CHAPTER FOUR:

ALTERNATIVES

4.1 Introduction

Chapter 3, *Facility Requirements*, identified the airside and landside 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, 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 a series of 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 levels vary by significant levels within a five-year period, BZN should consider updating the plan to reflect the changing conditions.

Alternative concepts were reviewed with BZN staff for further refinement. Then, a master plan concept was recommended in conjunction with airport layout plans and capital improvement programs (CIP). 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 Bozeman 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 Gallatin Airport Authority Board. 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 and 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 which have been identified in the previous chapter, providing a logical decision path which the Gallatin Airport Authority can follow in meeting projected needs. Through coordination with BZN Airport Staff, the Airport Board, 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.

4.2 Initial Considerations

It is the overall objective of this effort to provide for a balanced airside and landside 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 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.

4.3 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 increase runway lengths on all three paved runways. Other factors considered include taxiway circulation and the potential to provide additional or improved instrument approaches.

4.3.1 Runways

The design standards applicable to future development at BZN and are based on the ultimate runway classifications developed in previous analyses and summarized in **Table 4-1.**

Table 4-1 Facility Classifications

	Ultimate Classification
Runway 12-30	D-IV
Runway 11-29	D-IV
Runway 3-21	B-II (Small)
NW/SE Turf Runway	B-I (Small)
Taxiways*	TDG 5

* Taxiways designed according to applicable runway and landside facility

Runway 12-30

The forecast of critical aircraft indicates that future design of Runway 12-30 should be to Airport Approach Category / Airplane Design Group (AAC/ADG) D-IV design standards.

The future RPZ should protect for precision approaches to both runway ends.

FAA Memorandum, *Interim Guidance on Land Uses Within a Runway Protection Zone*, provides information related to RPZ land use compatibility. This guidance, published in September 2012, clarifies that the following are considered incompatible land uses:

- Buildings and structures;
- Recreational land uses (golf courses, sports fields, amusement parks, and other places of public assembly, etc.);
- Transportation facilities such as railroads, public roads and highways, vehicular parking facilities;
- Fuel storage facilities;
- Hazardous material storage;
- Wastewater treatment facilities;
- Above-ground utility infrastructure (sub-stations, solar arrays)

Many airports have incompatible land uses within their RPZs, including BZN. It is the responsibility of the airport sponsor to pursue policies that will ultimately provide for compatible land uses within the RPZs. If the size or location of an RPZ changes, thus introducing new incompatible land uses into the RPZ, a detailed alternatives analysis must be undertaken and approved by FAA headquarters. Changes in the size and/or location of an RPZ is a function of an airfield project (i.e. runway extension), a change in the critical design aircraft, a new or revised instrument approach, or a local development proposal within the RPZ (i.e., new or modified public roadway). Existing RPZ land use incompatibilities are generally acceptable, with the understanding that as opportunities arise to clear the RPZ, the airport sponsor should pursue and/or support those.

A future upgrade of a Precision Approach to Runway 30 would result in a larger RPZ, and introduce Airport Road, a public road considered an incompatible use, into the RPZ.

Three Alternatives were considered for maintaining the future RPZ for Runway 30 clear of Airport Road.

Alternative 1 is the "do nothing" alternative. Under this alternative, BZN would not plan for an upgrade to Runway 30 that would result in a larger RPZ. Airport Road in its current location also restricts the RPZ of Runway 29 from increasing from a visual approach RPZ to a non-precision approach RPZ. Given the constraints to future approaches to both Runway 29 and Runway 30, the "do nothing" alternative is not considered viable.

Alternative 2 is to relocate the threshold of Runway 30 to the northwest. A shift of approximately 1,110 feet would be required, resulting in a considerable reduction in usable runway length. Given the need for additional length on Runway 12-30 identified in the runway length analysis in Chapter 3 Facility Requirements, this is not considered a viable alternative.

Alternative 3 is to relocate Airport Road outside the future Runway 30 RPZ. BZN owns the land through which the road relocation passes in fee. Initial analysis indicates this is a viable and feasible option.

The relocation of Airport Road provides opportunity to shift the threshold of Runway 30 328 feet to the southeast to align with the current threshold of Runway 11-29. This shift establishes a more direct route to the Runway 29 threshold and, with the retention of the existing access taxiways, creates a bypass taxiway at the Runway 30 threshold.

Figure 4-1 depicts the alternative relocation of Airport Road and 328 foot shift of the Runway 30 threshold.

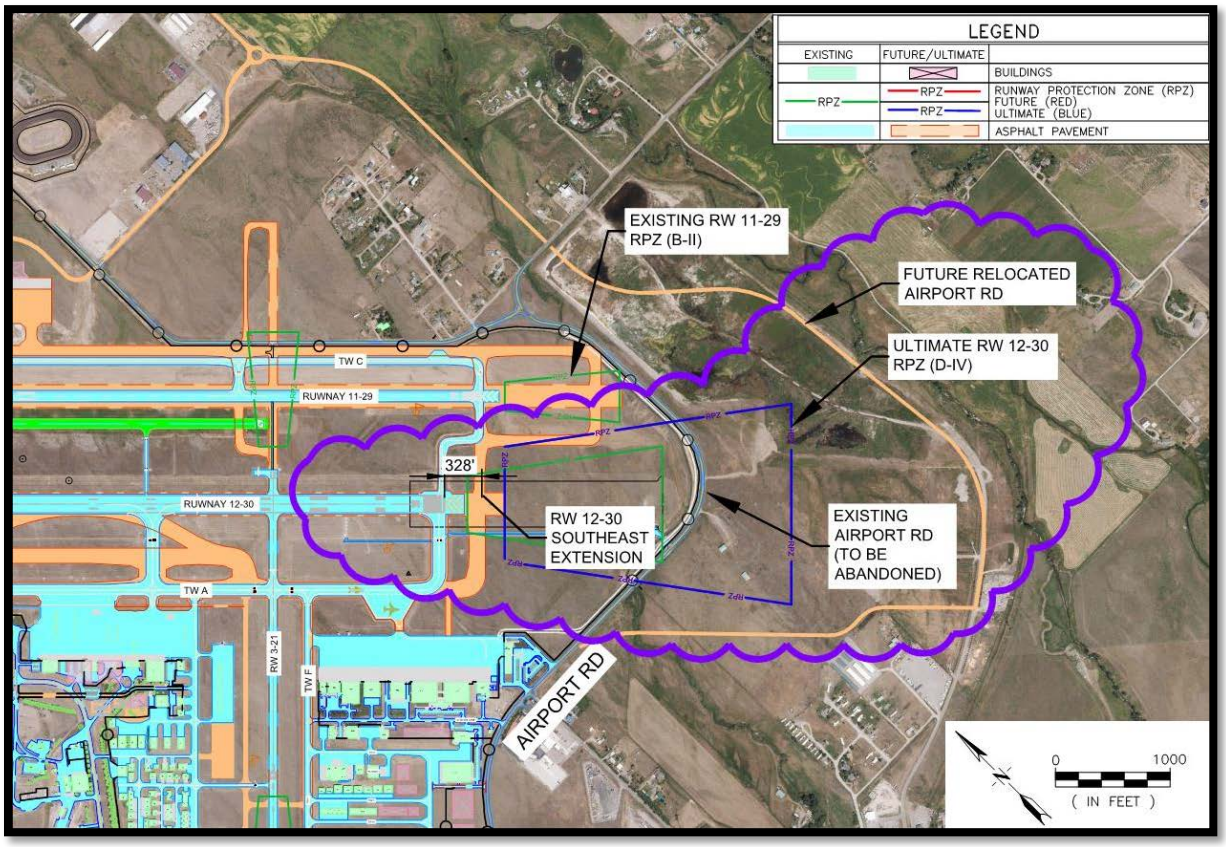

Figure 4-1: Airport Road Relocation / Runway 30 Extension

Results of the runway length analysis conducted in in Chapter 3, *Facility Requirements,* showed that the current runway length of 9,000 feet is acceptable for the aircraft currently operating at BZN. An ultimate extension of Runway 12-30 to 10,828 feet is recommended to increase payload capacity and the range of aircraft departing from BZN.

Extension of Runway 12-30 has historically been planned to the northwest. Dry Creek Road was relocated to allow for this extension and there are no known impacts to lands not owned or controlled by the Airport. Planning for extension of Runway 12-30 to the northwest should continue.

Figure 4-2 depicts an Alternative extending Runway 12-30 674 feet to northwest to the

point that it is limited by the ultimate RPZ crossing Dry Creek Road. With the 328 foot extension to the southeast, this brings the length of Runway 12-30 to a total length of 10,000 feet. In order to complete this runway extension, the Medium intensity Approach Lighting System with Runway alignment indicator lights (MALSR) and glide slope antenna will need to be relocated.

Previous planning depicted the ultimate northwest threshold of Runway 12-30 at a location 1,502 feet northwest of the existing threshold on the Airport Layout Plan. This layout has historically served as the basis for land use planning for BZN and surrounding jurisdictions. It is recommended that the ultimate threshold location continue to be shown on the Airport Layout Plan. This 1,502 extension, together with the 328 foot extension to the southeast reserves land for a maximum length of 10,828 for Runway 12-30. The ability to ultimately extend the runway to a maximum length of 10,828 feet should be preserved for the long term through airspace zoning. Ultimately, extension of the runway to this length would require justification and environmental approval at time of implementation. In particular, approval from FAA would be required to allow the corner of the RPZ for Runway 12 to cross Dry Creek Road. **Figure 4-2** depicts an ultimate extension to the northwest to 10,828 feet consistent with recommendations from previous planning and the current Airport Layout Plan.

