MIDDLEBURY STATE AIRPORT (6B0)

Airport Master Plan (DRAFT Working Paper #2)

May 2022

VERMONT AGENCY OF TRANSPORTATION

Prepared By:

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3 Facility Requirements

This chapter analyzes the ability of the Middlebury State Airport (6B0) and its existing facilities to accommodate the current and anticipated levels of activity as described in **Chapter 2, *Forecast of Aviation Activity***. The identified facilities include the following general categories:

- Airside Facility Requirements
- Landside Facility Requirements

The Facility Requirements analysis provide a basis for assessing the capability of existing Airport facilities to accommodate current and future levels of activity. The evaluation of this relationship frequently results in the identification of deficiencies that can be alleviated through planning and development activities. Analyses of various airside and landside functional areas were performed with the guidance of several publications, including:

- Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13B, *Airport Design*
- AC 150/5060-5, *Airport Capacity and Delay*
- AC 150/5325-4B, *Runway Length Requirements for Airport Design*

The facility requirement calculations were developed for the planning period of 2021 through 2041 and were based on various forecast components and should be regarded as generalized planning tools. Should the forecast prove conservative, the schedule for proposed developments may be advanced. Likewise, if traffic growth does not materialize, deferral of additional facilities may be practical.

3.1 Forecast Summary

Table 3-1 provides a summary of the preferred forecasts presented in **Chapter 2**, which have been used to estimate when activity levels will trigger the need for various improvements. In addition, this table provides forecasted peak operations (with a peak month of July), by month, day, and hour. Note that some airfield facilities are recommended for safety improvements, and not dependent on a specific airport activity level.

Table 3-1 – Forecast Summary

	Planning Period (year)			
Activity	**2026**	**2031**	**2036**	**2041**
Annual Operations	6,677	6,962	7,259	7,569
Peak Operations				
Peak Month	987	1,029	1,073	1,119
Peak Day (PMAD)	50	52	54	56
Peak Hour	7	8	8	8
Based Aircraft	32	34	36	39

Source: CHA, 2022.
Note PMAD – Peak Month Average Day

3.2 Airside Facility Requirements

It is important for airports to assess their existing infrastructure to determine the need for future improvements and associated airfield requirements. The airside facility requirements analysis includes an examination and evaluation of:

- Design Aircraft
- Runway Design Standards
- Taxiway Design Standards
- Airfield Capacity
- Runway Length Analysis
- Wind Coverage
- Airfield Pavement
- Lighting and Visual Aids
- Instrument Approach Procedures

The following provides a description of each item and an evaluation of existing and future requirements according to current FAA and industry standards.

3.2.1 Design Aircraft

The design, or critical, aircraft is defined as the most demanding aircraft operating or projected to operate on the airport's runway, taxiway, or apron. According to the FAA, the design aircraft can be either a specific aircraft model or a composite of several aircraft and must account for a minimum of 500 annual itinerant operations (i.e., an average of five landings per week). As defined within the **Chapter 2**, the design aircraft is classified using three parameters:

- ***Aircraft Approach Category (AAC):*** Consists of a letter (e.g., A through E) corresponding to the design aircraft's approach speed in landing configuration.
- ***Airplane Design Group (ADG):*** Consists of a Roman numeral (e.g., I through VI) corresponding to the design aircraft's wingspan or tail height, whichever is most restrictive.
- ***Taxiway Design Group (TDG):*** Consists of a number (e.g., 1 through 7) corresponding to the Main Gear Width (MGW) and the Cockpit to Main Gear (CMG) distance.

The identified ACC and ADG are combined to form the Runway Design Code (RDC), which specifies the appropriate design standards for the runway. In addition to the ACC and ADG, the RDC consists of a third component related to runway visibility minimums, expressed as Runway Visual Range (RVR). Currently, Runway 1-19 is not equipped with a published instrument approach procedure (IAP). As the runway is classified as a visual only, the third RDC component is labeled as VIS.

As a single runway airport, the RDC for the runway is used to determine the Airport Reference Code (ARC). The ARC is used for airport planning and design purposes and is signified by the highest RDC at the airport. The ARC uses the same classification system as the RDC, minus the runway visibility component.

As Runway 1-19 is classified with an RDC of B-I-VIS, the ARC for 6B0 is correspondingly B-I. As discussed in **Chapter 2**, the ADG class with the majority of operations at the Airport is A-I and A-II, however there is still consistent activity from aircraft as high as ADG B-II. Given this, and that the fleet mix consists of many older and out-of-production aircraft, there was not a specific critical aircraft applied. Rather, a grouping of light, multi-engine piston aircraft such as the Cessna 421; and light, turboprop aircraft such as the Piper Cheyanne. Additionally, it is important to note that the airport is limited to regular use by aircraft less than 12,500 pounds in weight. As such, all design standards referenced in this chapter moving forward will adhere to B-I Small Aircraft parameters published in the FAA AC 150/5300-13B, *Airport Design.* "B-I" and "B-I Small" will be used interchangeably throughout this chapter. As the fleet mix within the forecast period is not anticipated to substantially change, it is recommended that ARC B-I is maintained.

Note that occasional use by larger aircraft (e.g., Beech King Air, Citations) is permitted at the Airport and at the pilot's discretion, but these aircraft are not the intended user, and facilities will remain designed for small aircraft.

Table 3-2 summaries the classifications applicable to 6B0 throughout the planning period.

Table 3-2 – Runway Design Code Analysis Summary

Runway	AAC	ADG	RVR
1-19	B	I	VIS (i.e., Visual Approach)

Source: FAA AC 150/5300-13A, *Airport Design*

3.2.2 FAA Design Standards

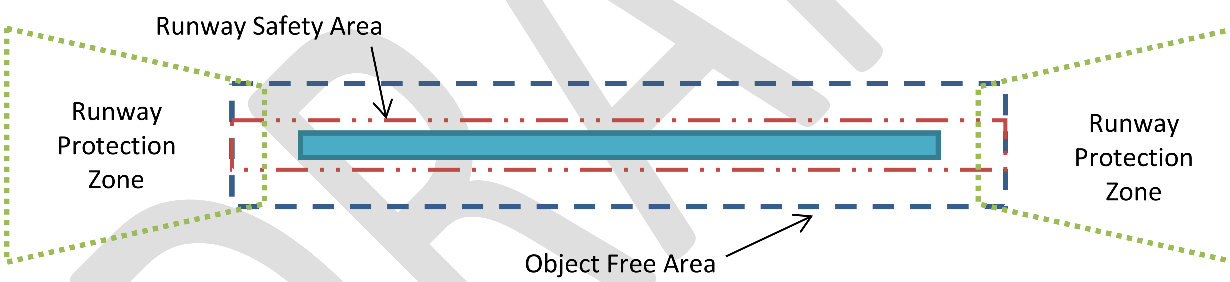
AC 150/5300-13B identifies safety areas and zones surrounding runways and taxiways that must be protected from objects, hazards, or obstacles that may impact safety. The key standards that protect the runway and taxiway areas consist of the following:

- ***Runway Safety Area (RSA) and Taxiway Safety Area (TSA):*** The RSA is a defined surface surrounding a runway prepared for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway. This area must also support snow removal, aircraft rescue, and firefighting vehicles/equipment. The RSA should be free of objects, except for those that must be located in the area because of their function. The TSA is a defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft deviating from the taxiway. RSA and TSA are graded, drained, and maintained, and typically consisted of a stabilized mowed grass area. Safety area enhancement projects are considered high priority by the FAA.

