. Taxiway connectors should be designed to limit runway crossings to the outer thirds of the runway and to minimize the number of runway crossings (AC 150/5300-13B, 4.8.1.2, 3&4). Exit taxiway locations for the future parallel runway should be determined in the design process utilizing current design software and fleet mix assumptions at the time of construction.

Taxiway A/C Intersection

The intersection of Taxiway A, Taxiway C, and RWY 10L–28R is identified in FAA's Hot Spot Improvement Program. This program looks for areas of problematic taxiway geometry that may benefit from intervention because of their history and/or potential to lead to pilot confusion and runway incursions. The intersection of Taxiway A, Taxiway C, and RWY 10L–28R is identified as a hot spot due to the wide expanse of pavement with wide fillet on westside of Taxiway C connector, the large non-movement area south of Taxiway A, the short distance from the ramp to Runway 10L-28R runway and the potential for direct access from the ramp to the runway.

Pavement removal and adding painted or artificial turf "no-taxi islands", as shown in **Figure 5-5** and **Figure 5-6,** can be used to more clearly define taxi routes for pilots in this location.



Source: AC150/5300-13B, Figure 4-2

Figure 5-5: Apron Taxiway Transition

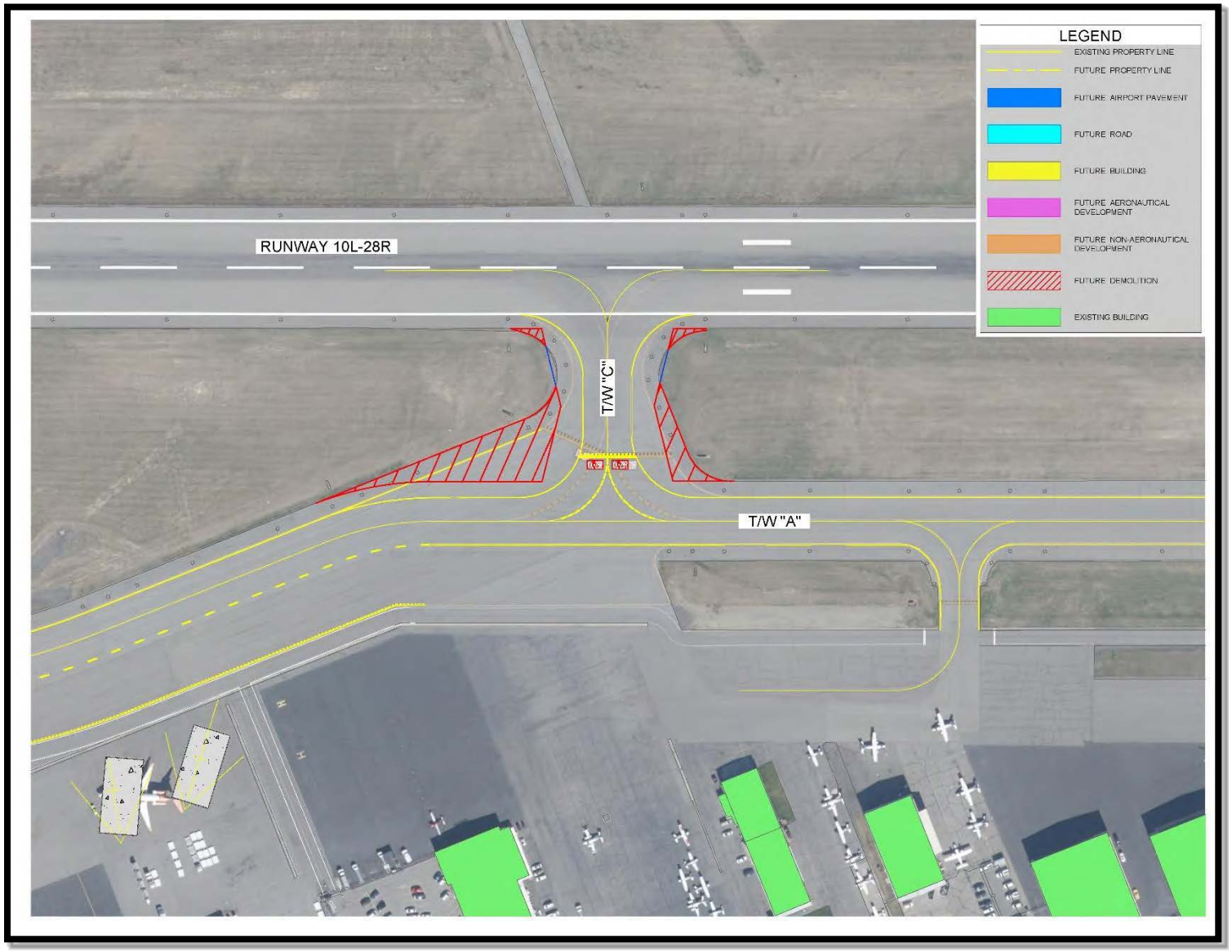


Figure 5-6: Taxiway C Pavement Removal / "No-Taxi Island

TW D – Northside Development

A new development area for corporate aviation has been identified on the north side of the airport to the west of the existing tanker base. This site would allow for corporate aviation expansion to the west of the existing tanker base without impact or restrictions on the tanker operations. A new parallel taxiway to serve this proposed northside development is depicted on **Figure 5-7.**