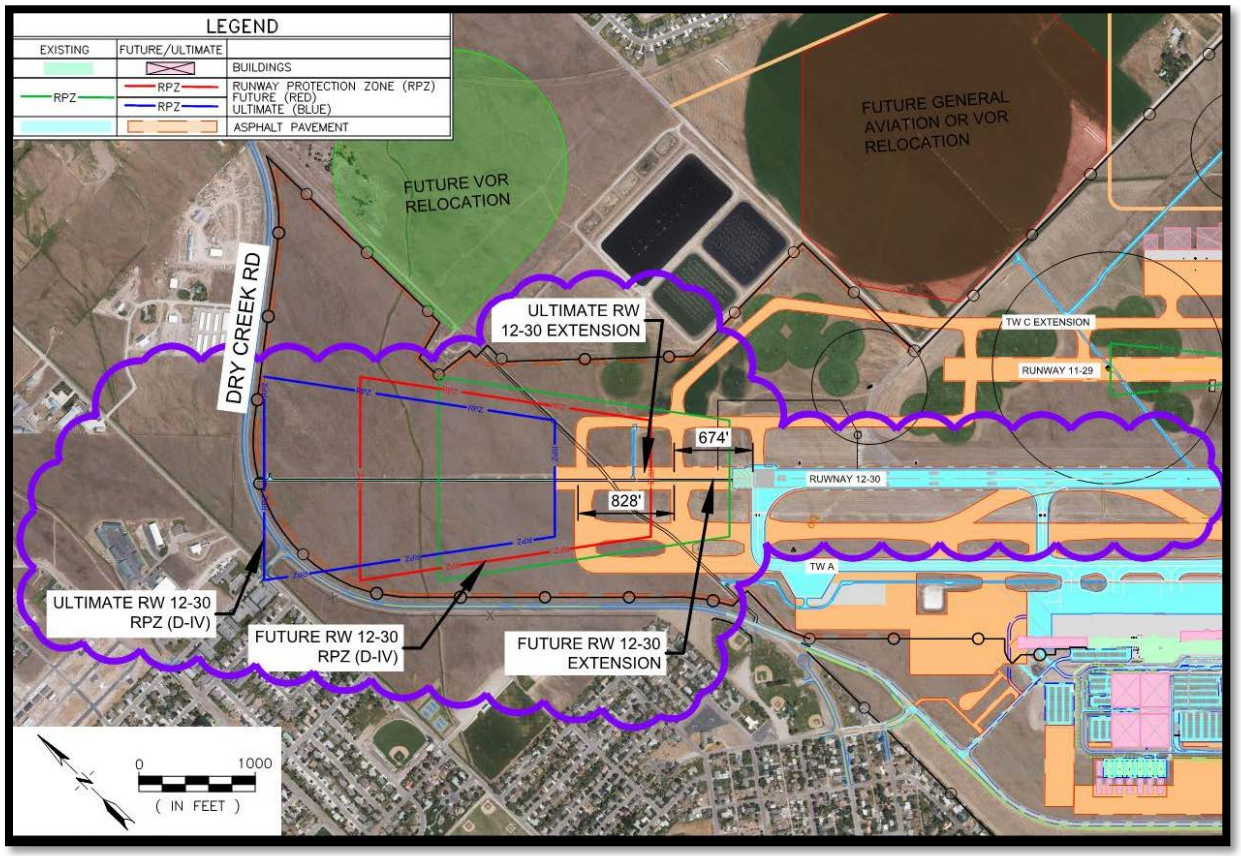

Figure 4-2: Runway 12-30 Extension

Currently, Runway 12-30 is the sole runway available for commercial flights at BZN. The pavement maintenance program provided in Chapter 3 *Facility Requirements* indicates a major rehabilitation of Runway 12-30 will be required in the 15 to 20 year time horizon. In order to minimize disruption to commercial schedules, it is recommended that lengthening of Runway 12-30 occur concurrently with the scheduled major maintenance project.

Runway 11-29

As noted in Chapter 3 *Facility Requirements*, Runway 11-29 was originally designed with the intent of separating small general aviation aircraft from larger and faster commercial airplane classes on the airfield. The analysis of airfield capacity indicated that future planning for the runway should include improvements to enhance the capacity of the airfield and accommodate traffic by aircraft weighing over 12,500 lbs. According to AC150/5325-4B paragraph 103, "additional primary runways for capacity justification are parallel to and equal in length to the existing primary runway unless they are intended for smaller airplanes."

Therefore, in order to provide maximum capacity enhancement benefits, Runway 11-29 should ultimately, to the extent practicable, be constructed to comparable standards as Runway 12-30. In addition to maximizing airfield capacity, this provides redundancy in cases of runway closure, for maintenance or for operational reasons.

In the future, D-IV aircraft are projected to be the most demanding type of aircraft with more than 500 operations at BZN, therefore Runway 12-30 and Runway 11-29 should ultimately be designed to D-IV standards with a width of 150 feet.

As an additional primary runway, Runway 11-29 should ideally be equal in length to Runway 12-30, however extension to the northwest is constrained by existing municipal sewer lagoons to the northwest.

Because the separation of Runway 12-30 and Runway 11-29 is less than 2,500 feet, simultaneous precision instrument approaches to both runways are not possible. For this reason the ultimate RPZs for Runway 11-29 are sized according to Non-Precision Instrument approach standards.

The alternative shown in **Figure 4-3** depicts a 2,430 foot lengthening of Runway 11-29 to the northwest, which is the maximum extent possible while keeping the municipal sewer lagoons out of the runway RPZ. **Figure 4-4** depicts an ultimate lengthening of Runway 11-29 by 1,020 feet to the southeast to a length of 8,500 feet. This lengthening would be constrained by the intersection of the Runway 29 RPZ with the relocated Airport Road public roadway. As noted in Chapter 3, this length would be adequate for landings by the critical aircraft at BZN and offers an opportunity to utilize Runway 11-29 as an arrivals runway with Runway 12-30 utilized as a departures runway. Relocation of the VOR would be required under this alternative and is also depicted on the alternative.

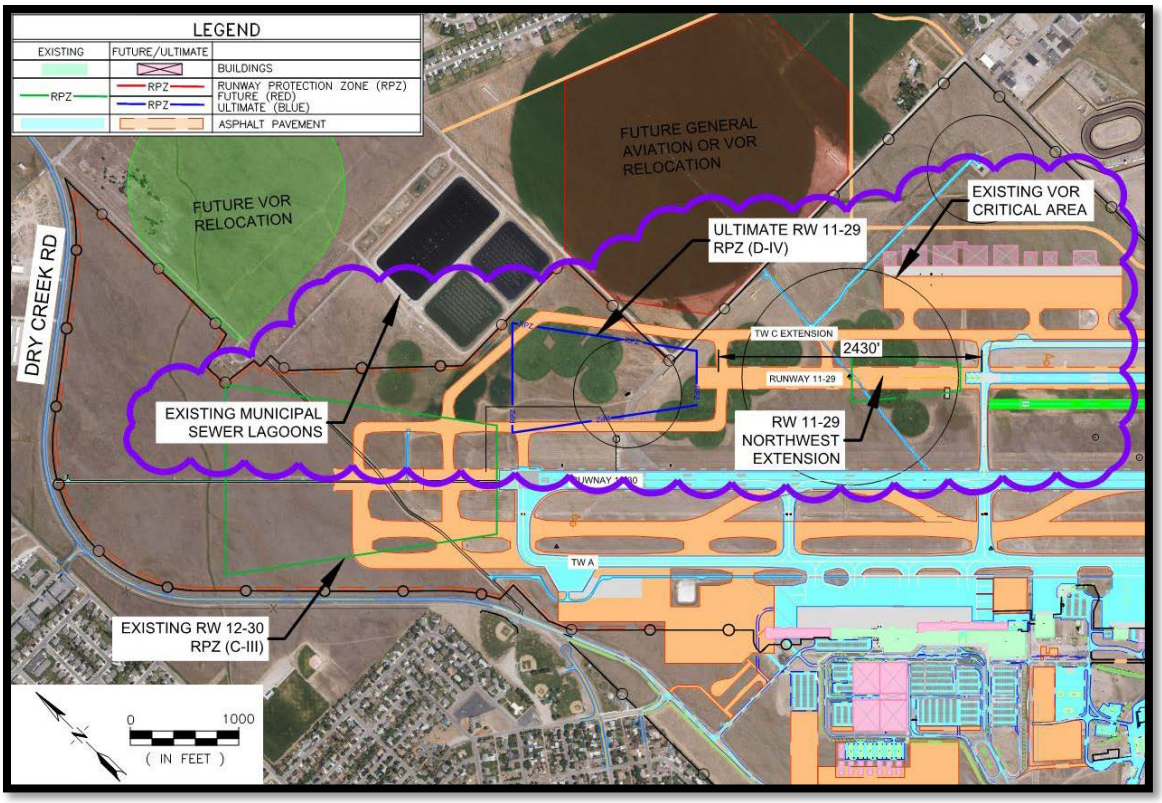

Figure 4-3: Runway 11-29 Northwest Extension, VOR Relocation

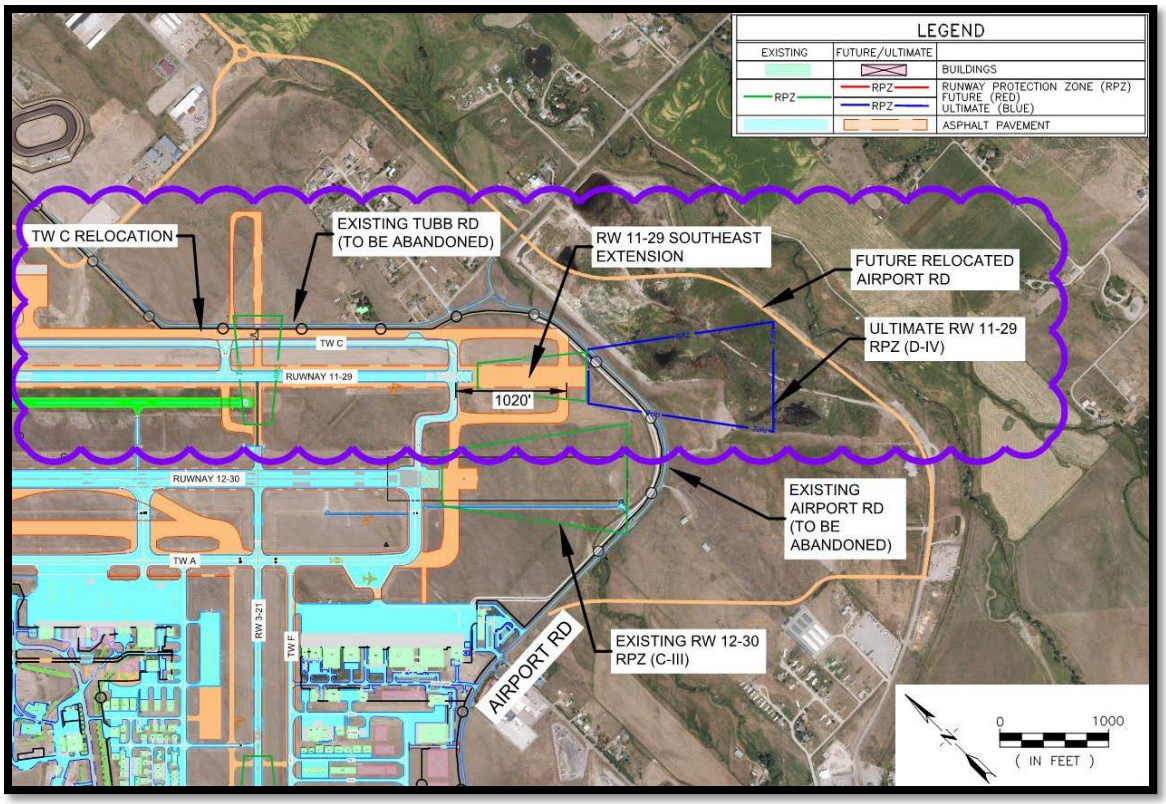

Figure 4-4: Runway 11-29 Southeast Extension

The timing of improving Runway 11-29 to additional primary runway standards should consider its potential utility as a redundant runway for use during rehabilitation and other events requiring the closure of 12-30. Ideally, the widening and lengthening of Runway 11-29 should occur prior to major rehabilitation or extension of Runway 12-30 to provide an alternate runway for airlines and other large aircraft during the closure of Runway 12-30.

Runway 3-21

Crosswind Runway 3-21 currently meets the standards of a B-I runway for small aircraft exclusively (under 12,500 pounds gross weight). As a crosswind runway, requirements for Runway 3-21 are based on wind analysis. Analysis of crosswind components at BZN, provided in Chapter 3, *Facility Requirements*, determined a requirement for a crosswind runway to serve up to B-II small aircraft at BZN. The analysis determined that Runway 3-21 should function as a visual, daytime use runway.

The ultimate length justified for Runway 3-21 is up to 5,700'. Previous planning represented on the current Airport Layout Plan depicts Runway 3-21 at 5,700 feet, with future standards according to requirements for D-IV aircraft and future RPZs for non precision Instrument approaches. Current planning for B-II small aircraft and limited to visual, daytime use runway results in smaller RPZs and the ability to adjust thresholds accordingly.

The ability to extend Runway 3-21 to the south is constrained by Interstate 90 public frontage road. The threshold for Runway 3 is displaced to maintain the RPZ for Runway 3 outside this road. With a smaller visual RPZ it is possible to shift the southern threshold of Runway 3 290 feet to the south.