- ***Runway Object Free Area (ROFA) and Taxiway Object Free Area (TOFA):*** The ROFA and TOFA are areas centered on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by remaining clear of objects (e.g., roads, buildings, parked aircraft, etc.), except for those that need to be within the area due to their function. There are no surface requirements for an OFA.
- ***Runway Protection Zone (RPZ):*** The RPZ is a trapezoidal area generally offset 200 feet from each runway end that is used to enhance the protection of people and property on the ground. The FAA encourages airport property ownership and compatible land uses within each RPZ and clearing of all above ground objects. Homes, other buildings, and wildlife attractants are considered incompatible land uses within an RPZ. Trees are not specifically prohibited (if not an airspace penetration) but are discouraged within the RPZ.
- ***Runway Object Free Zone (ROFZ):*** The ROFZ is centered about the runway with an elevation the same as the nearest point on the runway centerline. Objects that are not fixed-by-function are not permissible within the ROFZ.

Figure 3-1 depicts the discussed FAA design standards.

Figure 3-1 – FAA Safety Areas and Runway Protection Zones



The spatial dimensions of the RSA/TSA, ROFA/TOFA, and RPZ are defined by the RDC. **Table 3-3** presents the current FAA design standards applicable to 6B0.

Table 3-3 – Runway and Taxiway Design Standards

Airfield Area	Runway 1-19 (RDC B-I-VIS – TDG 1)
Runway Width	60'
RSA	
- Width	120'
- Length Beyond Runway End	240'
- Length Prior to Threshold	240'
ROFA	
- Width	250'
- Length Beyond Runway End	240'
- Length Prior to Threshold	240'
ROFZ	
- Width	250'
- Length Beyond Runway End	200'
Approach RPZ	
- Length	1,000'
- Inner Width	250'
- Outer Width	450'
Departure RPZ	
- Length	1,000'
- Inner Width	250'
- Outer Width	450'
Taxiway Width	25'
Taxiway Centerline to	
- Fixed or Movable Object	44.5'
Taxilane Centerline to	39.5'
- Fixed or Movable Object	
TSA	49'
TOFA	89'
Taxilane OFA	79'

Source: FAA AC 150/5300-13B, *Airport Design*

Additionally, Runway 1-19 has published declared distances (**Table 3-4**), including a 141-foot displacement on the Runway 1 end, to accommodate non-standard terrain south of the runway.

Table 3-4 – Declared Distances

Declared Distance	Runway 1 End	Runway 19 End
Take Off Run Available (TORA)	3,206'	3,206'
Take Off Distance Available (TODA)	3,206'	3,206'
Accelerate Stop Distance Available (ASDA)	3,206'	3,065'
Landing Distances Available (LDA)	3,065'	3,065'

3.2.3 Runway Design Standards

Using the FAA design standards listed in **Table 3-3**, this section reviews the existing runway conditions at 6B0 and discusses any related deficiencies. **Figure 3-2** depicts Runway 1-19 safety and object free areas.

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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

0 200 400 800

LEGEND

- Airport Property Boundary
- ### Ground Contour (Feet MSL)
- ROFA Runway Object Free Area
- RSA Runway Safety Area
- TOFA Taxiway Object Free Area
- TSA Taxiway Safety Area
- OFZ Obstacle Free Zone
- RVZ Runway Visibility Zone
- Navaid Critical Area

Figure 3-2
6B0 Safety Areas

3.2.3.1 Runway Width

Prior to the 2017 runway reconstruction project (discussed within Chapter 1), Runway 1-19 was 50 feet in width. However, the reconstruction project widened the runway to the current width of 60 feet per RDC B-I-VIS standards, as listed on **Table 3-3**. As such, the current runway width is adequate and should be maintained throughout the planning period.

3.2.3.2 Runway Safety Area (RSA)

According to AC 150/5300-13B, the standard RDC B-I runway dimensions include a length beyond and prior to the runway end of 240 feet and may have a width as narrow as 120 feet. Additionally, the first 200 feet beyond the runway ends must have a grade between zero and three percent.

The north runway end contains standard RSA grading and remains free of all incompatible objects. However, the terrain approximately 100 feet south of the runway drops off beyond FAA design standards. As such, the Runway 1 threshold is displaced 141 feet and contains declared distances (Table 3-4) effectively providing 240 feet of standard RSA beyond the Runway 1 threshold.