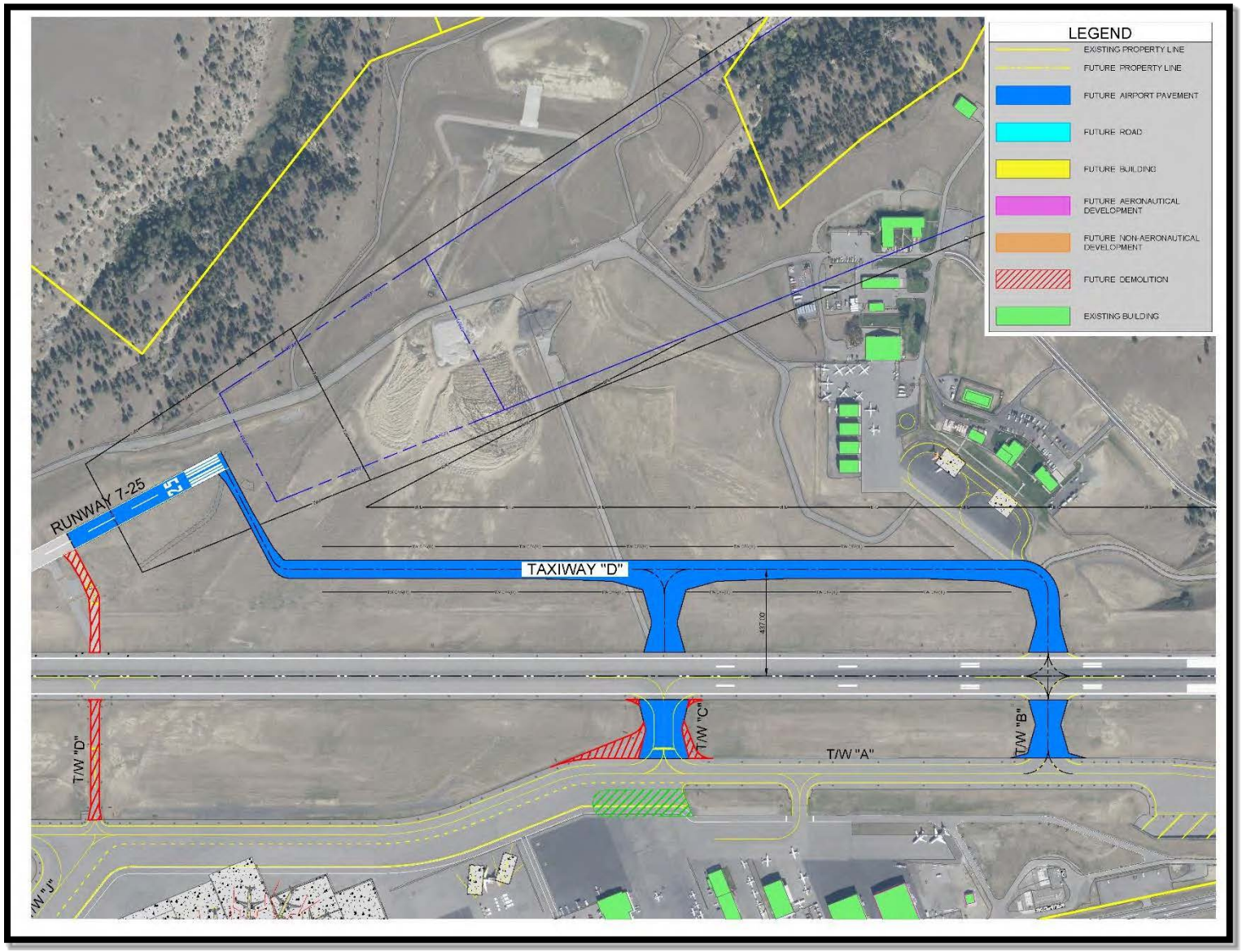


Figure 5-7: TW D – Northside Development

Bypass taxiways & holding aprons

With additional activity in the future, it may be necessary to provide holding aprons or bypass taxiways connecting Taxiway A and Runway 10L-28R. Bypass taxiways should be designed to allow passing of ultimate Design Group IV aircraft.

5.4 Terminal

Terminal Building

Considerations relative to the passenger terminal and access into the passenger terminal area include:

- Provision for automobile parking expansion - Increasing parking demands will require that the parking lots be expanded. Expanded automobile parking facilities are anticipated to be required for the general public, employees, and rental car ready and return.
- Provision for additional aircraft gates - Expansion of the terminal from the current 9 gates to a minimum of 12 gates is anticipated to meet forecasted demands within the planning horizon. Provision for additional gates within the planning period is considered in terminal planning concepts to accommodate potential unanticipated demand within the planning horizon and ultimate buildout of the terminal building.
- Addition of airline ticketing counter positions.
- Provision for expanded outbound bag screening and inbound baggage makeup - With growth in enplaning and deplaning passengers over the planning horizon. Additional area will be required for the makeup of outbound baggage and handling of inbound baggage.
- Provision for holdroom expansion. Holdroom requirements will increase as additional gates are added and utilized.
- Provision for additional baggage claim frontage and lobby area
- Expanded concessions

Figure 5-8 shows expansion of the terminal to both the east and the west to accommodate 12 aircraft gates (including the ground-loading EAS gate).

Figure 5-9 shows expansion of the terminal to the east only to accommodate 12 aircraft gates. Rather than expand the west holdroom, one gate serves two aircraft with a split jet bridge.

The evaluation of facility requirements determined that expansion to the terminal building from nine to twelve gates is likely to be required in the planning horizon. Alternative 1 adds two gates to the B concourse with a 6,050 square foot expansion of the east holdrooms and one gate to the A concourse with a 21,160 square foot expansion of the holdroom. Alternative 2 adds two gates to the B Concourse with a 21,160 square foot expansion of the east holdrooms and adds one gate to the A concourse without expanding the holdroom using a split jet bridge. Alternative 2, in not expanding the A Concourse, would be the most cost-effective option.

The existing A concourse could potentially accommodate the additional passengers utilizing a split jet bridge without adding to the building footprint. Additional seating within the existing square footage can be gained in circulation areas and through more efficient seating layouts. Depending on the departure schedules for airlines using the holdroom, shared use between gates can provide greater flexibility of use. At this time, Alternative 2 is the recommended Alternative for terminal expansion. Evaluation of airline operations and scheduling nearer the time of construction may demonstrate the need for additional holdroom space. If this is the case, Alternative 1 can be utilized.

Expansion of the east B concourse as shown in both Alternative A and Alternative B requires expansion of the terminal apron to the east, necessitating removal of the Rocky Mountain College apron and hangar and relocation of employee parking.