To the north, extension of Runway 3-21 is ultimately constrained by Jetway Drive, a public roadway.

Figure 4-5 depicts a lengthening of Runway 3-21 in two stages. The first stage would lengthen Runway 3-21 by 185 to the northeast to 3,125 feet. At this length, adding a crossing of Runway 11-29 is avoided. Tubb road would be abandoned to allow a clear RPZ and Jetway Drive would be realigned to a new route.

The second stage would lengthen Runway 3-21 by 1,975 feet to an ultimate length of 5,100 feet.

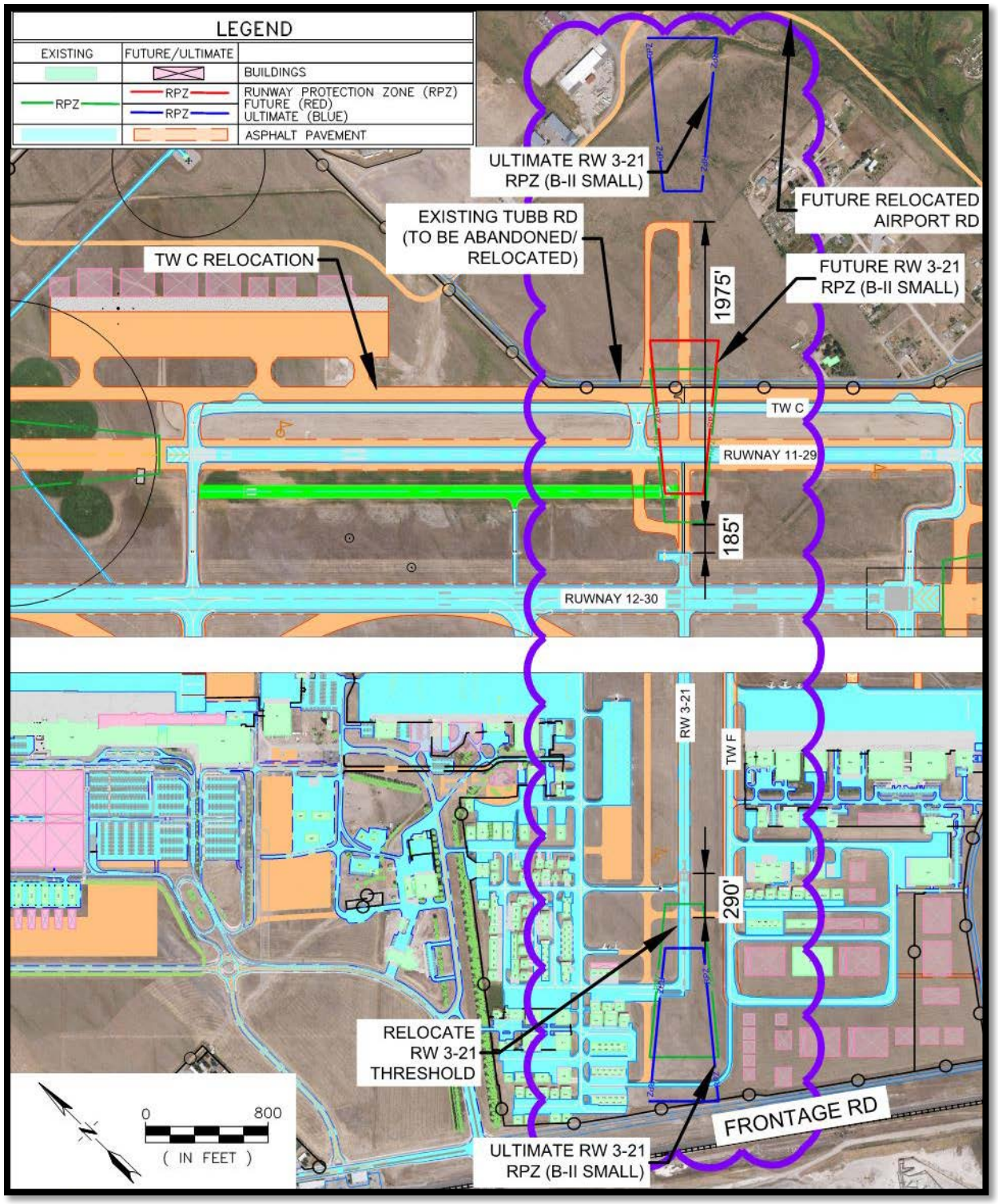

Figure 4-5: Runway 3-21 Extension Phase I, Phase 2

4.3.2 Taxiways

The facility needs evaluation for taxiways at the airport recommended a number of targeted improvements to improve operational efficiency.

- Remove general aviation apron access taxiway that aligns with connecting Taxiway A-2 to create a staggered layout.
- Extend taxiways with runway lengthening projects.
- Consider adding bypass taxiways and secondary parallel taxiways to serve the existing runway system.
- Consider addition of high speed exits for capacity improvement and operational efficiency
- Increase separation between Taxiway C and Runway 11-29 to 400 feet.
- Resolve "hammerhead" taxiway issue at Runway 21 threshold.

With the exception of increasing the separation of Taxiway C and Runway 11-29 to 400 feet, these improvements have limited alternatives beyond build / no build.

Figure 4-6 depicts bypass taxiways on Taxiway A, the parallel taxiway to Runway 12-30. These bypasses are established with the addition of parallel taxiway length corresponding to the lengthening of the ends of Runway 12 and Runway 30. Maintenance of the existing threshold access taxiways creates internal bypass taxiways for the system at minimal cost.

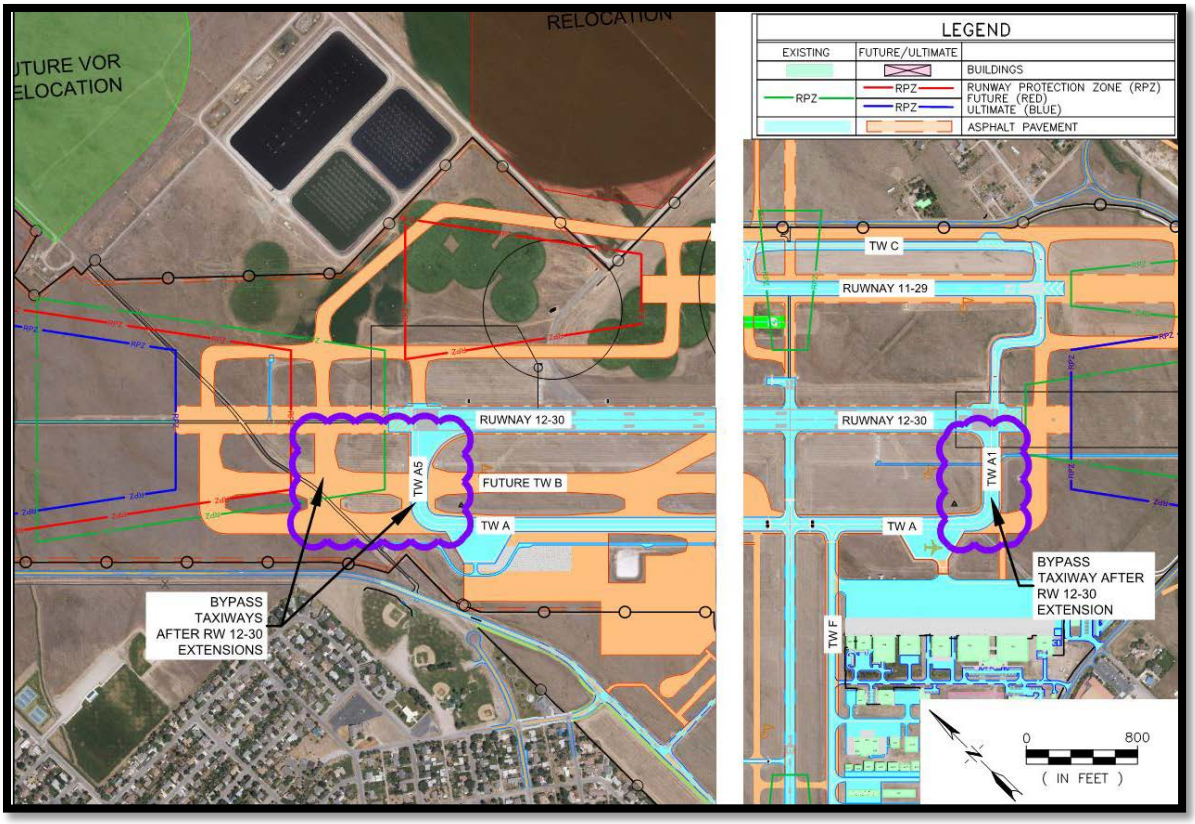

Figure 4-6: Bypass Taxiways Runway 12-30 / Taxiway A

Figure 4-7 shows the addition of high speed exits and a secondary parallel taxiway to the Runway 12-30 / Taxiway A system. **Figure 4-7** depicts a parallel taxiway serving the general aviation development area to the west of Runway 3-21. As noted in Chapter 3, *Facility Requirements*, high speed exits increase capacity by speeding the clearing of the runway by landing aircraft. Secondary parallel taxiways improve operational efficiency by allowing for separation between larger and faster aircraft from smaller and slower aircraft and also by offering the possibility of bi-directional taxiing.

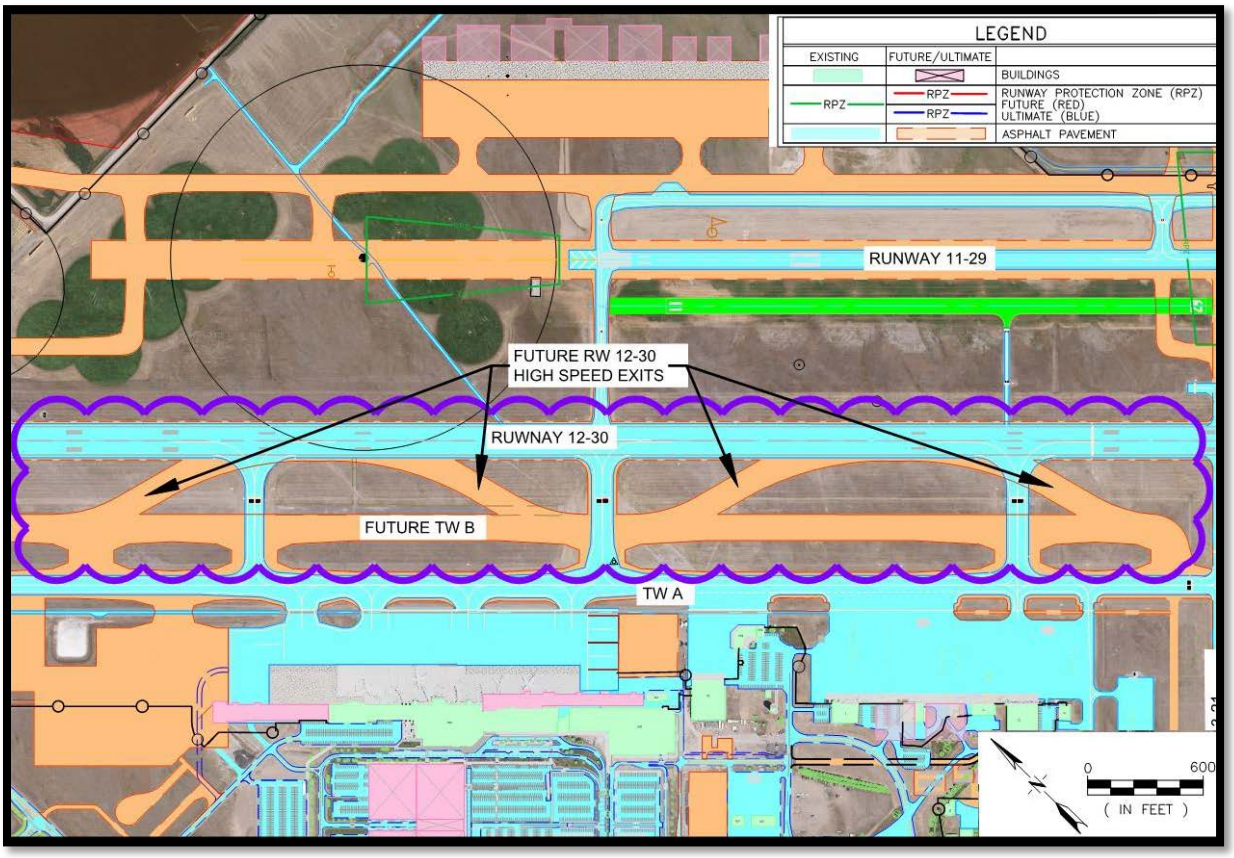

Figure 4-7: Taxiway A, Secondary Parallel Taxiway and High Speed Exits

Taxiway C and Runway 11-29 have an existing centerline to centerline separation of 307.5 feet. A separation of 400 feet will be required when the runway is upgraded to D-IV standards. A 93 foot shift to north is shown in **Figure 4-8**. This shift requires the abandonment of Tubb Road as shown.