3.2.3.3 Runway Object Free Area (ROFA)

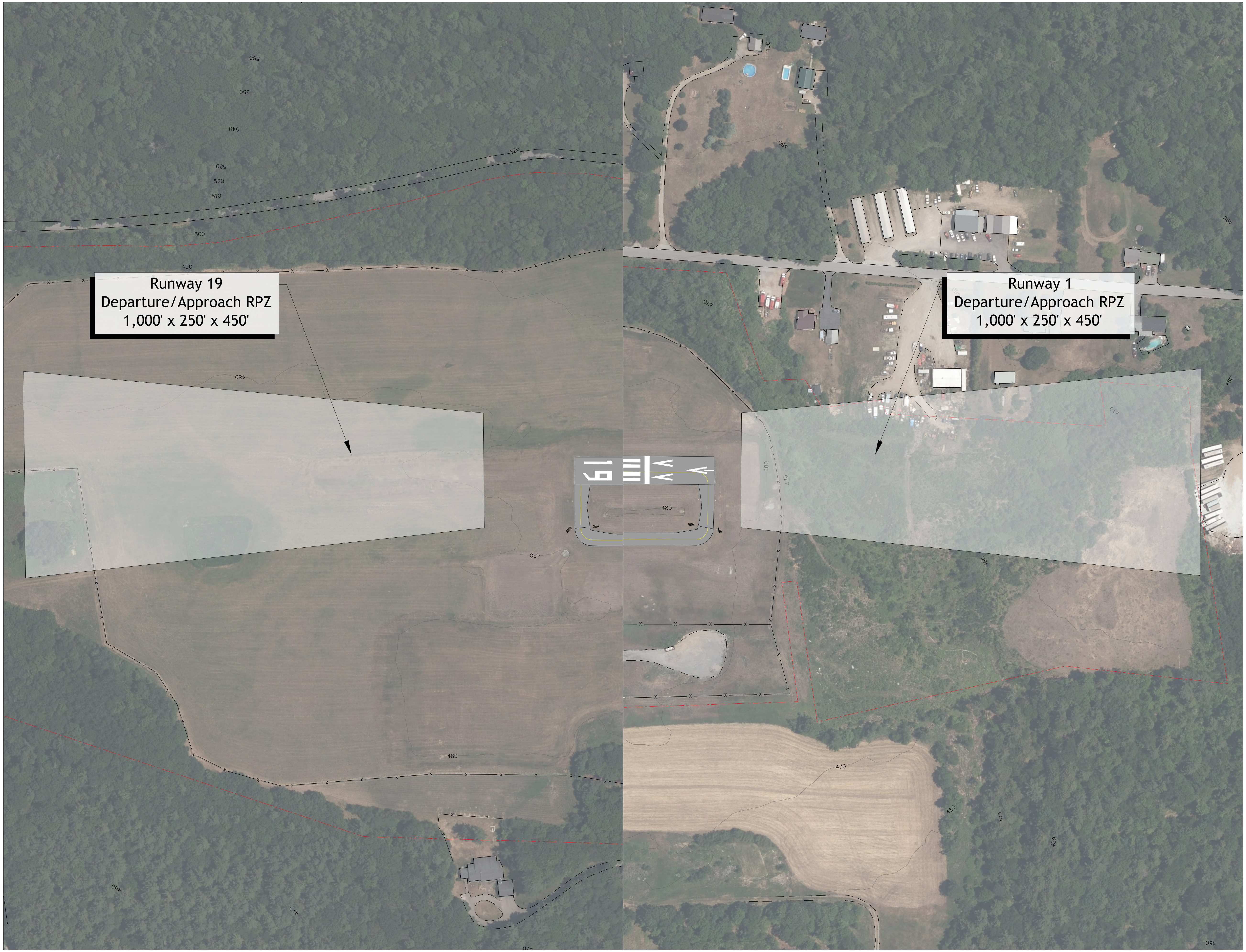
The Runway 1-19 OFA is 250 feet in width and also extends 240 feet beyond each runway end. Although incompatible objects are not permitted within the ROFA, the terrain within the ROFA may decrease. The Runway 1-19 ROFA laterally and beyond the runway ends remains free of incompatible objects and obstructions, partially due to the aforementioned declared distances.

3.2.3.4 Runway Protection Zone (RPZ)

The Runway Protection Zones (RPZ) begins 200-feet from each runway end/threshold. Airport ownership and control of the RPZs, either through easement or acquisition, is desirable to ensure compatible land uses, airspace, and ground protection within the area. As the RPZs are primarily designated to protect people and property on the ground, the FAA considers the clearing of all objects within RPZs a safety benefit. **Figure 3-3** depicts the RWY 1-19 RPZs.

As Runway 1 has a has 141-foot displaced threshold, the Approach and Departure RPZ begin at different locations. The Runway 1 Approach RPZ begins 200 feet from the runway's displaced threshold whereas the Departure RPZ begins 200 feet from the end of the runway. The Runway 1 RPZs share the dimensions (e.g., 250-foot inner width, 450-foot outer width, and 1,000-foot length). Sections the RPZs beyond the airport property boundary containing portions of a private salvage yard and forested area. Easement acquisition should be considered for that area.

The Runway 19 RPZs dimensions are the same as Runway 1 and begin 200 feet from the runway end. The Runway 19 RPZs are entirely located within airport property and are free of incompatible objects.



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MIDDLEBURRY
STATE AIRPORT
MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 100 200 400

LEGEND

- Airport Property Boundary
- ### Ground Contour (Feet MSL)
- RPZ Runway Protection Zone

Figure 3-3
Runway Protection Zones

3.2.4 Taxiway Design Standards

The runway is equipped with a full parallel taxiway, with six designated stub segments as listed within **Table 3-5**. The current width of all taxiways at 6B0 is 25 feet per FAA TDG-1A and 1B design standards.

Table 3-5 - Taxiways

Taxiway	TDG	Width	Taxiway Safety Area	Taxiway Object Free Area
A	2	25 FT	49 FT	89 FT
A1	2	25 FT	49 FT	89 FT
A2	2	25 FT	49 FT	89 FT
A3	2	25 FT	49 FT	89 FT
A4	2	25 FT	49 FT	89 FT
A5	2	25 FT	49 FT	89 FT
A6	2	25 FT	49 FT	89 FT

Source: CHA, 2022

It is recommended this width be maintained through the forecast period unless aircraft activity by larger aircraft warrant. As the taxiway system was rehabilitated in 2017, all pavement geometry meets current FAA design standards.

Taxiway Safety Area (TSA) and Taxiway Object Free Area (TOFA) widths are based upon Airplane Design Group (ADG). As the 6B0 taxiway system is designated as Group I, the current TSA and TOFA widths are 49 feet and 89 feet, respectively. A review of site conditions determined that the TSA surface conditions satisfy the FAA standard to support both aircraft and vehicles within the area. All objects within the TOFA are fixed-by-function.

3.2.5 Airfield Capacity

Airfield capacity is defined as the maximum rate that aircraft can arrive at, or depart from, an airfield with an acceptable level of delay. It is a measure of the number of operations that can be accommodated at an airport during a given time period, which is determined based on the available airfield system (e.g., runways, taxiways, NAVAIDs, etc.) and airport activity characteristics.

The current guidance provided by the FAA to evaluate airfield capacity is described in AC 150/5060-5, *Airport Capacity and Delay*. The following provides a brief definition of the two key capacity parameters:

- ***Annual Service Volume (ASV):*** A reasonable estimate of the airport's annual maximum capacity, accounting for annual weather characteristics, runway use, aircraft fleet mix, and other conditions.

- ***Hourly Airfield Capacity:*** The maximum number of aircraft operations that can take place on the runway system in one hour. As airport activity occurs in certain peaks throughout the day, accommodating the peak hour activity is most critical.

AC 150/5060-5 provides the estimated ASV and hourly airfield capacity for VFR and IFR operations based on various runway configurations and the type of aircraft operating, or projected to operate, at the airport. **Table 3-6** presents the ASV and hourly airfield capacity for the single runway configuration and type of aircraft operating at 6B0. The table also list the forecast activity level. See **Appendix A** for the FAA AC 150/5060-5 Hourly Capacity Worksheet.

Table 3-6 – ASV and Hourly Capacity

ASV*	Hourly Operations (VFR)*	Hourly Operations (IFR)*	2041 Annual Operations	2041 Peak Hour Operations
>100,000	97	20	7,569	8

Source: AC 150/5060-5, *Airport Capacity and Delay*; CHA
*ASV based on runway configuration #1 with a mix index of 0-20 and a touch-and-go percentage of 25, modified per Table 4-26.