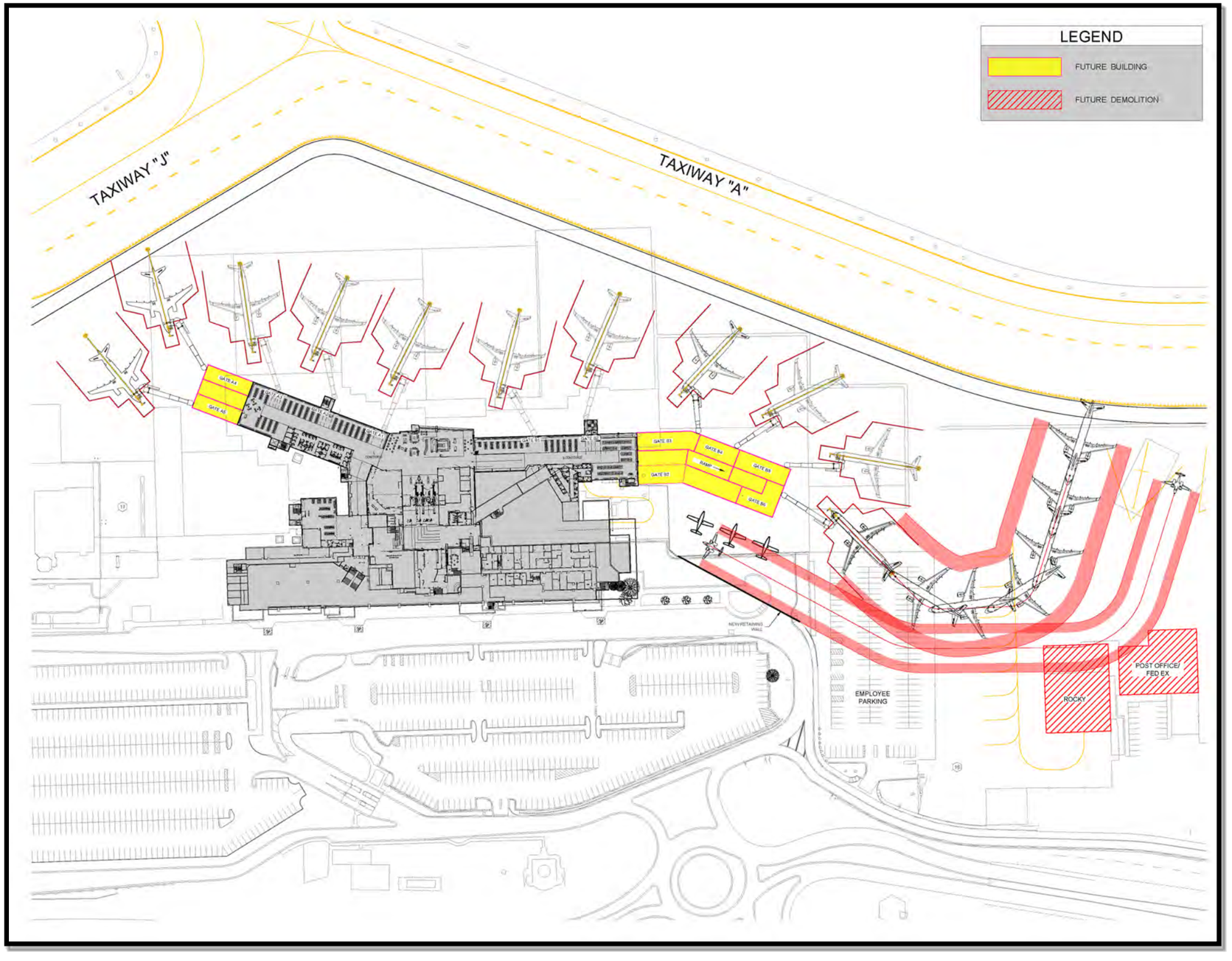


Figure 5-8: Alternative 1 Future Terminal Expansion

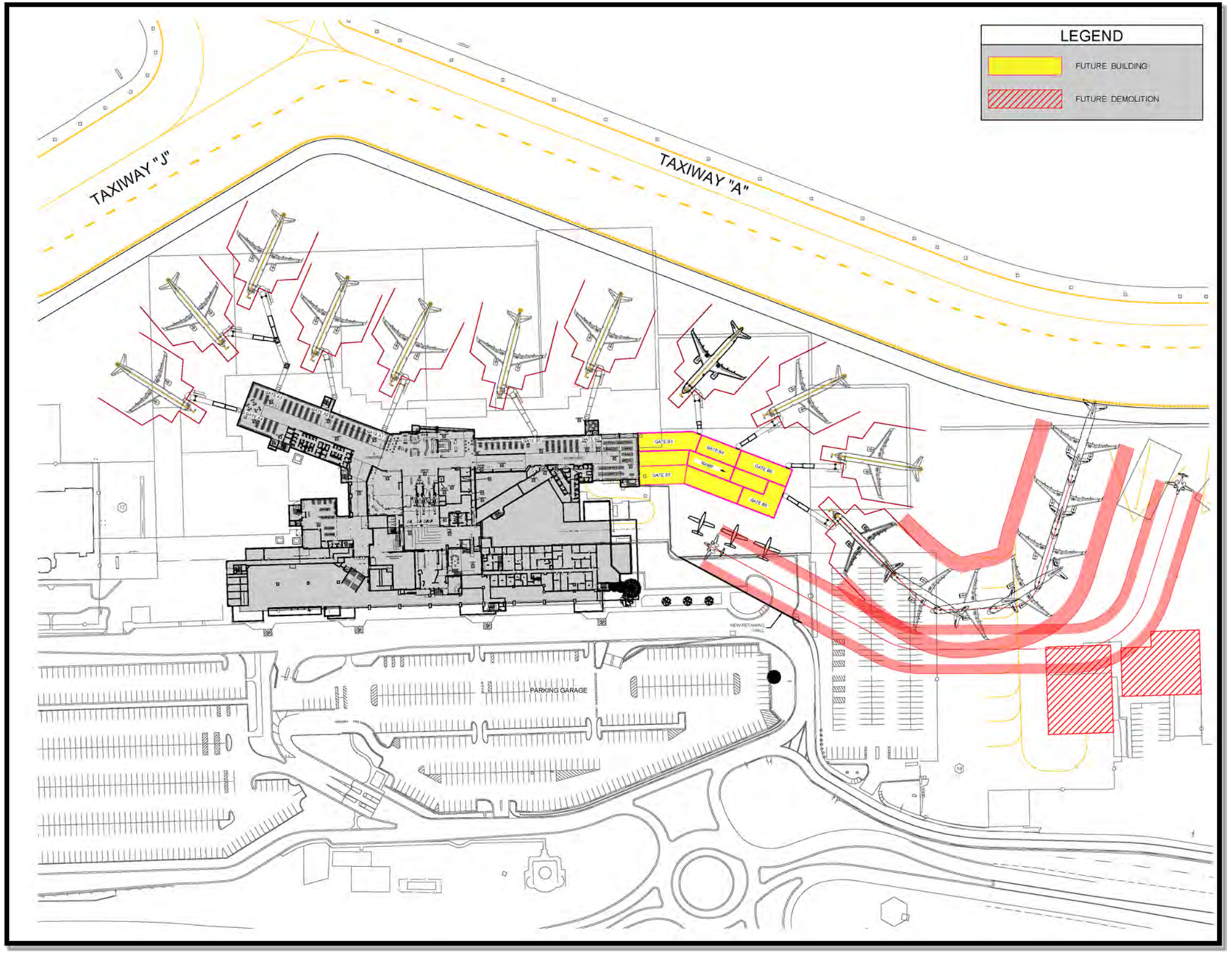


Figure 5-9: Alternative 2 Future Terminal Expansion

Auto Parking

Table 5-2: Public Parking Requirements BIL, from Facility Requirements analysis in Chapter 4, shows that BIL has an immediate demand of approximately 350 parking spaces. An additional 1,500 plus more spaces are anticipated to be needed by the end of the planning period.

Table 5-2: Public Parking Requirements BIL

	Existing Spaces	Current Demand	2028	2033	2038	2043
Enplanements	427,843	427,843	486,897	560,057	624,658	679,248
Public Parking Spaces	1,216	1,563	1,778	2,045	2,281	2,481
Employee Parking Spaces	172	172	196	225	251	273
Rental Car Ready/Return Spaces	232	232	264	304	339	368
Total Existing Parking	**1,620**	**1,620**	**1,620**	**1,620**	**1,620**	**1,620**
Total Parking Demand		**1,967**	**2,238**	**2,574**	**2,871**	**3,122**
Total Capacity / (Deficiency)		**(347)**	**(618)**	**(954)**	**(1,251)**	**(1,502)**

*Red Text = Deficiency

Figure 5-10: Existing Auto Parking depicts the existing public auto parking layout at BIL. As shown, there is little vacant land near the terminal that can be developed for public parking. The limited available land for expanded parking within optimal walking distances to the terminal presents a challenge for the airport. A multi-level parking structure will ultimately be needed to accommodate future parking demand within optimal walking distances of the terminal building. The overall cost of a parking garage (on a cost-per-space basis) is around three times that of a ground parking space. The timing and phasing of constructing a parking structure must include consideration of the displacement of ground parking spaces that will occur during construction. Implementation strategies could include initially creating a surplus of ground parking spaces to accommodate displaced spaces when parking garage construction occurs.

Relocation of Rocky College associated with the extension of the east B Concourse could provide available land for parking. However, the need for additional parking will come before Rocky College is relocated.

Shuttle Lot

A multi-level parking structure is included in long-term planning for public parking at BIL. Due to the expense of parking garage construction, a parking structure may not be feasible in the near term. A shuttle lot location is identified in **Figure 5-11** to accommodate parking demand in the near-term. The 11-acre site shown could accommodate an estimated 1,500 parking spaces. This location could also accommodate auto parking spaces displaced during construction of a parking structure.

Parking Garage

Figure 5-12 depicts three alternative locations for a parking structure. Alternative 1 is located in the existing long-term parking lot immediately west of the terminal building. This location provides short walking distances to the terminal, and a functionally equivalent operation to the existing long-term lot. Alternative 2 is located directly in front of terminal building. While this location provides the shortest walking distances and most direct access to the terminal, it would block the view of the landmark terminal structure for approaching visitors. Alternative 3 to the east of the terminal would require displacement of Rocky Mountain College and existing employee parking.

Alternative 1 has been selected as the preferred option due to its proximity to the terminal, and the lack of impact to the view of the existing terminal building and the lack of impact to Rocky Mountain College facilities.