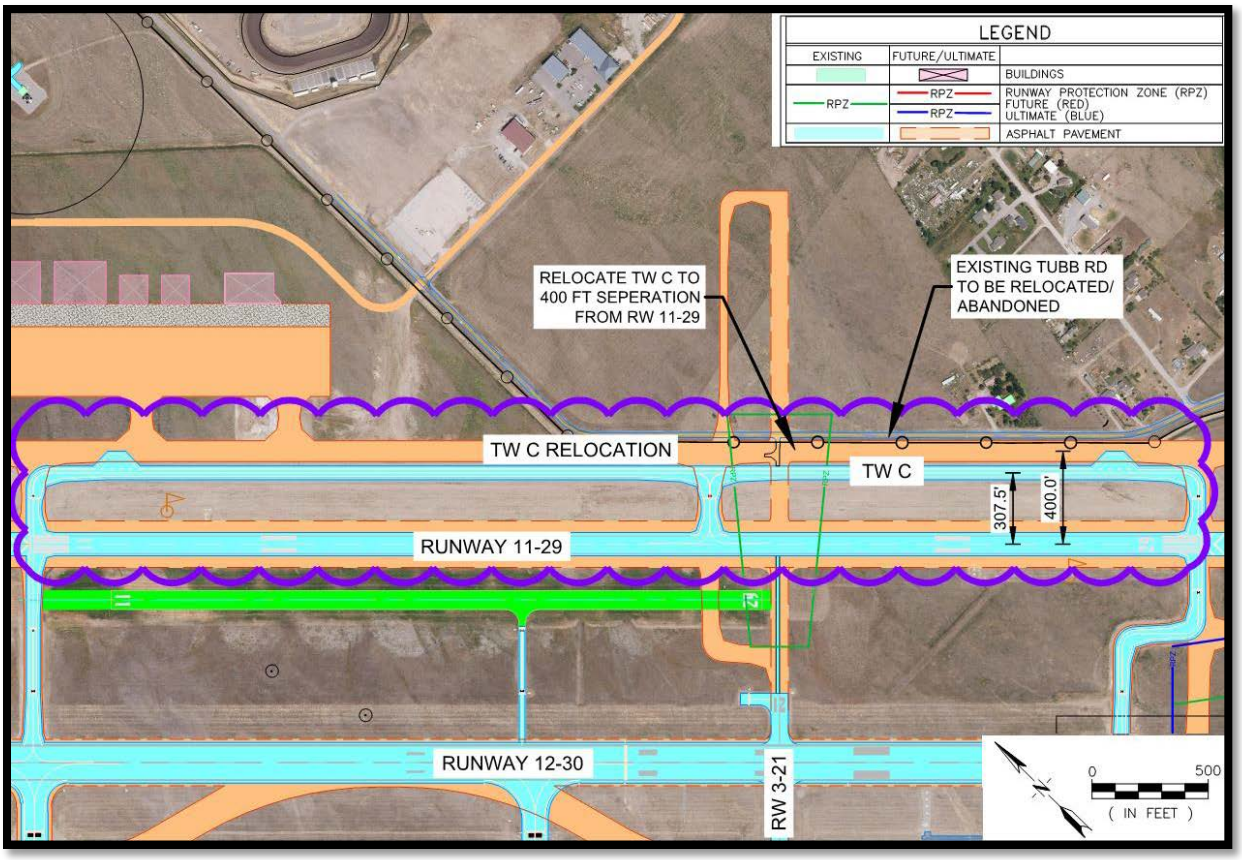

Figure 4-8: Increase Separation of Runway 11-29 and Taxiway C to 400 feet

An issue has been noted with the existing "hammerhead" turnaround taxi segment at the existing threshold of Runway 21. This turnaround is located at on offset of less than 400 feet from Runway 12-30. If the segment is defined as a parallel taxiway, this is a non-standard condition. Plans for the extension of Runway 3-21 will include removal of this segment and construction of a taxiway connector to Runway 11-29 at an appropriate minimum offset as shown in **Figure 4-9**.

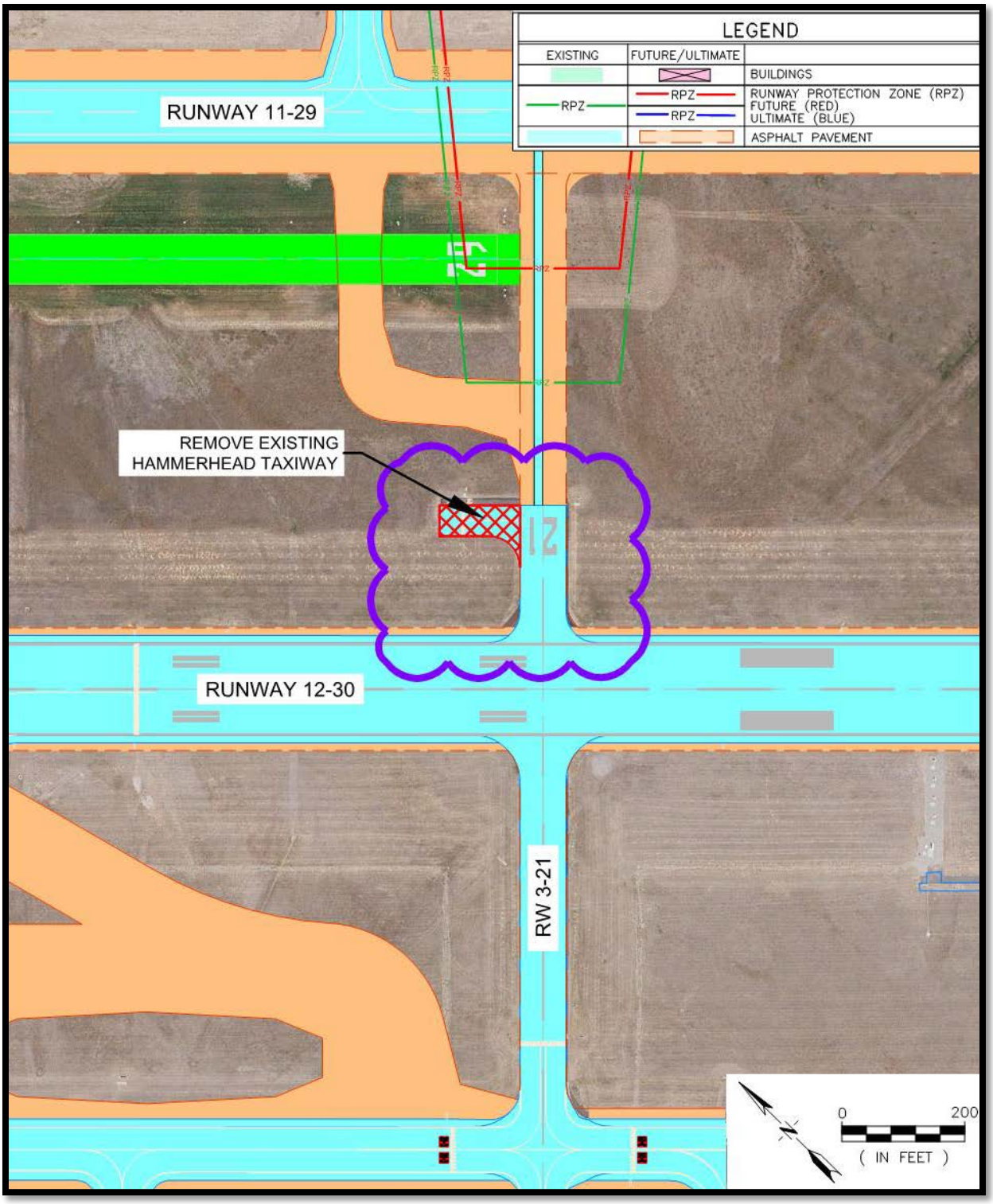

Figure 4-9: Runway 3-21 "Hammerhead" Taxiway Removal

Figures 4-10, **4-11** and **4-12** show a progression of the recommended airside development alternatives from current, existing conditions, to phased "future" and, finally, "ultimate" conditions.

Figure 4-10: Current Airfield Layout

Figure 4-11: Recommended Future Airfield Layout

Figure 4-12: Recommended Ultimate Airfield Layout

4.3.3 Instrument Approaches, Lighting, Visual Approach Aids

Runway 12-30

Currently, Runway 12 is classified as a precision approach category I (CAT I) runway. Runway 12 is served by an Instrument Landing System (ILS) consisting of a glide-slope, localizer and a Medium-intensity Approach Lighting System with Runway alignment indicator (MALSR).

A CAT I runway is defined as being a runway with an instrument approach procedure which provides for approaches to a decision height of not less than 200 feet and visibility of not less than ½ mile. The decision height for ILS Runway 12 is 200 feet with a visibility minimum of ½ statute mile.

Improvement to the minimums of Runway 12-30 could be attained with designation as a Category II Runway with a Runway Visual Range (RVR) of 1,200 feet (1/4 mile).

The RVR is a system that measures visibility, background luminance, and runway light intensity to determine the distance a pilot should be able to see down the runway. An RVR system consists of sensors and monitoring equipment that interface with the Automated Surface Observing System (ASOS) to provide pilots with real time takeoff and landing visibility information.

FAA Order 8400.13E addresses the ground equipment requirements necessary for approval of a CAT II approach visibility minima as low as RVR 1200. To be eligible for standard CAT II operations at RVR 1200, runways must have at least the following ancillary components:

- Approach Lighting System with Sequenced Flashing Lights configuration 2 (ALSF-2)
- High Intensity Runway Lights (HIRL),
- Touchdown Zone (TDZ) lighting
- Runway Centerline lighting (RCL)

It is recommended that BZN plan for a Category II approach designation and an ultimate RVR of 1200 on Runway 12-30.

Runway 30 currently has two NPI approaches

- RNP Runway 30
- RNAV / GPS -A Runway 30

It is recommended that as far as practicable, Runway 30 be brought to the same precision approach standards as Runway 12. This could include the addition of ILS and approach lighting or using GPS technology such as an LPV approach.