Based on the runway configuration and operating aircraft at 6B0, the ASV is over 100,000 operations and the hourly airfield capacity is 97 operations for VFR and 20 operations for IFR. A total of 7,569 annual operations and eight peak hour operations are projected at 6B0 by the end of the planning period. Therefore, the Airport has surplus airfield capacity to accommodate existing and projected growth in operations, including instrument operations. Airfield improvements are not needed to increase operational capacity.

3.2.6 Runway Length

Runway length requirements are based on a variety of conditions including: airport elevation, mean daily maximum air temperature, runway gradient, and the gross takeoff and landing weights of the design aircraft expected to regularly use the runway (i.e., at least 500 annual itinerant operations).

AC 150/5325-4B, *Runway Length Requirements for Airport Design*, outlines the process for determining recommended runway length at an airport. In summary, this process involves: identifying the design aircraft, or family of aircraft, and its maximum certified takeoff weight (MTOW); calculating the recommended runway length for the design aircraft based on the appropriate "runway length curves"; and, if appropriate, adjusting the recommended runway length for aircraft and runway characteristics (e.g., runway gradient, wet runway conditions).

Additionally, the AC 150-5323-4B also provides general guidelines of runway length requirements based on an airport's fleet mix. As such, utilizing the Advisory Circular's Figure 2-1, *Small Airplanes with Fewer than 10 Passenger Seats*, a runway length of 3,100 feet would provide sufficient length to 95% of this type of aircraft (AAC A-1 and B-1 - small aircraft) during the hot summer months when adjusted adjusting for the mean day maximum hot month temperature (85° Fahrenheit) and the airport elevation (~500 feet Mean Sea Level). However, to accommodate 100% of the fleet mix in average high temperature conditions throughout the year (59° Fahrenheit), the AC recommends a runway length of 3,400 feet.

For a more airport specific approach, the most demanding, regular use aircraft is utilized to determine runway length requirements. As discussed in **Chapter 2**, the design aircraft for 6B0 has been identified as a mix of ARC B-I aircraft currently. Based on historical activity data, the most demanding aircraft to use 6B0 on a non-regular basis is the Pilatus PC-12 (B-II), which is classified as a small aircraft (under 12,500 pounds) with an MTOW of 9,700 pounds. Runway length requirements for this particular aircraft is listed in **Table 3-7**.

Table 3-7 - Critical Aircraft Runway Length Requirements

Aircraft Type	Runway Length Requirements*	
	Takeoff	Landing
Pilatus PC-12	2,485 ft	2,170 ft
Cessna 421	2,320 ft	2,300 ft

S* = At Sea Level, International Standard Atmosphere, MTOW
Source: Manufacture published performance tables. Commercial use (i.e., Part 135) would be higher.

Runway 1-19 currently provides 3,206 feet of takeoff run, and 3,060 feet of landing run, due to the displaced threshold on the Runway 1 end, which is considered adequate for the planning period. While there is no significant change in the critical aircraft forecasted, it should be noted that limited jet and turboprop activity is projected within the forecast period. Although, some turbine and light jet operations may be hindered by the current runway length, such operations are not anticipated to exceed 500 annually within the planning forecast. Should the Airport experience increased aircraft operations by aircraft requiring additional runway length, additional study will be required.

3.2.7 Wind Coverage

Local wind conditions at an airport can have a significant role in runway use as aircraft operate most efficiently when landing and departing into the wind. Runways not oriented to take full advantage of the prevailing wind patterns are used infrequently. Pilots must ensure that the crosswind component, or wind component perpendicular to the direction of travel, is not beyond the limits of the aircraft. Crosswind components differ depending on the size of aircraft and the associated ARC for the runway. According to FAA criteria, an airport should provide at least 95 percent wind coverage for aircraft categories anticipated to use the airport regularly.

The 95 percent wind coverage is computed on the basis of a crosswind not exceeding 10.5 knots for ARC A-I and B-I, and 13 knots for ARC A-II and B-II. Given the ARC for 6B0 is not forecast to exceed ARC B-I, **Table 3-8** provides the coverage for the all-weather, VFR, and IFR weather wind conditions for a 10.5 and 13-knot crosswind for the Airport's runway.

Table 3-8 – Runway Wind Coverage

Weather Condition	10.5 Knots	13 Knots
All-Weather	99.86%	99.93%
VFR	99.85%	99.93%
IFR	99.98%	99.99%

Source: NOAA National Climatic Data Center
Middlebury State Airport 2014 – 2021

Table 3-8 shows that combined runway wind coverage at 6B0 for each weather condition (i.e., all-weather, VFR, and IFR) exceeds the 95 percent minimum wind coverage for each crosswind component. Therefore, adequate wind coverage is provided at 6B0 by the current runway configuration.

3.2.8 Airfield Pavement Strength

An important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. The design strength of the pavement at an airport is typically determined by the strength of both the pavement section and subgrade, the weight of the aircraft utilizing the airfield, and the number of operations from these aircraft.

Currently, Runway 1-19 provides adequate strength for unlimited use by small aircraft (under 12,500 lbs.). Thus, the current pavement section provided adequate weight bearing throughout the planning period.

3.2.9 Airfield Pavement Condition

All VTrans-maintained pavement areas (including all taxiways and Runway 1-19) were reconstructed during the 2017 runway extension project. As such, a surface rehabilitation of those pavement areas will likely be needed by the end of the forecasting period. The main tie-down ramp and fueling apron pavements were constructed in before 1995 and are recommended for rehabilitation in the short-term .

Maintenance of apron pavement connected to private hangars are under the responsibility of the tenant and/or leaseholder.

3.2.1 Airfield Lighting, Navigational Aids & Instrument Procedures

As previously discussed in **Chapter 1**, Runway 1-19 is not equipped with runway edge lighting, navigational approach aids, or published Instrument Approach Procedures (IAPs). Each of the following facilities were considered in this study:

- Medium Intensity Runway Lights (MIRL)
- Visual Glide Slope Indicators (VGSI)
- Instrument Approach Procedures

3.2.1.1 *Medium Intensity Runway Lights (MIRL)*

Middlebury Airport is the only state airport (with a paved runway) without runway edge lights. While it is not a requirement for an airport to have runway edge lights, lighting does improve the usability of the airport. Runway lights would allow aircraft to operate at the airport during the evening hours in the winter months, whereas presently they cannot operate during those times. As such, MIRLs are recommended as a medium or long-term improvement.

3.2.1.2 *Visual Glide Slope Indicators*

Independent of airfield lighting, it is recommended that the airport install a 2-Box Precision Approach Path Indicator (PAPI-2) on both runway ends. This system aids pilots visually via red and white lights relaying the correct approach glide slope path. The installation of a PAPI-2 would provide additional safety and consistency in aircraft landing operations.

3.2.1.3 *Instrument Approach Procedures*

To increase availability of the runway during poor visibility weather conditions (i.e., low clouds, or hazy), it is recommended that non-precision IAPs are established on one or both runway ends. New procedure are now developed using GPS-based technology, and could enable landing when visibility is between 1 and 3 miles. The establishment of a GPS-based IAP does not require installation of ground-based equipment nor require the addition of airfield lighting. The master plan study has developed the data needed by FAA to design IAPs for the airport; which are recommended in the short term.