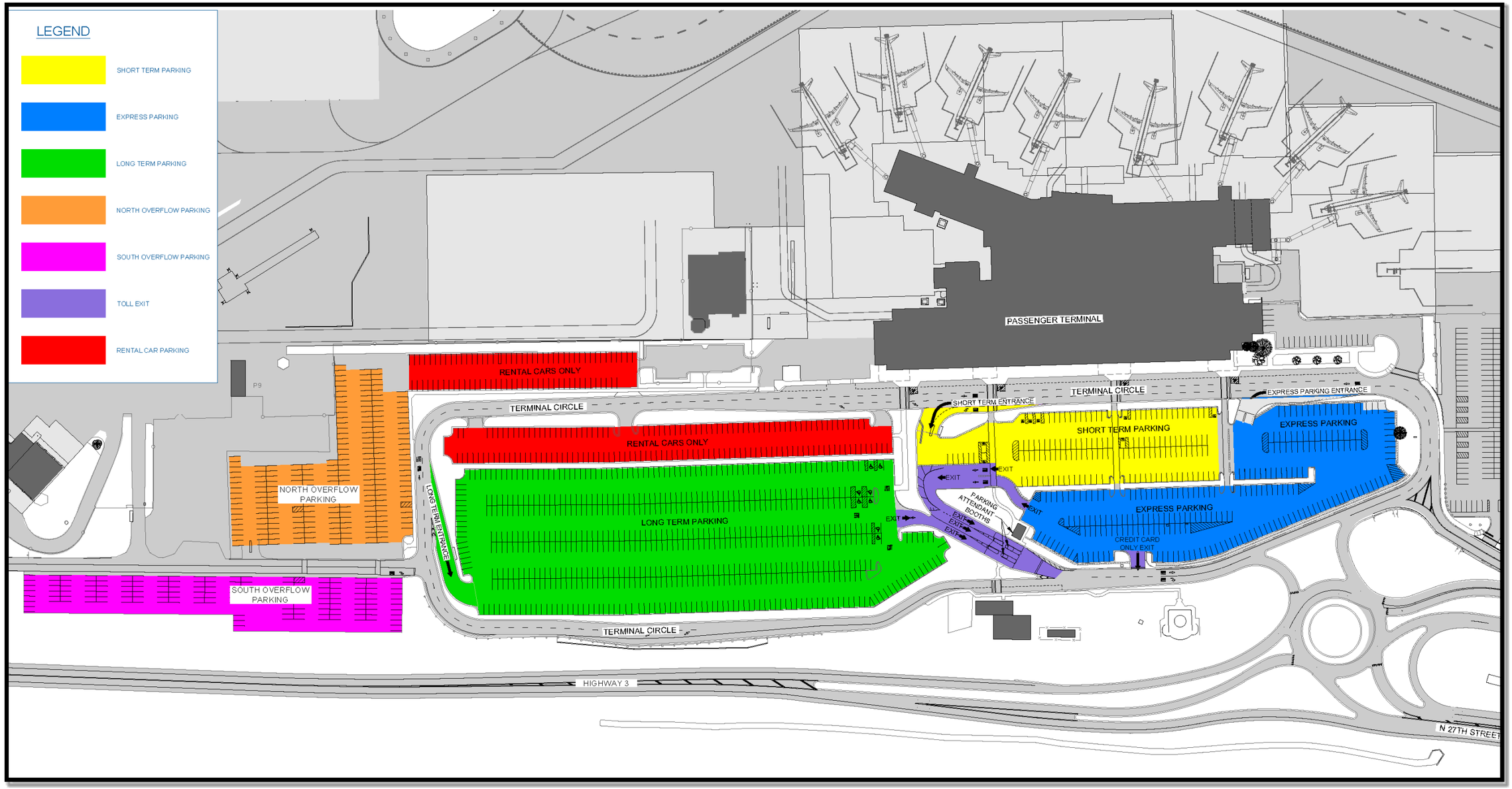


Figure 5-10: Existing Auto Parking

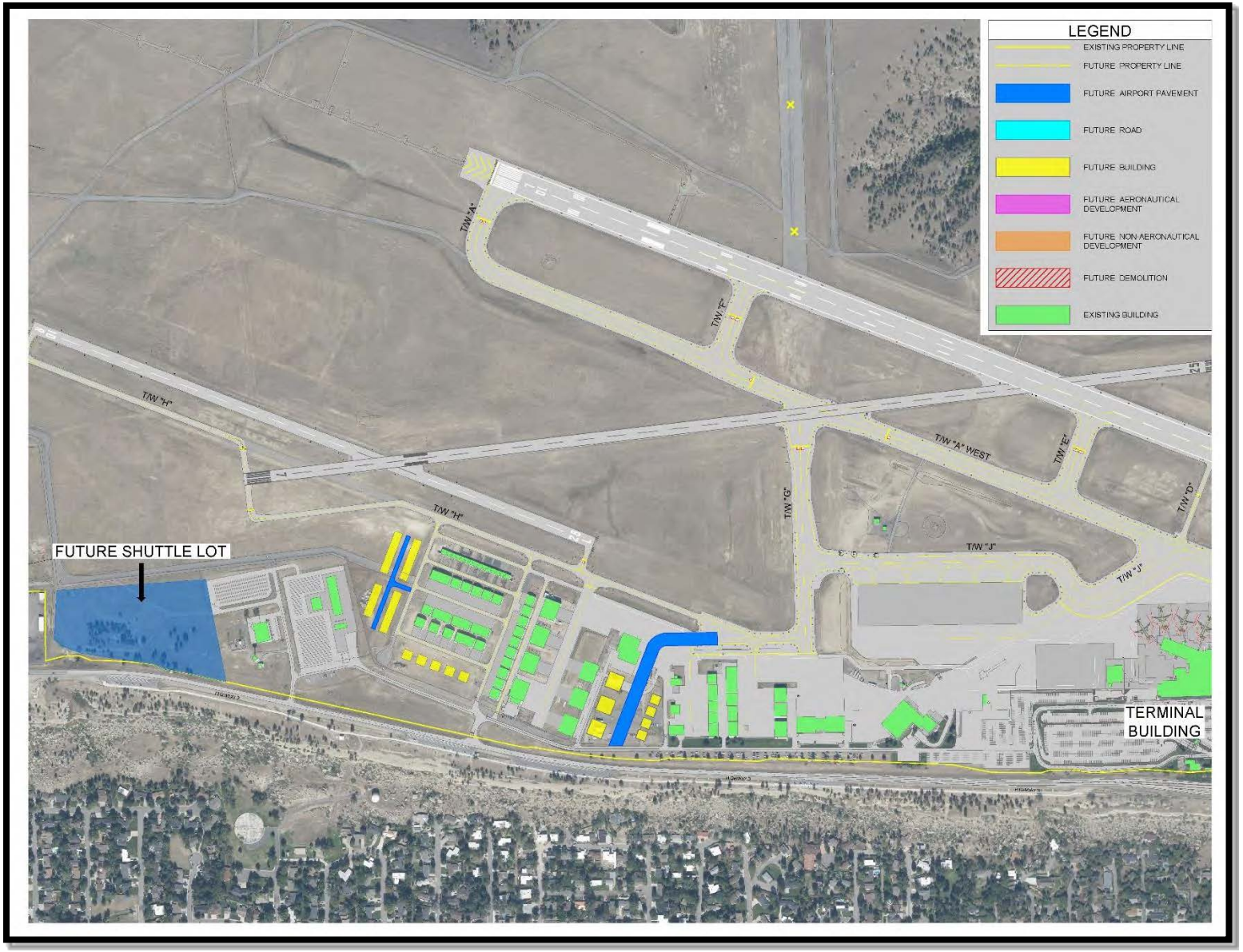


Figure 5-11: Shuttle Lot Location

Figure 5-12: Parking Garage Alternatives

5.5 General Aviation Alternatives

Considerations relative to potential general aviation alternatives include:

- Provisions for storage hangars – There is a projected need for additional storage positions, for both small and large aircraft.
- Provisions for parking aprons – The facility needs additional apron space and parking positions immediately and through the planning period.