Runway 11-29

Runway 11-29 does not have a published approach at this time. The separation between Runway 11-29 and Runway 12-30 is not sufficient to allow dual simultaneous precision instrument approaches (a 3,000 – 4,300 foot separation is required). Therefore, precision ILS approaches are not practical for Runway 11-29. However, a "sidestep maneuver" can be authorized by FAA to reduce minimums and provide redundant instrument approaches in the event of closure to Runway 12-30 for construction, maintenance or operational necessity.

Sidestep Minimums are established at some airports, where an ILS approach is installed on one of two parallel runways. The FAA has prescribed straight-in landing minimums to the "other" runway which does not have the localizer installation incorporating a sidestep

maneuver. A Sidestep maneuver is a visual maneuver performed by a pilot at the completion of an instrument approach to permit a straight-in landing on a parallel runway to either side of the runway to which the instrument approach was conducted. Since the glide slope cannot be used all the way to the runway, the landing minimums are greater than the full precision approach, but better than visual circle to land minimums.

Additional future NPI RNAV/GPS approaches on Runway 11-29 should also be accounted for in reserving appropriate setbacks and determining RPZ dimensions.

Runway 3-21

Runway 3-21 does not have a published approach at this time. As noted previously, the analysis of facility requirements in Chapter 3 indicates that it should be planned to remain a visual unlighted runway through the planning horizon.

4.4 Terminal

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 20 aircraft gates. Expansion of the terminal from the current 12 gates to 20 gates is anticipated to be required in the planning horizon.
- Addition of airline ticketing offices (ATO): Additional office space will be required with the entry of new airlines.
- 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 screening 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 secure and non-secure side concessions
- Additional secure and non-secure side restroom space

Six conceptual terminal expansion schemes were evaluated in the previous master plan for BZN.

The six schemes were refined into 2 concepts; a "T" concept and a linear concept. The linear concept, was chosen. This linear model has served as the basis for two major terminal expansion projects. Continuation of the linear expansion concept will continue in future planning with expansion of concourses to northwest

Figures 4-14 through **4-19** show a conceptual linear expansion of the terminal to a 20 gate facility. An expansion of the building to the northwest accommodates future airline ticketing and office space needs as well as baggage makeup. baggage claim, holdroom space, secure and non-secure side concessions space new administrative space,

expanded baggage claim and additional secure and non-secure side restrooms.

As shown on **Figure 4-13**, the layout includes expansion of the commercial apron parking layout with a consolidated de-icing apron to the west. Expansion of terminal auto parking areas is shown with the incorporation of a multi-level parking structure recognizing limited available land for terminal parking within optimal walking distances. Terminal curbside capacity is expanded with the addition of a separate parking area within the short term lot for ground transportation vehicles.

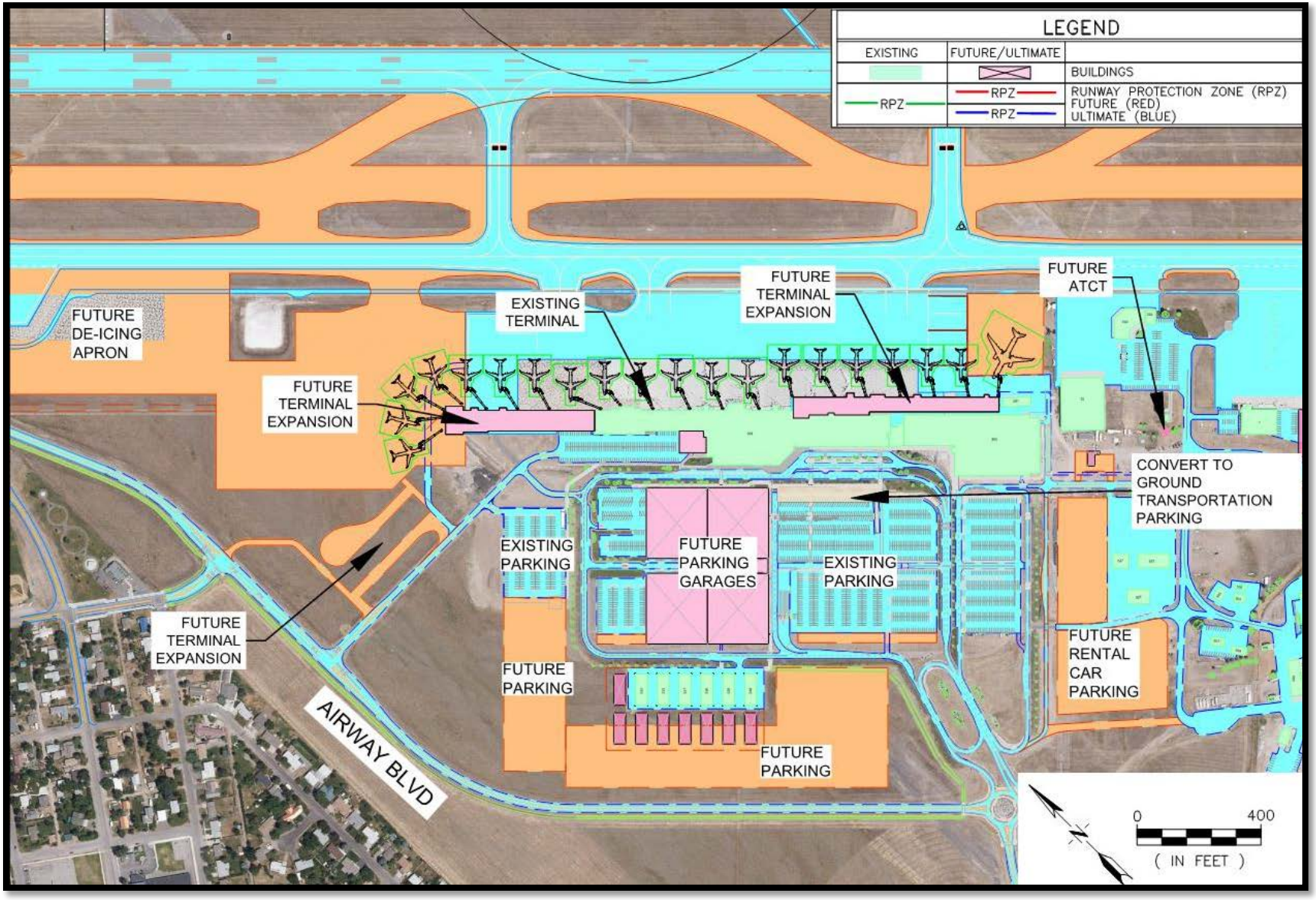

Figure 4-13 Terminal Area

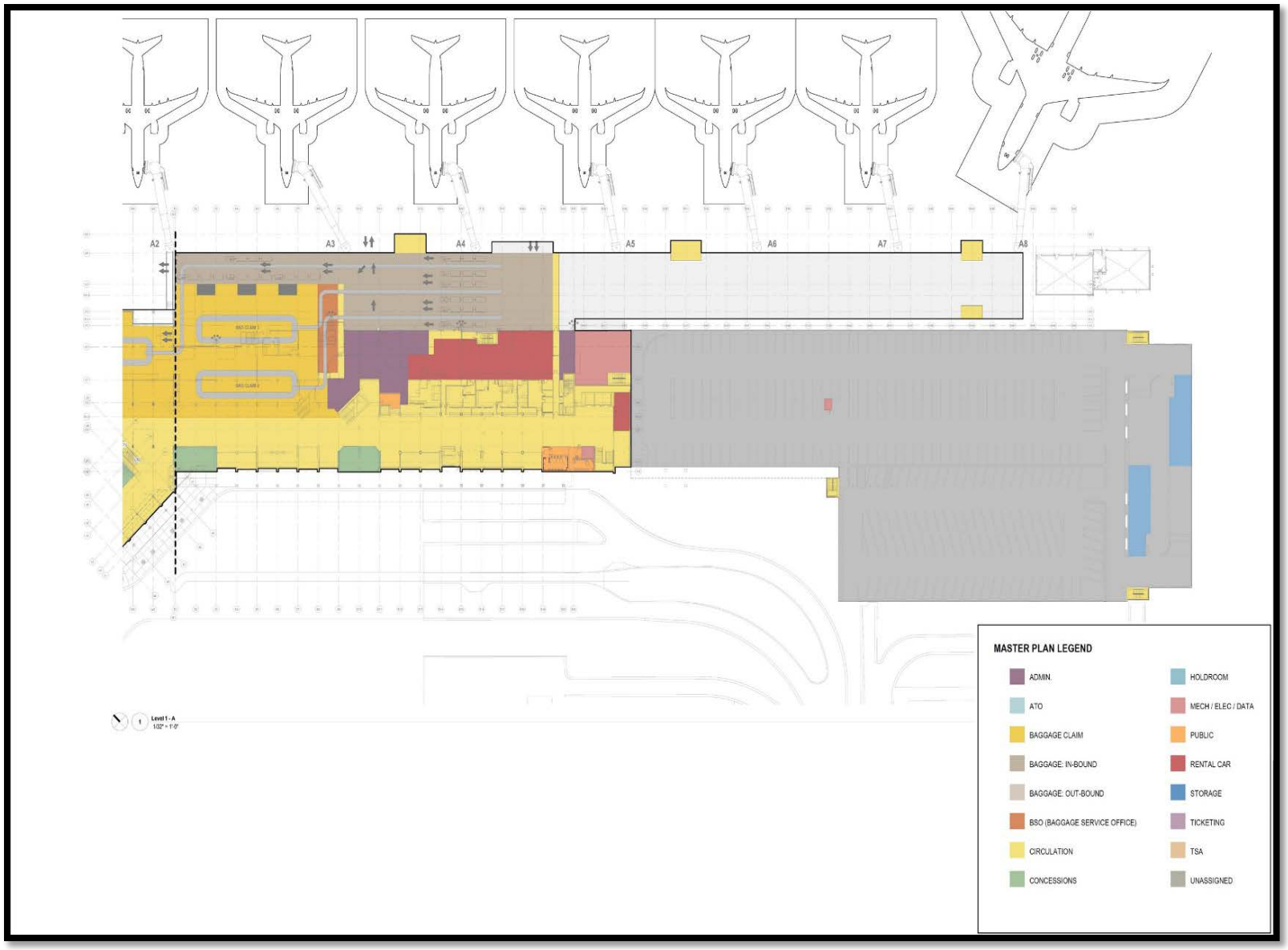

Figure 4-14: Terminal Lower Level (1 of 3)