While the facilities listed above are recommended airfield improvements, they are not dependent on each other and thus can be pursued individually based on airport activity demand.

3.2.2 Airspace Obstructions

As Runway 1-19 is currently a visual approach runway, **Table 3-9** lists the existing airspace approach surfaces.

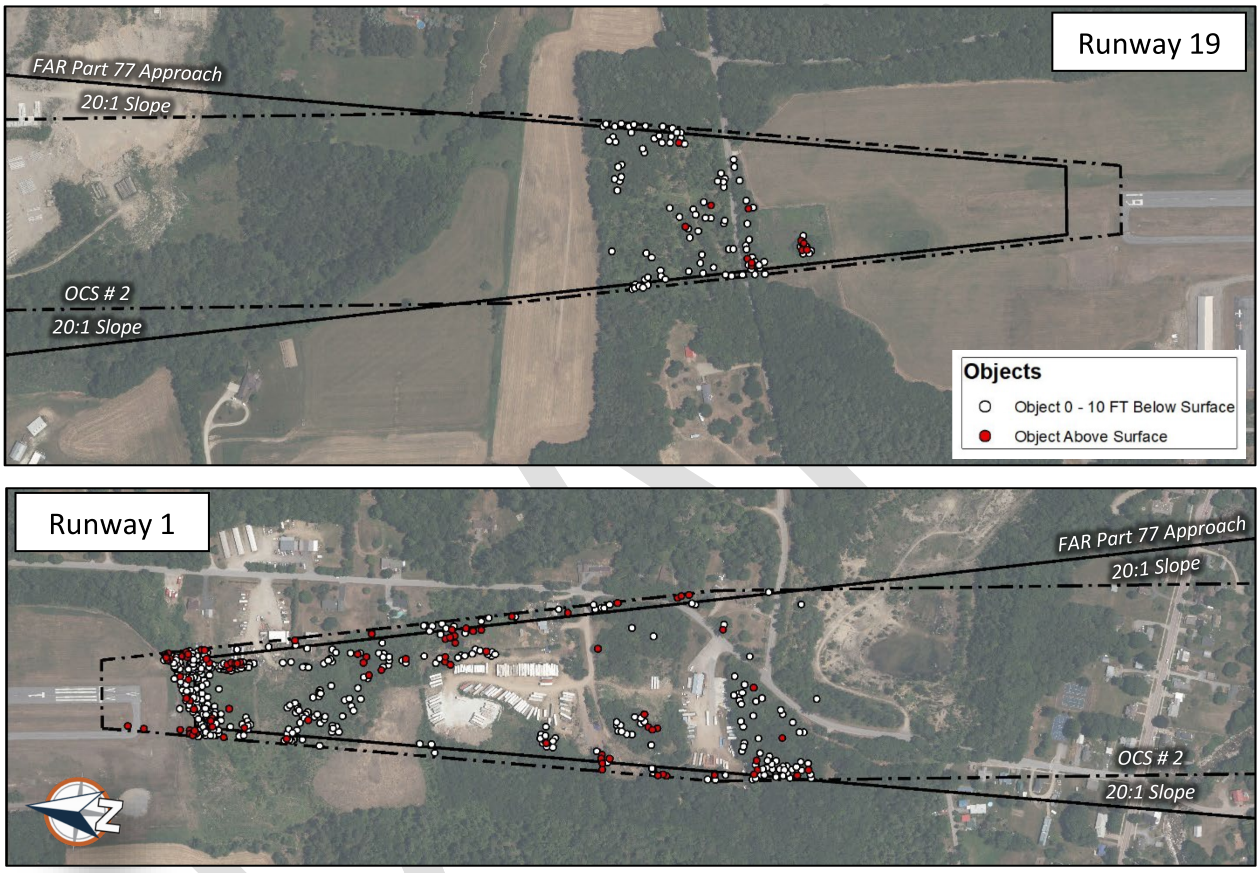
Table 3-9 – Existing Runway 1-19 Approach Surfaces

Runway 1-19	Type	Slope
FAR Part 77	Visual (A)*	20:1
Obstacle Clearance Surface**	#2	20:1

*Utility runway
**Table 3-2 of FAA Engineering Brief No. 99A

Figure 3-4 depicts the objects penetrating each existing approach surface along with the objects 10 feet below. It is important note that although several objects (mostly trees) penetrate each runway's 20:1 FAR Part 77 approach surface, each 20:1 Obstacle Clearance Surface (OCS) remains clear of all objects. It is recommended that objects penetrating the FAR Part 77 approach surfaces are cleared. Avigation easements over each of the areas beyond airport property are recommended.

Figure 3-4 – Runway 1-19 Existing Approach Surfaces



Source: NV5 & CHA, 2022
Note: No penetrations to the existing OCS # 2

As mentioned, non-precision IAPs are recommended for one or both ends of Runway 1-19. Upon establishing IAPs, the FAR Part 77 approach surface would widen but continue to slope upwards at a 20:1 slope. However, different OCSs would apply, including the potential introduction of a 30:1 sloped surface if the IAP provides vertical approach guidance. **Table 3-10** lists the potential future approach surfaces upon establishing IAPs. It is important to note that the future approach surfaces would only apply to the runway end with the IAP. For planning purposes, OCS #6 (30:1 slope) is listed to demonstrate the most restrictive scenario. If only lateral approach guidance is provided, only OCS #4 would apply.