Buildout of Existing GA Areas

The general aviation area is nearing buildout and has limited options for alternate development patterns. Arrangements of a variety of hangar types and sizes and associated taxilanes and aprons are identified for the existing west general aviation area on **Figure 5-13** and for the east hangar area on **Figure 5-14.**

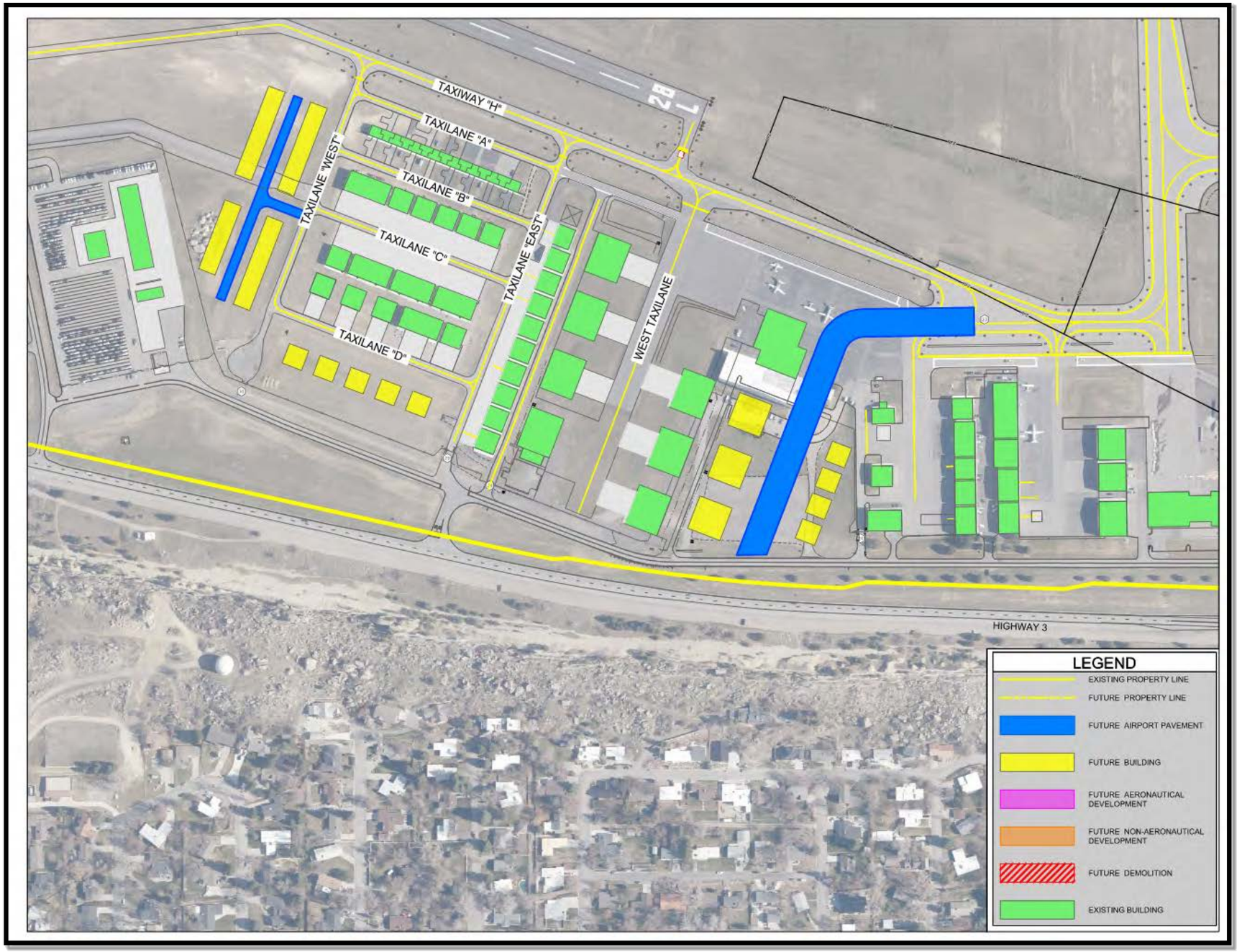


Figure 5-13: GA Hangars West

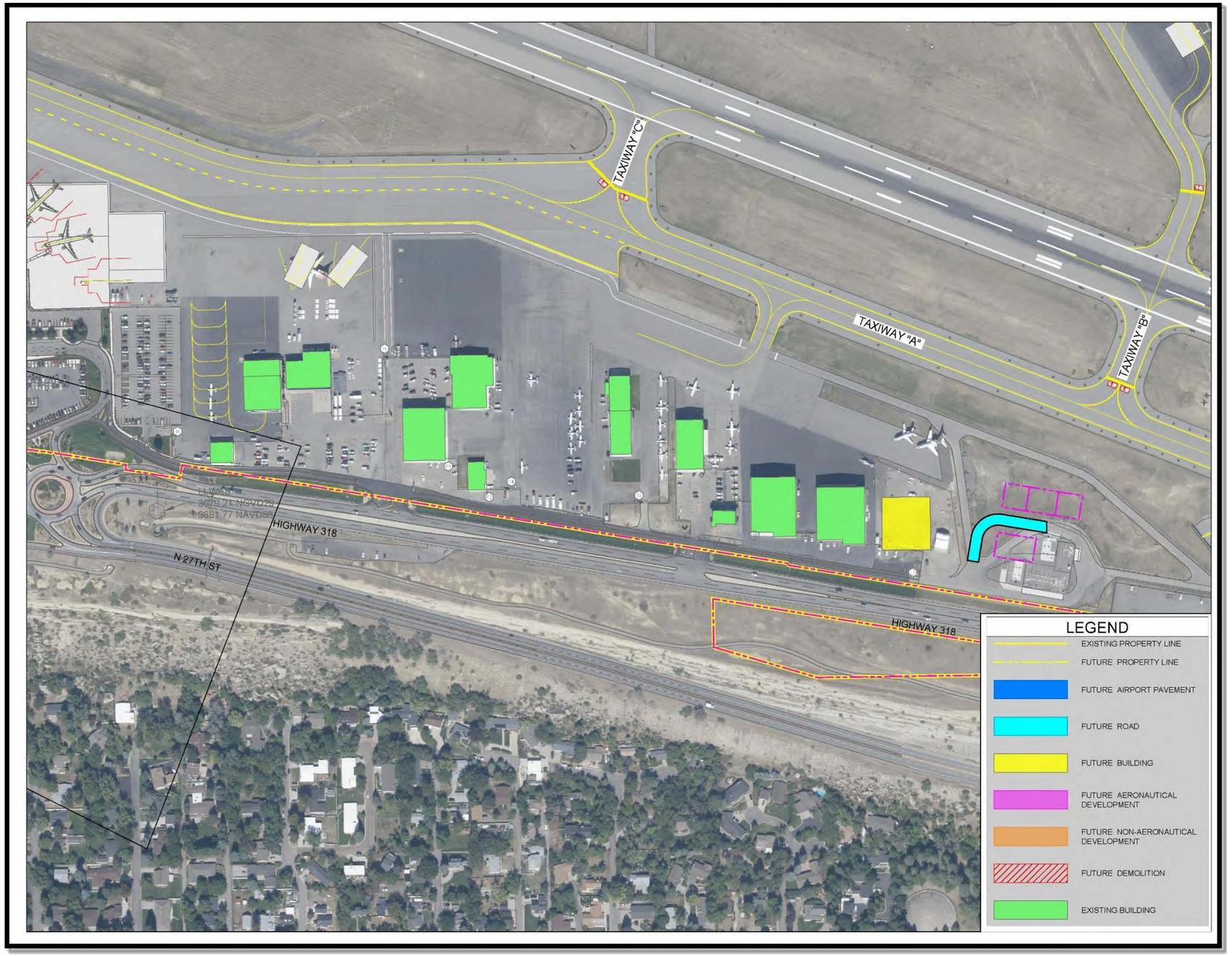


Figure 5-14: GA Hangars East

Northeast Area Development

An additional corporate aviation development area is identified on the north side of the airport to the west of the existing tanker base. This site would allow for corporate aviation expansion to the west of the existing tanker base without impact or restrictions on the tanker operations. This location would require an extension of the access road and installation and updating of utilities in the area. Keeping business activities isolated from typical airport operations is beneficial to both the business users and airport tenants, and this location achieves that isolation. Development of this area would occur in accordance with demand and availability of funding.