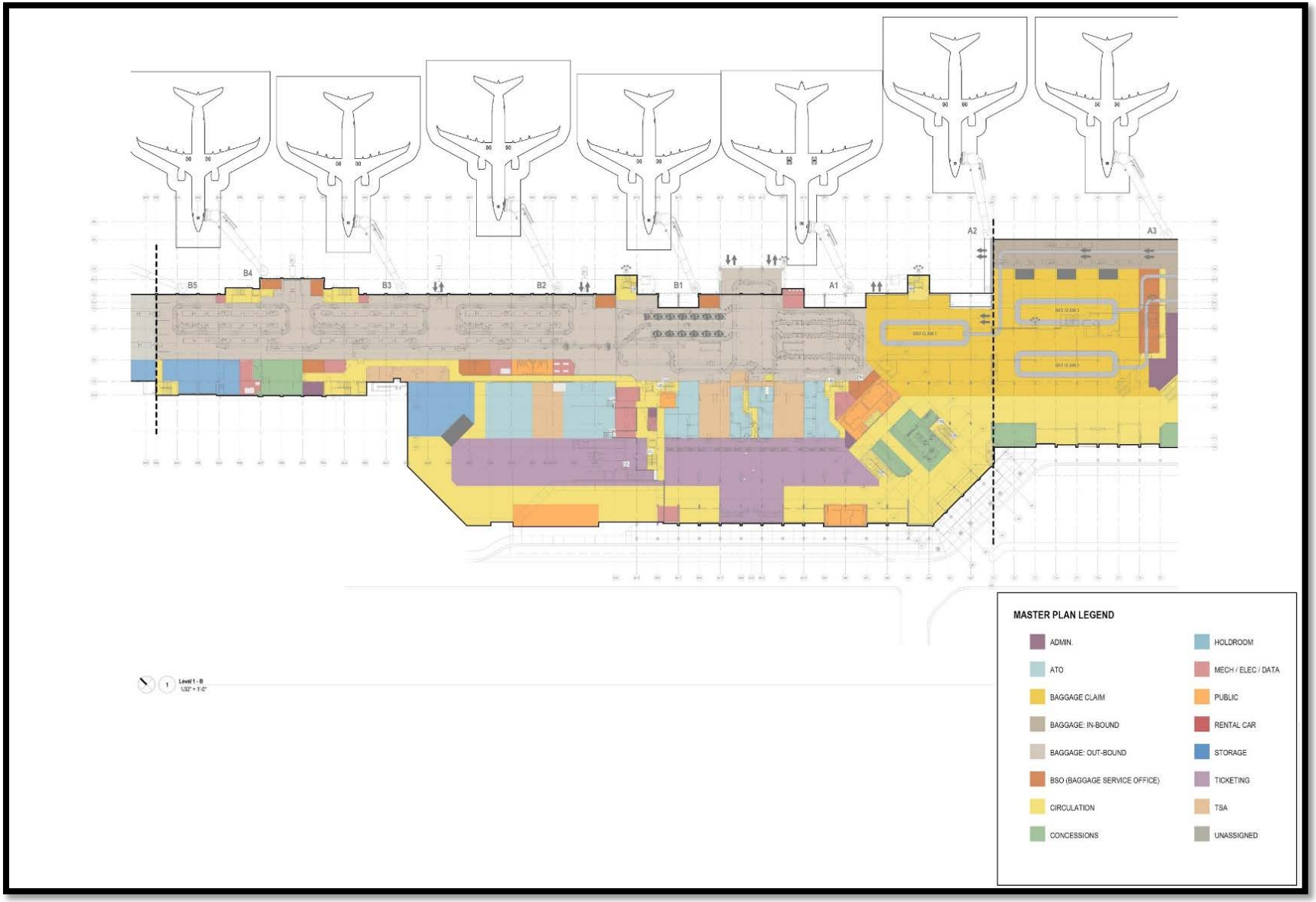

Figure 4-15: Terminal Lower Level (2 of 3)

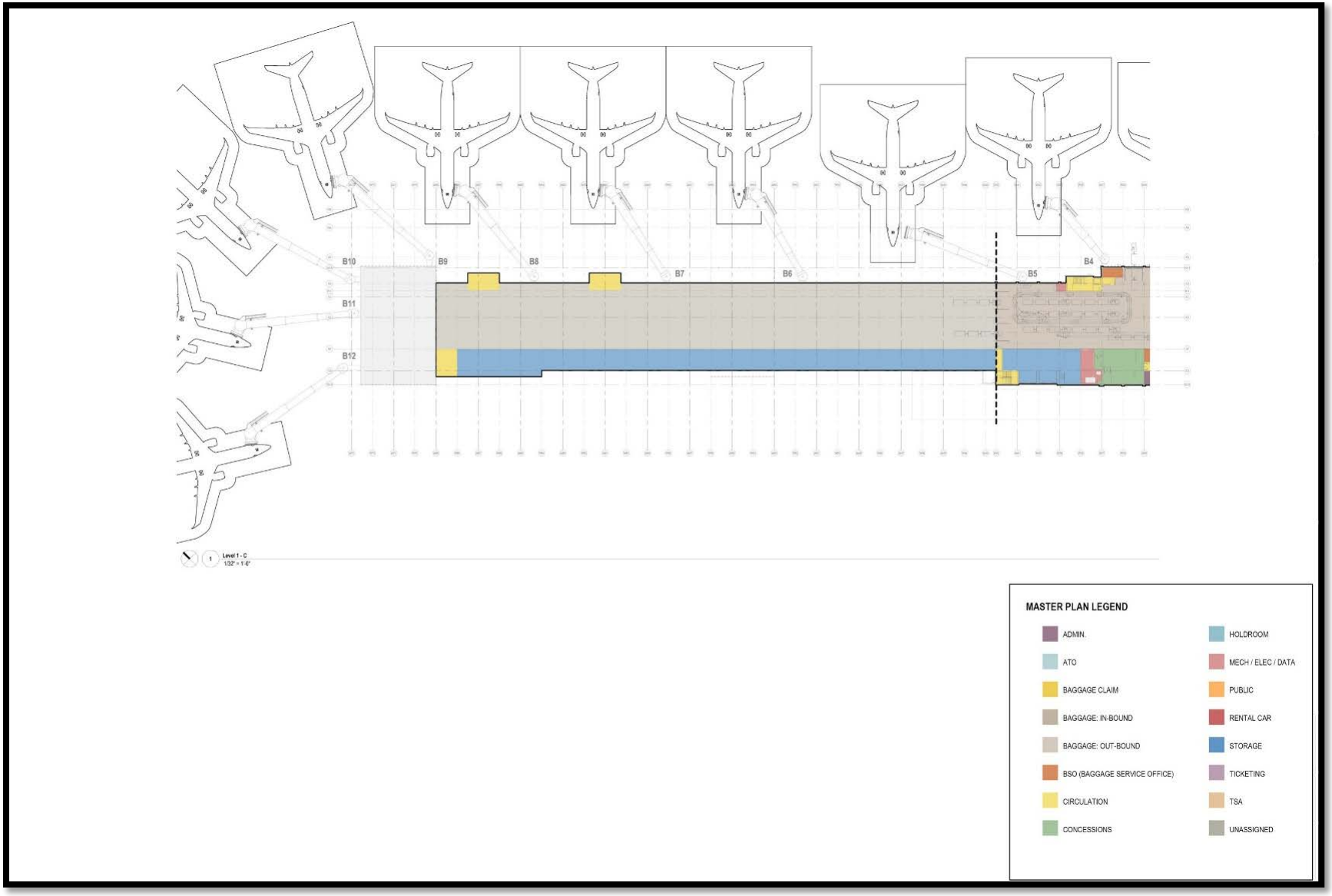

Figure 4-16: Terminal Lower Level (3 of 3)

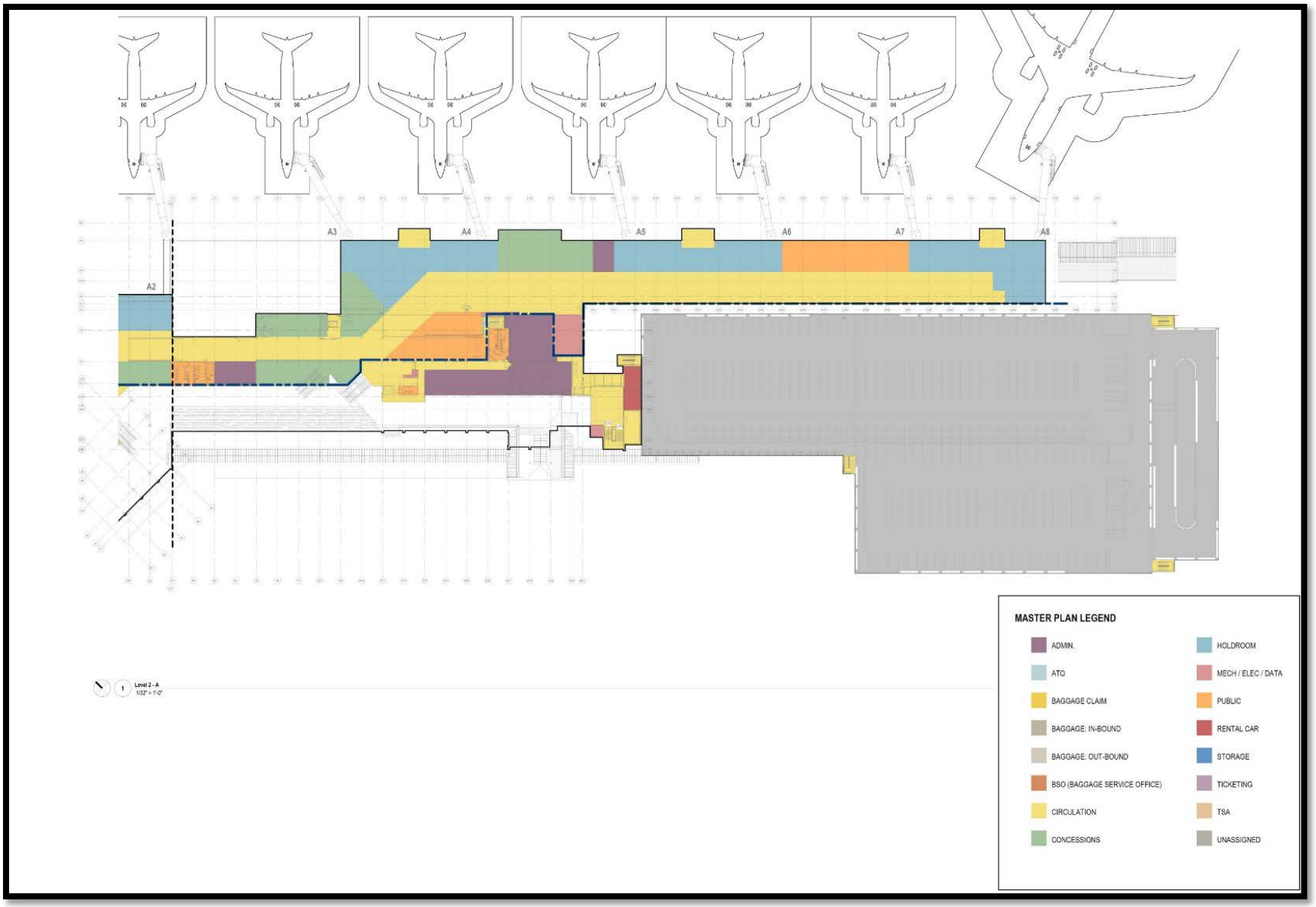

Figure 4-17: Terminal Upper Level (1 of 3)