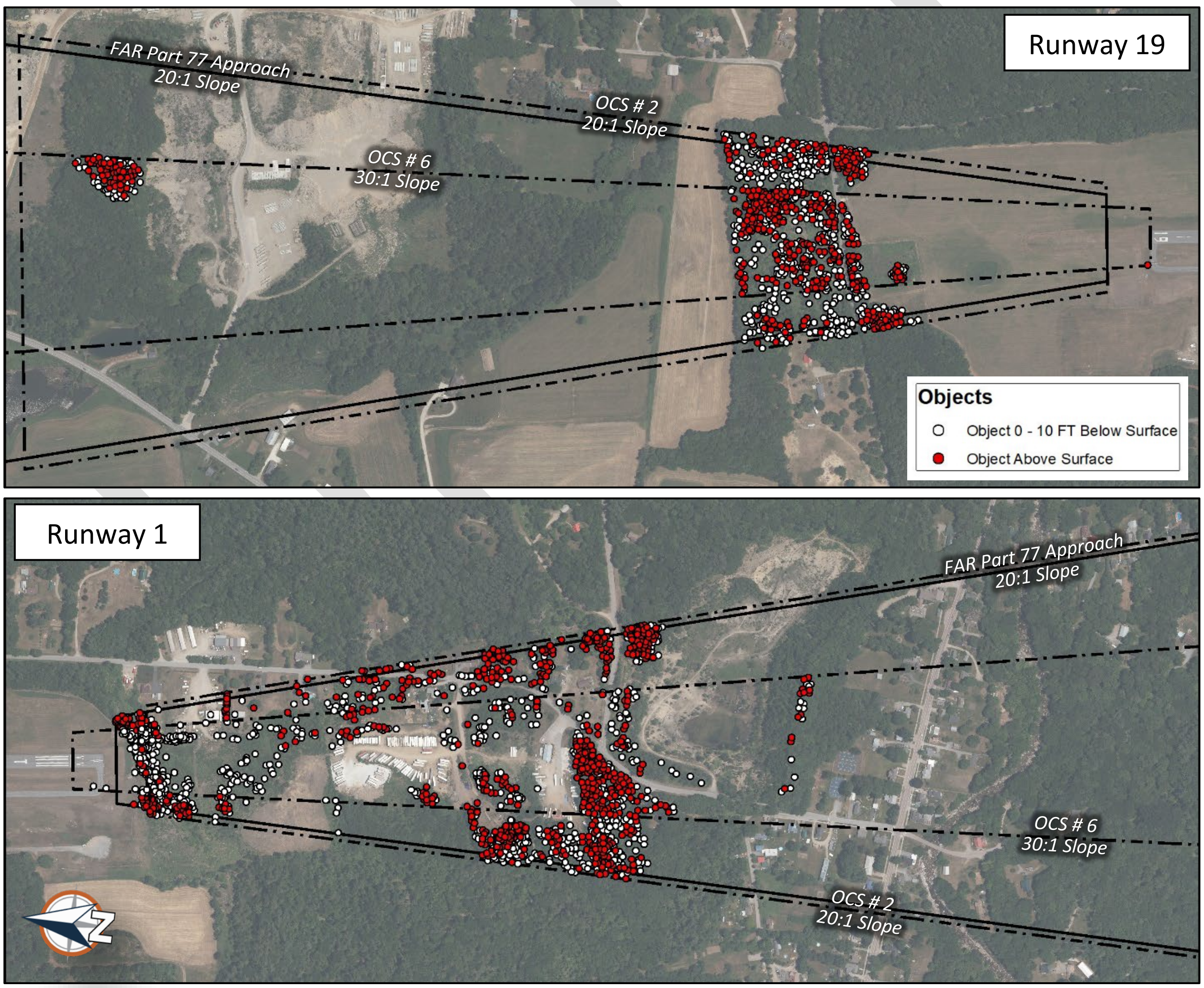
Table 3-10 – Future Runway 1-19 Approach Surfaces

Runway 1-19	Type	Slope
FAR Part 77	Non-Precision (A)*	20:1
Obstacle Clearance Surface***	#4	20:1
	#6**	30:1

*Utility runway
**Only applicable if IAP provides vertical approach guidance
***Table 3-2 of FAA Engineering Brief No. 99A

Figure 3-5 depicts the objects penetrating each approach surface along with the objects 10 feet below. Due to the wider and more restrictive (i.e., lower) approach slopes, several objects (mostly trees) penetrate each surface. As with the existing surfaces, avigation easements are recommended for each area beyond the airport property. Additional depiction of the obstruction data pertaining to the existing and future surfaces is provided within the Airport Layout Plan.

Figure 3-5 – Runway 1-19 Future Approach Surfaces



Source: NV5 & CHA, 2022

3.3 Landside Facility Requirements

The landside facility requirements examine existing airport facilities and structures that accommodate the movement and storage of aircraft, and provide facilities to support pilots, passengers, and airport employees. The landside facility requirements analysis includes an examination and evaluation of:

- Aircraft Storage Space
- Fuel Storage Requirements
- Vehicle Parking Requirements
- Airport Security and Fencing

The following sections provides a description of each item and an evaluation of existing and future requirements according to current FAA and industry standards.

3.3.1 Aircraft Storage & Tie-Down Space

Due to various weather conditions, hangars are highly desirable in the State of Vermont as snowstorms, frost, and intense cold can cause icing on parked aircraft, which can be extremely disrupting to aircraft operations. Additionally, during warmer months, heat and sun exposure can damage avionics and fade paint, and thunderstorms and hail can cause considerable damage. For GA airports, while virtually all aircraft owners would prefer hangar storage over tie-downs, hangar requirements are generally a function of the number and type of based aircraft, hangar rental/construction costs, and area climate.

As discussed within **Chapter 2**, 6B0 is not forecasted to experience a significant growth in based aircraft. However, as shown on **Table 3-11,** the based aircraft fleet mix is anticipated to slightly change.

Table 3-11 – 6B0 Current and Forecasted Based Aircraft

Aircraft Type	2021	2026	2031	2036	2041
Single-Engine	29	30	32	32	34
Multi-Engine	0	1	1	1	2
Turboprop	0	0	0	1	1
Jet*	1	1	1	2	2
Rotor	0	0	0	0	0
Total	**30**	**32**	**34**	**36**	**39**

Source: CHA, 2022. *Includes an existing historic based jet aircraft

Based upon an on-airport site visits, it is estimated that in 2021, nine single-engine based aircraft and one based jet utilize tie-down space within the North Apron. It is assumed that the remaining 20 based aircraft utilize hangar storage. For planning purposes, it is also assumed that all future based aircraft will utilize hangar storage. Additionally, 13 tie-down spaces (equally approximately

58,500 square feet) within the southern portion of the North Apron are reserved for visiting aircraft or transient aircraft awaiting maintenance.

Therefore, using approximate aircraft storage area requirements by aircraft type (i.e., single-engine, multi-engine, etc.), general square footage requirements for the existing based aircraft (both hangar and tie-down storage) is listed within the tables below. **Table 3-12** and **Table 3-13**.

Table 3-12 – Estimated Aircraft Hangar Storage Area Requirements

		2021	2026	2031	2036	2041
Aircraft Type	Estimated Hangar Space Requirement (SF)	Area (SF)	Area (SF)	Area (SF)	Area (SF)	Area (SF)
Single-Engine	1,600	32,000	33,600	36,800	36,800	40,000
Multi-Engine	2,000	0	2,000	2,000	2,000	4,000
Turboprop	3,000	0	0	0	3,000	3,000
Jet	4,400	0	0	0	4,400	4,400
Rotor	1,600	0	0	0	0	0
Total		**32,000**	**35,600**	**38,800**	**46,200**	**51,400**

Source: CHA, 2022.

Note: Assumes 20 existing aircraft utilize hangar storage with an additional nine aircraft requiring hangar storage by the end of the planning period.

Table 3-13 – Estimated Aircraft Tie-Down Area Requirements

		2021	2026	2031	2036	2041
Aircraft Type	Estimated Hangar Space Requirement (SF)	Area (SF)	Area (SF)	Area (SF)	Area (SF)	Area (SF)
Single-Engine	2,700	37,800	37,800	37,800	37,800	37,800
Jet	4,500	4,500	4,500	4,500	4,500	4,500
Transient Aircraft	4,500	58,500	58,500	58,500	58,500	58,500
Total		**100,800**	**100,800**	**100,800**	**100,800**	**100,800**

Source: CHA, 2022.