Water pressure is currently too low to support substantial development on the north side of the airport. An upsizing of the water line serving the north side of the airport is necessary to support future development and to improve water pressure for the existing facilities, such as the Bureau of Land Management and Alpine Air, on the north side. **Figure 5-15** shows routing of a new 10-inch water line across the airfield to serve existing and planned north side facilities.

Two layout alternatives for the northeast area have been developed and are shown in **Figure 5-16 and Figure 5-17.** The options are conceptual in nature but will follow the parameters and general intent of planning. The final layout of this area will largely depend on the first facility to be developed in this area. Construction of new hangars and site improvements will be predicated on actual demand for hangar sites. It is assumed that all hangars will be constructed by private entities on leased land.

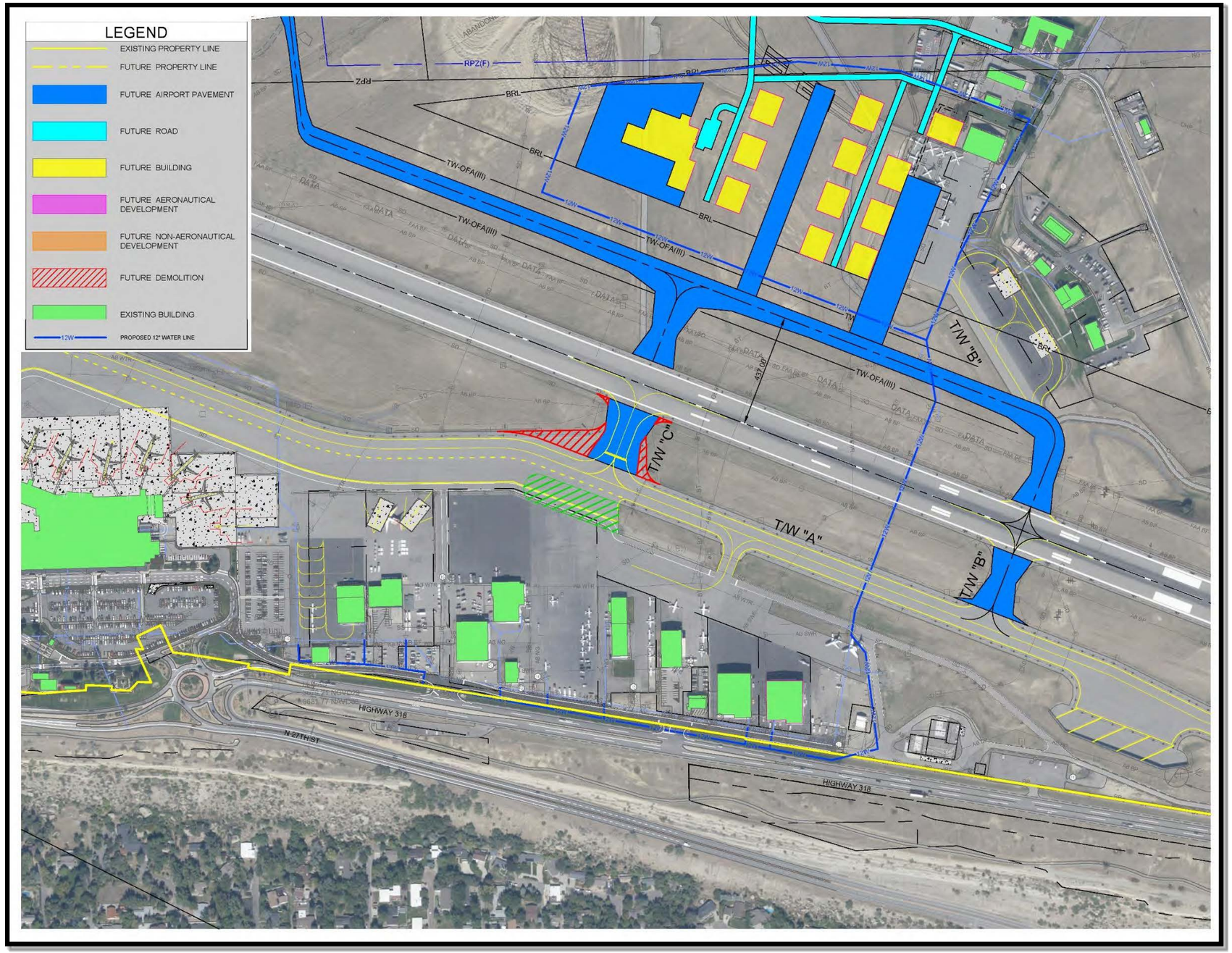


Figure 5-15: Waterline Extension / Upgrade

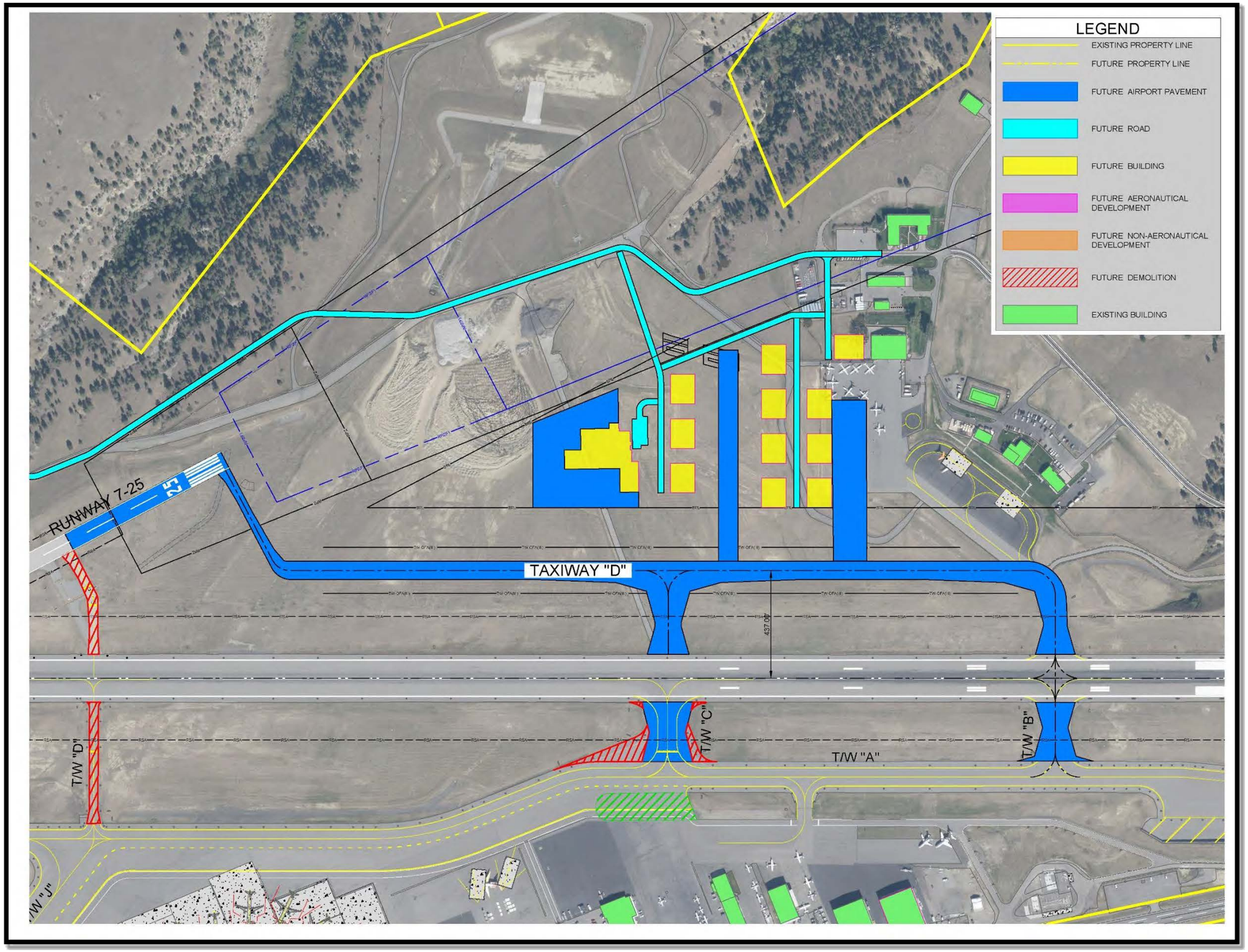


Figure 5-16: Northside Development Alternative 1

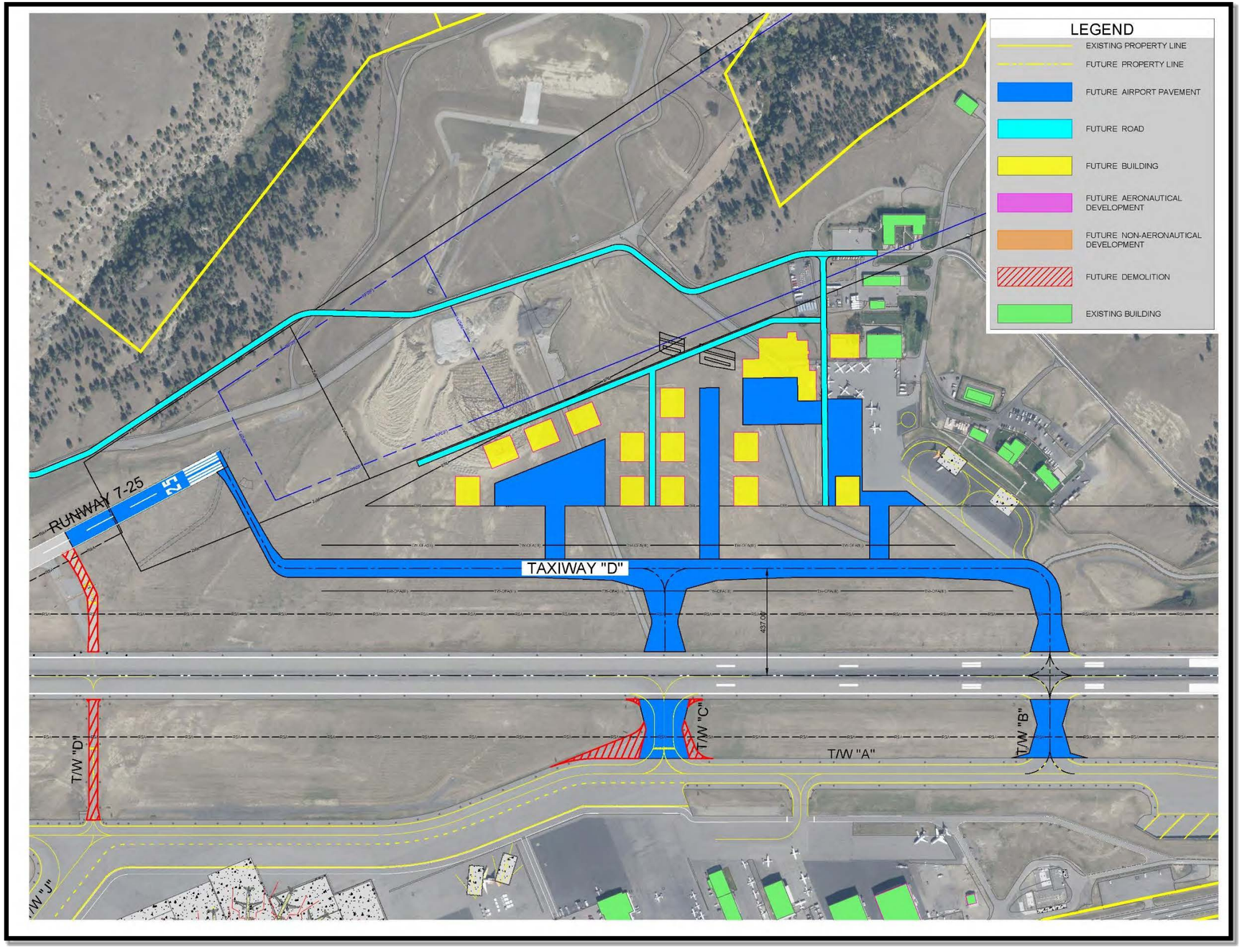


Figure 5-17: Northside Development Alternative 2

5.6 Air Cargo

BIL serves as a cargo hub for the region. Cargo facilities include sorting facilities and aprons for FedEx and UPS on both sides of the terminal. In addition, Alpine Air Express, which operates feeder aircraft for UPS to and from nine mountain region markets, occupies a campus on the airport's north side.

Demand forecasts prepared in Chapter 2 of this study, concluded that annual cargo volumes are forecast to more than double over the course of the planning period. New and expanded cargo ramps and sorting facilities will be required. In addition, consolidation of some or all air cargo operations may be desirable for increased operational efficiency and optimization of land use. The airport operations building site, which houses ARFF and SRE functions, is currently a limiting factor in the logical expansion of cargo facilities on the west side of the terminal.