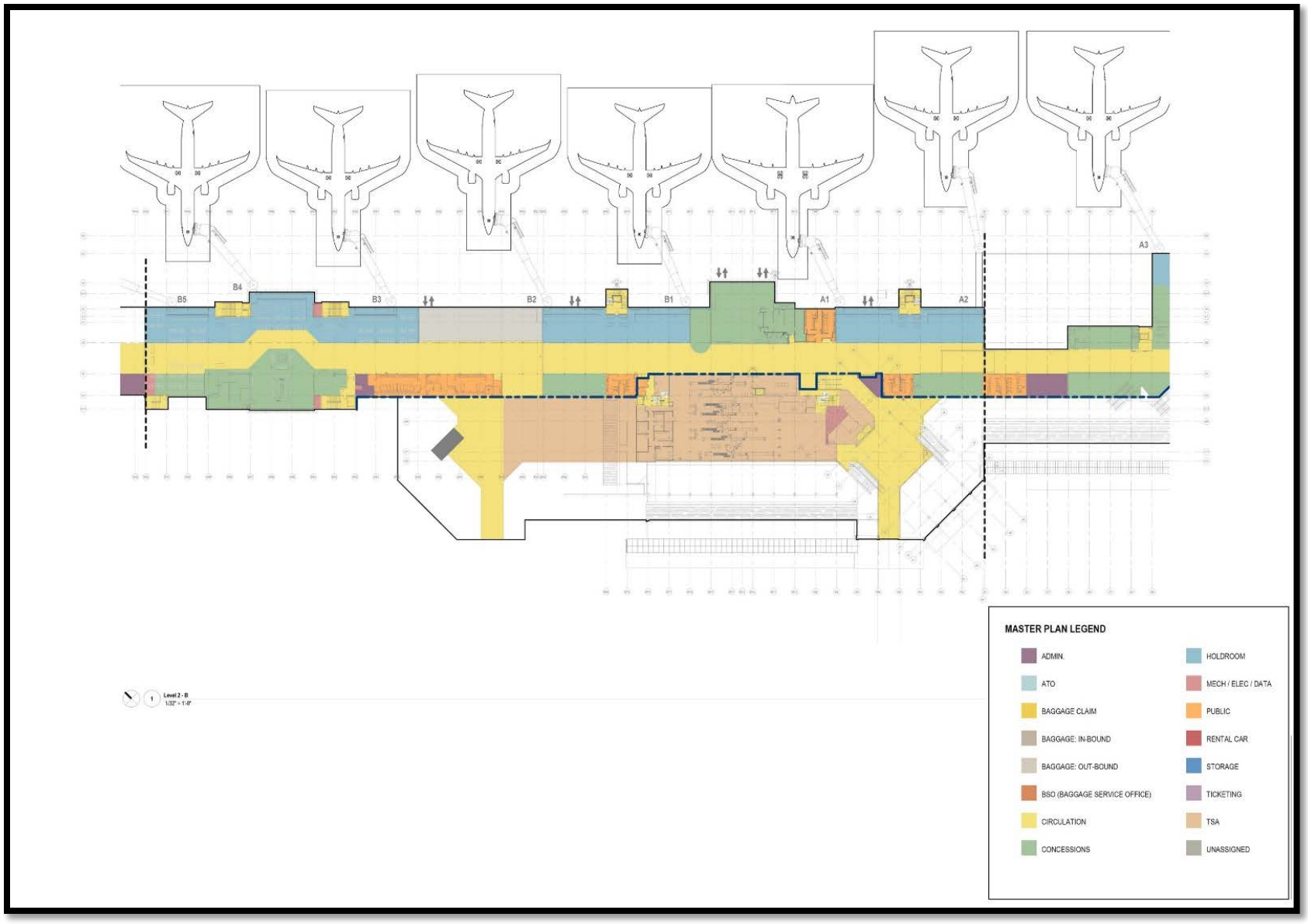

Figure 4-18: Terminal Upper Level (2 of 3)

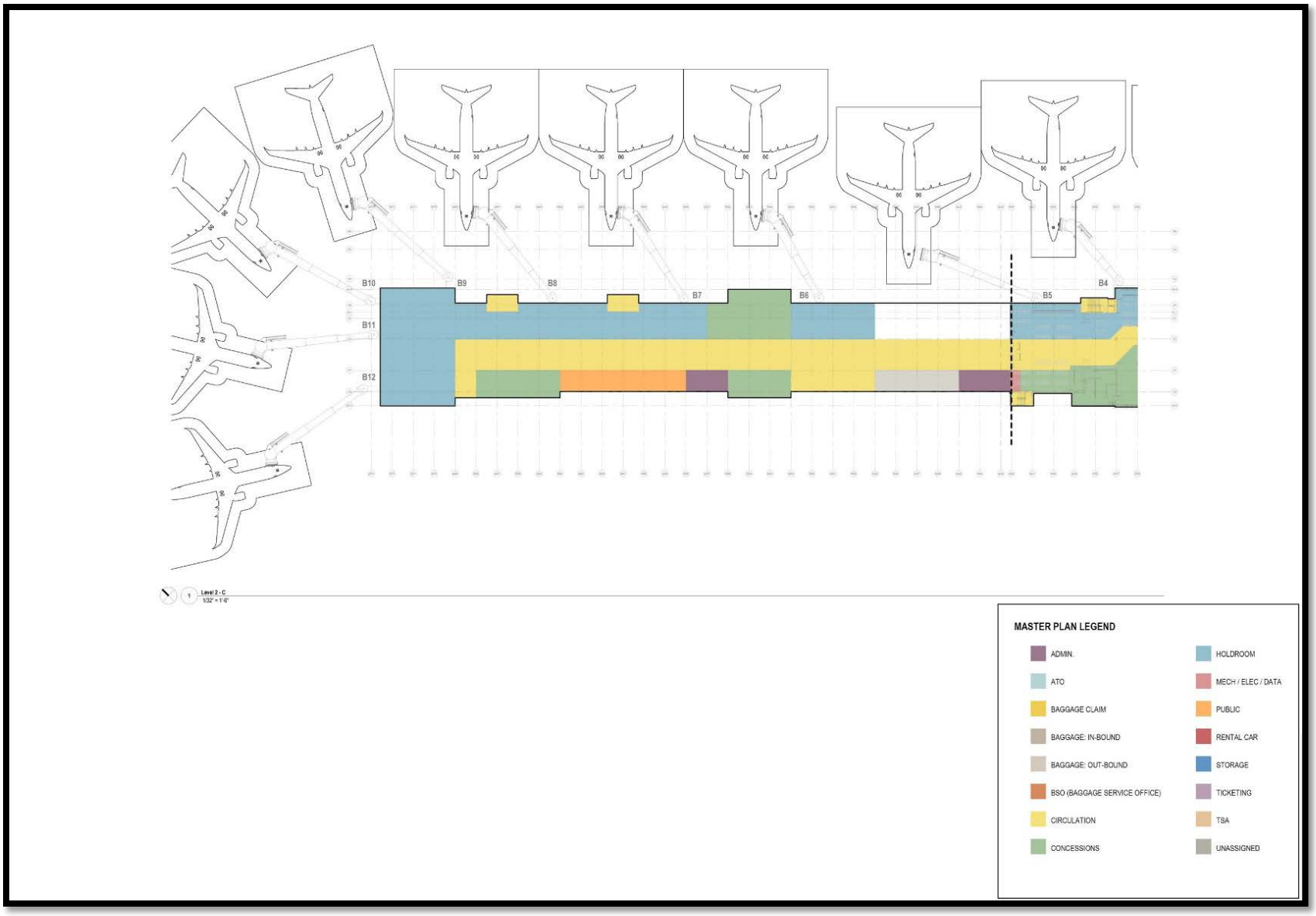

Figure 4-19: Terminal Upper Level (3 of 3)

4.5 General Aviation Alternatives

Considerations relative to potential general aviation alternatives include:

- **Additional storage hangars**
  The facility needs evaluation has projected the need for as many as 189 additional storage positions, for both small and large aircraft.

- **Aircraft Parking Apron**
  There is currently approximately 151,000 square yards of parking apron in the general aviation area, which includes the general aviation ramp, the general aviation tie down area and the east ramp. The results of the facilities requirements analysis indicate that additional apron space and parking positions are needed immediately and through the planning period.

Arrangements of a variety of hangar types and sizes and associated taxilanes and aprons are identified on **Figures 4-20** through **Figure 4-23**. **Figure 4-20** depicts the historic general aviation area. This area is nearing buildout and has limited options for alternate development patterns. A relocation of Wings Way is shown for interior circulation to allow limited new hangar development. **Figures 4-21** and **4-22** show two alternative layouts for the east ramp hangar development area.

Expansion of the GA tie down apron is shown in **Figure 4-20.** The aprons at the existing east ramp general aviation area are currently built out. New apron space to accommodate current and future demand, as well as a mixture of small conventional hangars, t-hangars and large executive hangars is shown north of Runway 11-29 in **Figure 4-23.** A future hangar development area is also reserved to the northwest of this area for the long term future.