As discussed within **Chapter 1**, there is approximately 32,600 square feet of existing hangar storage space at 6B0. Currently the Airport is at hangar capacity. With the additional aircraft anticipated throughout the forecast period, additional hangar demand is likely.

Additionally, the North Apron provides approximately 120,915 square feet of tie-down space. With the existing based aircraft along with space reserved for transient aircraft, the North Apron is anticipated to continue to provide adequate apron and tie-down space.

3.3.2 Fuel Storage Requirements

A 10,000 gallon 100 Low-Lead underground fuel storage tank is located on the western portion of the Fuel Apron. The fuel pump allows for 24-hour self-serve refueling. Jet-A fuel is not currently available at the Airport. The FBO may consider providing capacity for Jet-A fuel if they secure fueling contracts with based or itinerant aircraft users that require additional storage. However, currently capacity is adequate.

3.3.3 Vehicle Parking Requirements

Vehicle parking facilities are intended to provide space for design hour passengers/pilots, visitors, employees, etc. Consideration should also be made for off-peak passenger/pilots leaving a vehicle at the airport overnight or for an extend period of time. The existing airport parking lot accommodates approximately 15 vehicles and is often near capacity. No other formal parking facility is provided at the Airport. However, tenants generally park adjacent to, or within their hangars, throughout the terminal area. The following potential additional facilities should be considered, and integrated into the recommended plan:

- Terminal/FBO facilities: Provide 5-10 additional parking spaces at or adjacent to the existing parking lot. Alternatively, if a new general aviation terminal building can be provided in the short-term planning period, provide at least 10 parking space for the new facility, which will alleviate some of the parking demand at the existing lot.
- T-Hangar and North Apron: Provide a small, designated vehicle parking area between the T-Hangar and North Apron for approximately five vehicles. An asphalt or gravel surface may be provided. The goal is to discourage airport tenants and users from parking on the apron or taxilanes.
- New hangars: For medium or large new hangar developments, designated parking should be provided to reduce parking on aprons and taxilanes. Either individual or common lots can be provided.

3.3.4 Airport Security and Fencing

6B0 provides airport fencing throughout the airfield accessible by electronic keypads in key locations and locks in others. It is not expected that 6B0 will require additional security fencing throughout the planning period beyond regular maintenance.

3.4 Facility Requirements Summary

Table 3-14 provides a summary of the recommendations discussed within this chapter. These recommendations are carried forward to the Airfield Alternatives where, if applicable, solutions are presented.

Table 3-14 – Facility Recommendations

Facility	Recommendation
Navigational Aids	• Add Non-Precision Instrument Approaches to Runways 1 and 19 • Install PAPI-2 to Runways 1 and 19
Hangar and Apron Parking	• Construct additional hangar space • Construct additional apron space for transient aircraft
Terminal/FBO Building	• Comprehensive renovation of the existing passenger/pilot lounge • Alternatively, construct standalone building offering amenities in line with an FBO. • Construct additional vehicle parking lot
Airspace	• Acquire avigation easements for Runway RPZs & off-airport aircraft surfaces

Source: CHA, 2022

4 Development Alternatives

The primary focus of this element of the Master Plan Update for the Middlebury State Airport (6B0) is the identification and evaluation of development alternatives considered as key components of the overall Airport's improvement strategy. This chapter provides development strategies to accommodate future aviation demand identified in ***Chapter 2, Forecasts of Aviation Demand***, as well as the deficiencies and constraints identified in ***Chapter 3, Facility Requirements***. The overall goal of this analysis, as stated in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, *Airport Master Plans*, is to:

- Identify alternative concepts to address previously identified facility requirements.
- Evaluate these alternatives, individually and collectively, so there is a clear understanding of strengths, weaknesses, and implications of each.
- Select a reasonable alternative.

Development alternatives, or concepts, may focus on demand/capacity relationships, operational safety, and/or improving the Airport's revenue stream. Additionally, it may be necessary to include development concepts for future years beyond the term of the planning period, in order to protect areas reserved for future runway or taxiway development, facility expansion, etc.

The development concepts presented in this chapter are organized based on specific areas at the Airport. From this effort, and using the previously determined facility requirements, the most reasonable and feasible alternative was identified for each area. The alternatives identified represent a level of detail consistent with FAA guidance for a master planning effort. The alternatives have been designed to address the airport facility deficits identified in ***Chapter 3*** and are presented as follows:

- Runway, Taxiways & Design Standards
- Navigation and Visual Aids
- Hangar & Terminal Development

The goal of this chapter is to identify a range of alternatives for airfield and landside development that are consistent with the FAA guidelines and standards and goals of 6B0. The alternatives are based on a review of the Airport's needs as well as current environmental, physical, and financial constraints. Note that prior to the development of any airport project, an environmental analysis and permitting may be required. The following sections summarize previous findings related to facility requirements and the objectives of the alternative development process.

4.1 Influencing Development Factors

There are several factors that influence the evaluation of the alternatives and determine the final recommended development plan. These factors include:

- **FAA Design Standards (i.e., safety)** – Airfield recommendations and designs consistent with the guidance provided by FAA AC 150/5300-13B, *Airport Design*. At 6B0, key considerations include navigational aids, taxiways, and required clearances from aprons and hangars.
- **Environmental Impacts** – Evaluation of the potential impacts on the environment, as Airport improvements may impact wetlands, water quality, and flooding.
- **Consistency with Master Plan Objectives**:
  - **Airfield Requirements** – Accommodating projected operations and design aircraft
  - **Apron Capacity** – Satisfying the projected needs and constraints of the apron area
  - **Hangar Layout** – Identifying areas for future hangar development
  - **Terminal Building** – Provides support space for pilots and passengers
- **Construction and Maintenance Costs** – The overall project feasibility, associated costs, constructability.

Table 4-1 summarizes the facility requirements identified in the previous chapter.

Table 4-1 – Summary of Facility Requirements

Facility	Recommendation
Airfield	• Install a PAPI system on Runways 1 and 19 • Publish Instrument Approaches Procedures to Runways 1 and 19 • Potential Tree Removal for Obstructions
Hangar and Apron Parking	• Construct additional hangars • Construct additional apron space for transient aircraft
Passenger Terminal Building	• Construct standalone passenger terminal building offering amenities. • Include Itinerant aircraft apron and vehicle parking

4.2 Development Alternatives

4.2.1 Airfield Alternatives

4.2.1.1 *Runway, Taxiways & Design Standards*

The current airfield facilities are capable of accommodating the forecasted activity levels and Critical Aircraft. As such, expansion and development of the runway and taxiway system is not recommended during the planning period. Thus, the runway will remain at its current length of 3,200 feet and width of 60 feet. Additionally, review of the key FAA airfield design standard also found the existing runway/taxiway system to satisfy requirements, without upgrades. Therefore, no development alternatives were identified or needed for the airfield at Middlebury State Airport.