Relocation of operations functions, ARFF and SRE, to new location would allow air cargo sorting facilities to expand into the vacated operations building as shown in **Figure 5-18.**

Figure 5-18: Cargo Facilities

5.7 Support Facility Alternatives

Considerations relative to support facility alternatives include:

- Provisions for expansion and relocation of Aircraft Rescue and Fire Fighting (ARFF) facilities - The facility needs evaluation projected the need to accommodate additional facilities for ARFF equipment and operations.
- Provisions for expansion and relocation of Snow Removal Equipment (SRE) and maintenance storage facilities - The facility needs evaluation identified the need for additional SRE and maintenance equipment storage space as new equipment is acquired.
- Provisions for expanded fuel storage facilities - The facility needs evaluation has projected the need for additional fuel storage tanks to accommodate fuel demand over the planning period.

Analysis in the facility requirements chapter indicated the need to examine the expansion of support facilities at the airport. This section identifies the expansion of these facilities which meets the long-term growth requirements of the airport.

Operations Building Relocation

The current ARFF facility is co-located with airport airfield maintenance and snow removal equipment (SRE) operations, all within one shared building, known as the operations building.

The preferred planning direction is to relocate and construct a new facility to house ARFF and snow removal operations. **Figure** 5-19 shows three alternative sites to relocate the airport operations building. Alternative sites 1 and site 2 locate the facility on the northeast side of the airport. These sites would be incorporated into the northside development discussed previously in this chapter. Alternative site 3 locates the facility in the terminal area. Advantages and disadvantages related to the three sites are summarized in **Table 5-3**: Operations Facility Alternatives.