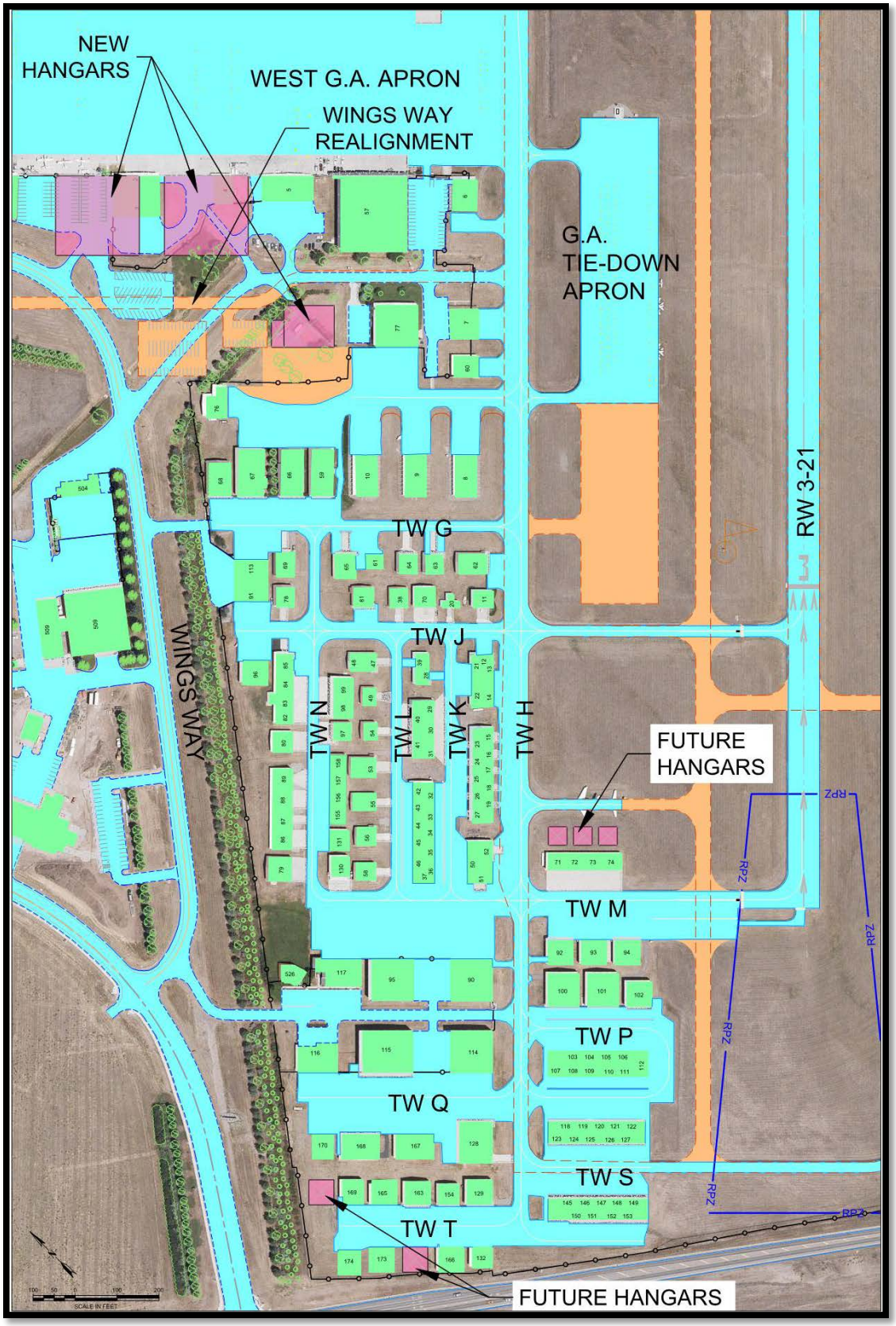

Figure 4-20: West GA Area

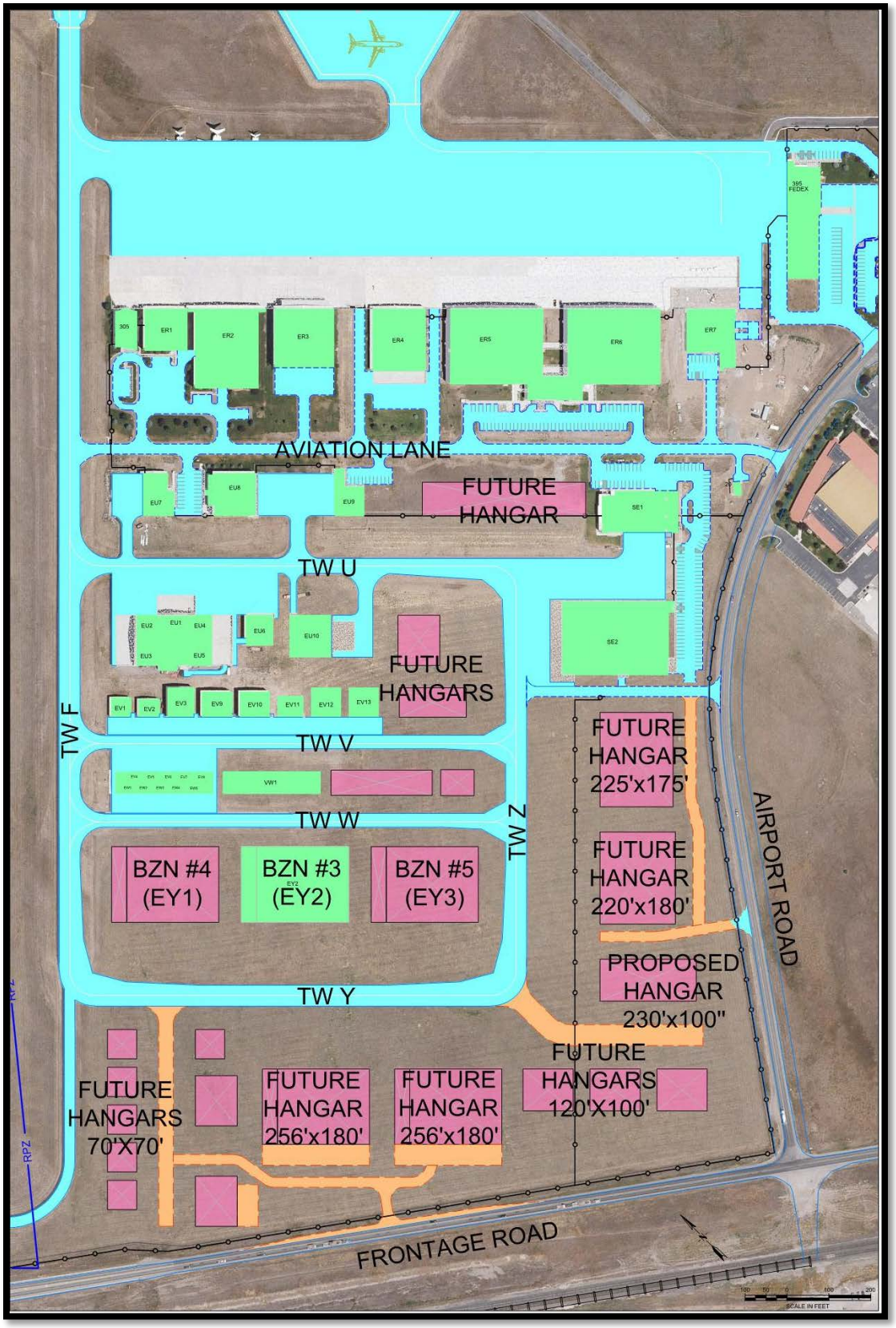

Figure 4-21: East GA Area – Alternative 1

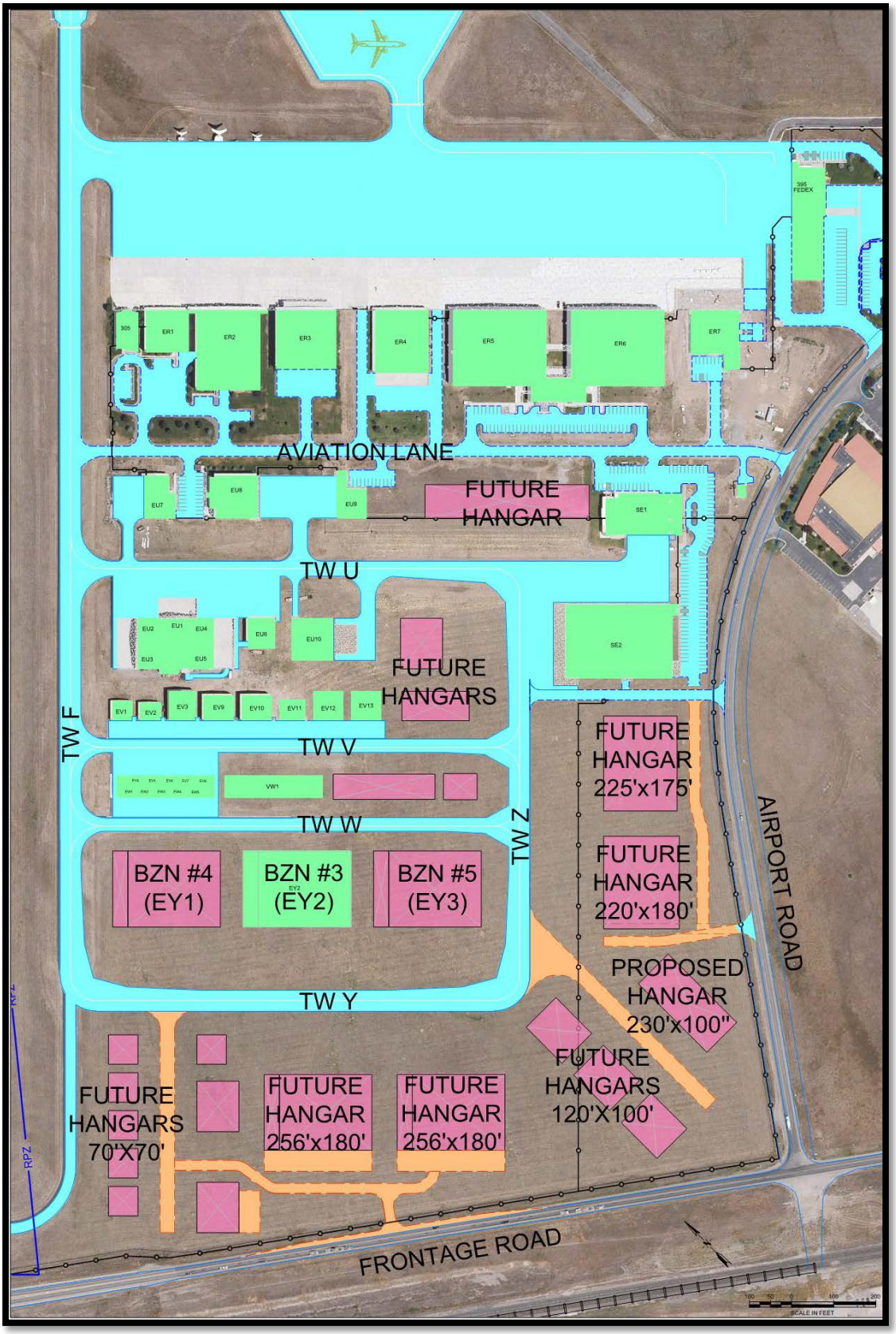

Figure 4-22: East GA Area – Alternative 2

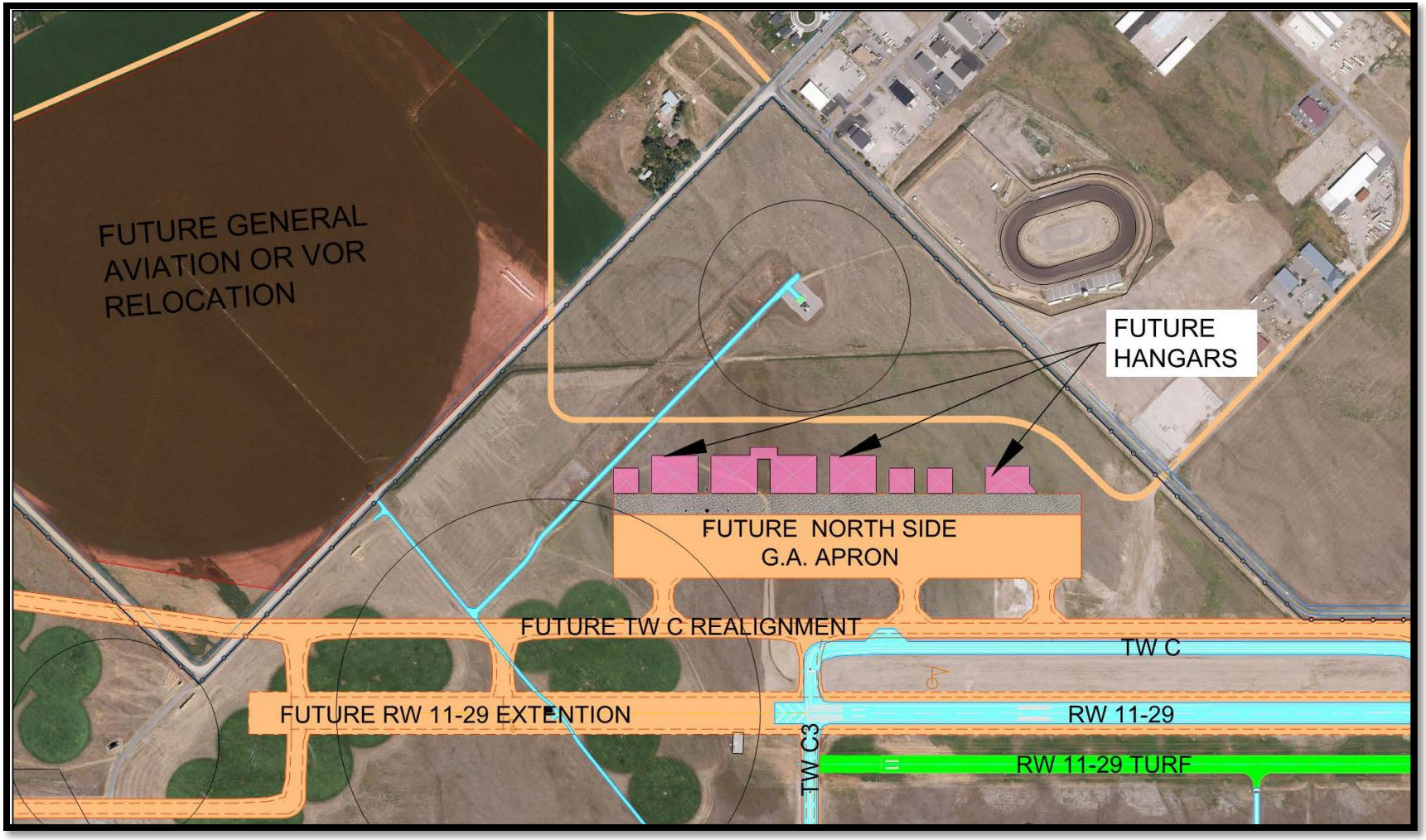

Figure 4-23: North GA Area