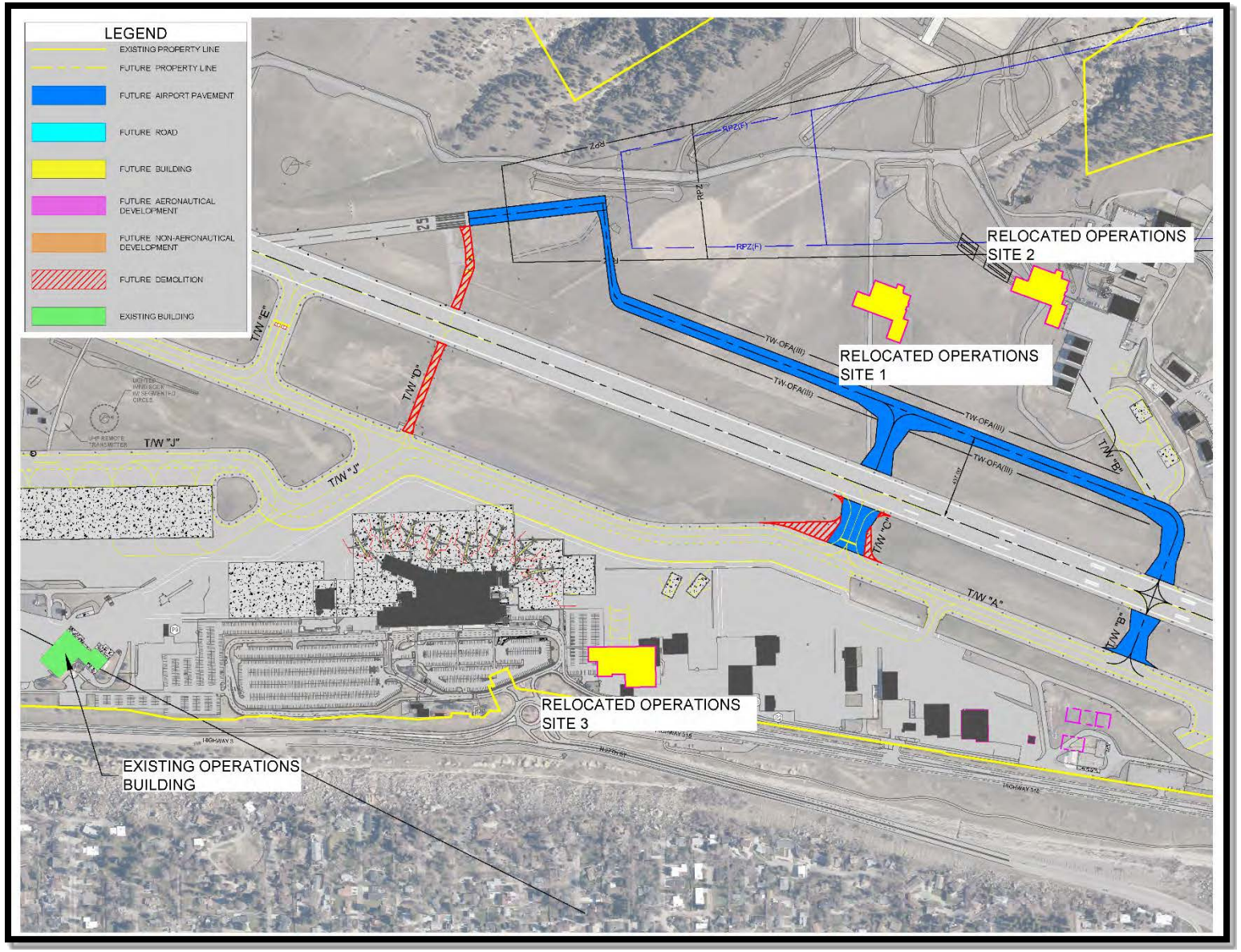


Figure 5-19: Operations Building Relocation Alternatives

Evaluation

Table 5-3: Operations Facility Alternatives compares the three operations facility site development alternatives.

Table 5-3: Operations Facility Alternatives

Alternative Description	Advantages	Disadvantages
Alternative Site 1: Northside Development Area - Northeast	Low response time to airfield emergencies Shorter access road to airfield required	Longer access to utilities
Alternative Site 2: Northside Development Area - Southwest	Low response time to airfield emergencies Good access to utilities	Longer access road to airfield required
Alternative Site 3: Terminal Area	Low response time to airfield emergencies Best response time to terminal area	Contributes to congestion in terminal area Limits the site for future aeronautical uses potentially more suited to flightline

Fuel Farm

The facility requirements analysis presented in Chapter 4 project a deficiency of aviation fuel storage capacity over the planning period. The existing fuel farm site can accommodate limited expansion, but additional reserve space will be needed as demand grows.

Three alternative sites for locating additional fuel storage facilities once the existing site reaches capacity are shown on **Figure 5-20: Fuel Storage Expansion Sites.** All three sites are accessible to both the airside and landside, meet airfield safety requirements, and do not impact aircraft operations.

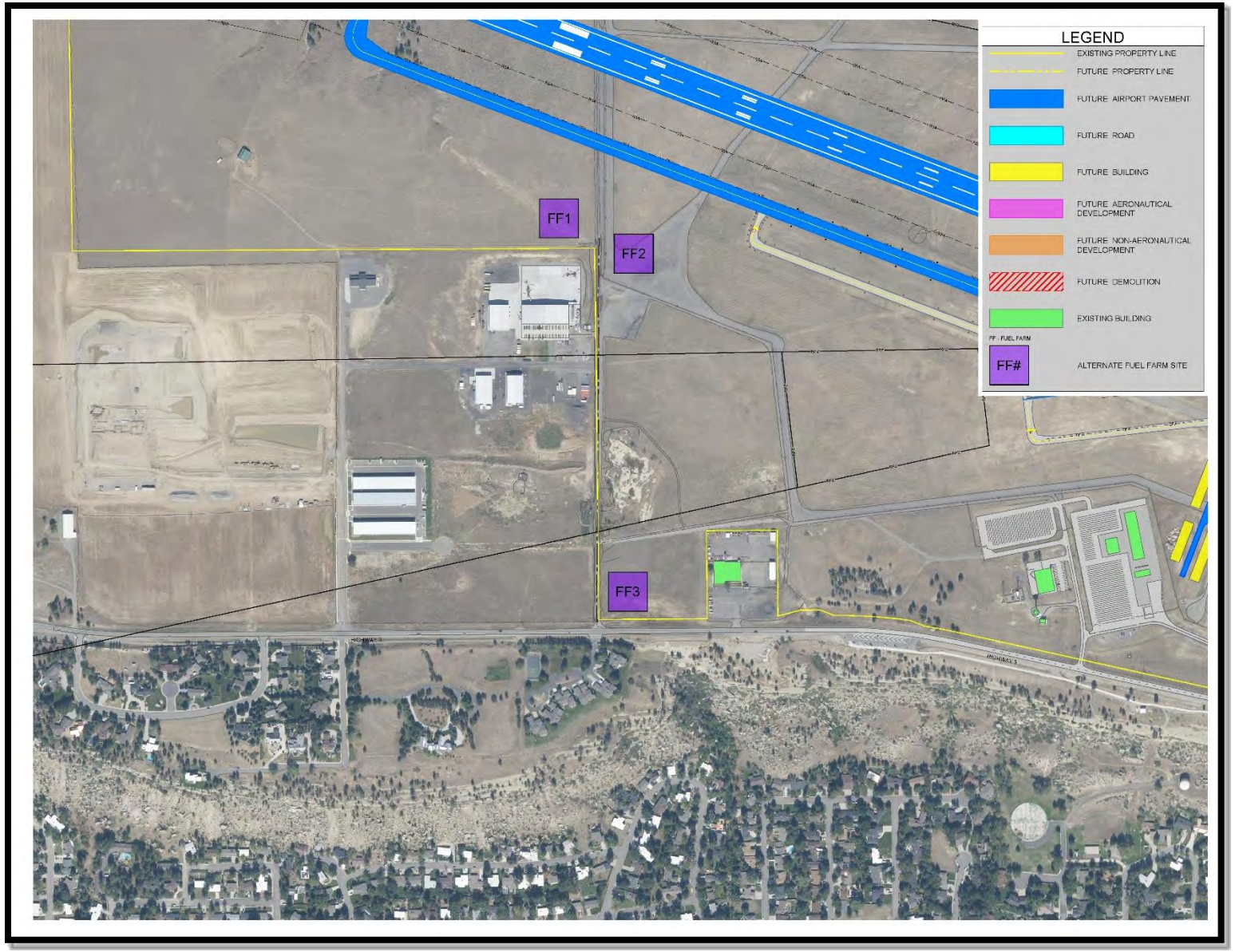


Figure 5-20: Fuel Storage Expansion Sites