4.2.1.2 *Navigation and Visual Aids*

Facility improvements to increase the accuracy of airplane approaches and landings were identified in Chapter 3; however, these improvements do not require the development of alternatives based on their limited nature.

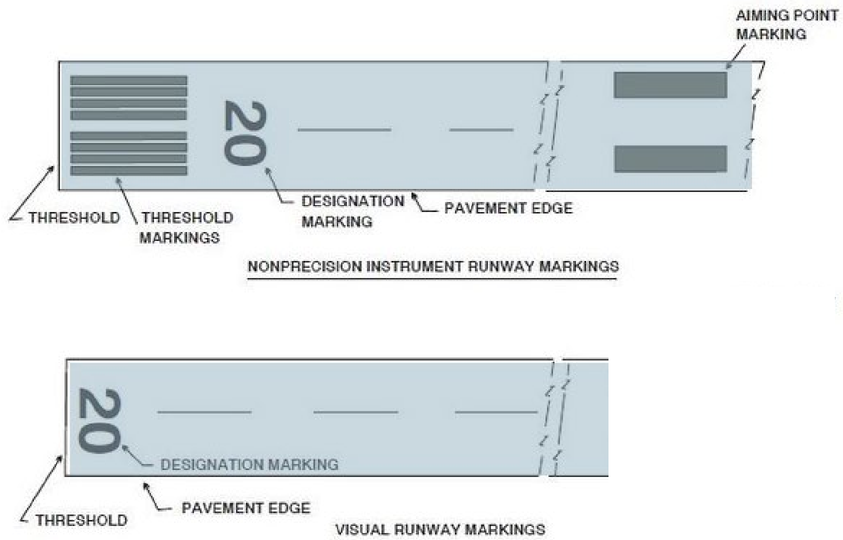
A 2-box Precision Approach Path Indicator (PAPI-2) system is a simple visual aid that indicates to the pilot if they are on the ideal glide path to the runway end. The PAPI units are installed on the sides of the runway near the landing threshold. The stationary units are aimed toward approaching aircraft and the pilot will see a red or white light that indicate if they are on the ideal glide path (or too high to low). The photo below is the existing PAPI system installed on Runway 19 at Morrisville-Stowe State Airport, with a closeup of the small 2 by 3 foot unit. These PAPI units are recommended on both ends of the runway at 6B0.

Sample PAPI Unit (Source Flight Light, Inc.)

To enhance operations during cloudy and low visibility conditions, Instrument Approach Procedures (IAPs) are also recommended to both runway ends. Currently, operations at the airport are permitted when weather conditions satisfy the required minimums to operate under Visual Flight Rules (VFR). One or more IAPs could allow for landings when visibility is lower (i.e., below 3-miles) and provide greater flexibility for airport users. However, due to the high terrain to the east of the airport, activity during very low visibility (i.e., ≤1-mile), may not be feasible.

For Middlebury Airport, such improvements would include the addition of non-precision IAPs, which would consist of a navigation procedure using the existing GPS system to guide aircraft toward the runway ends. This guidance can be both lateral and vertical and aligns inbound aircraft with the runway at a determined altitude.

In Vermont, there are nine State operated airports with paved runways; Middlebury is the only one of these without an IAP. Establishing non-precision IAPs at 6B0 would not include the addition of any lighting systems or other facilities. The only visible changes at the airport would be additional runway markings to provide greater visual contrast of the runway to the pilots. Below is an FAA illustration of visual vs non-precision instrument runway markings.



4.2.1.3 *Approach Obstructions*

With the recommendation of non-precision IAPs, the runway approach surface dimensions may change, based on the design and type of procedures established. This could result in the need for additional tree obstruction removal. **Table 4-2** lists the potential future approach surface standards upon establishing IAPs to either end of the runway.

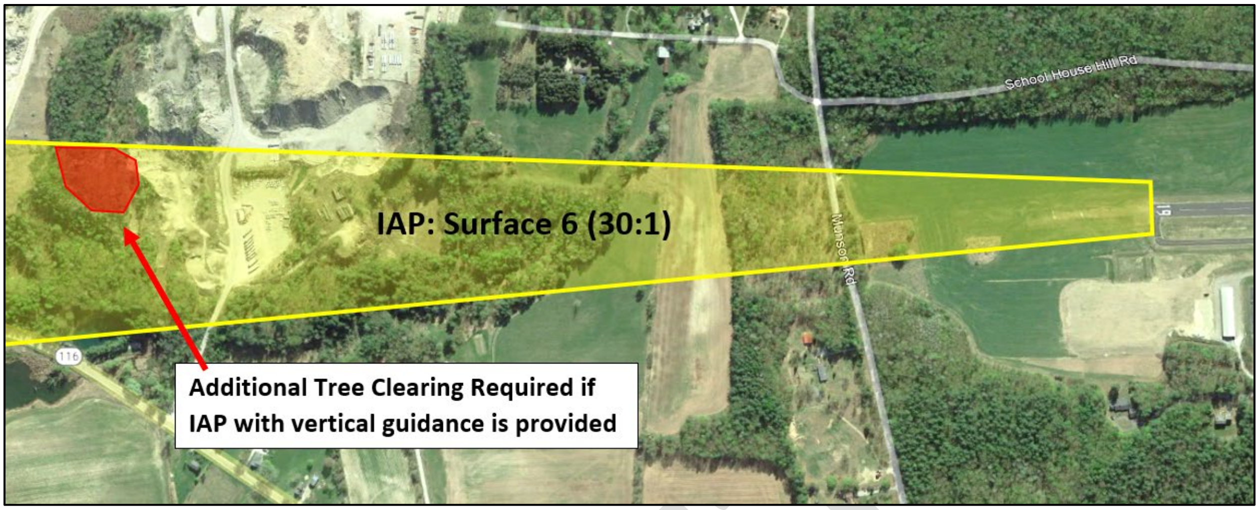
Currently, the visual approaches at 6B0 require clearing, at minimum, Approach Surface 2. If and when IAPs are published, the surface type would change to Surface 4, and potentially Surface 6. As only the FAA can develop and establish procedures, coordination will be conducted with FAA to plan for and incorporate any additional clearing into the recommended plan.

Table 4-2 – Future Runway 1-19 Approach Surfaces

Runway 1-19	Approach*	Start Location	Inner Width	Slope
Existing Conditions - Visual	Surface 2	Threshold	250’	20:1
IAP without vertical guidance	Surface 4	200’ Beyond Threshold	400’	20:1
IAP with vertical guidance*	Surface 6	Threshold	260’	30:1

*Per FAA Advisory Circular 150/5300-13B, and visibility ≥1 mile.

Due to the more restrictive (i.e., lower) approach slopes associated with adding IAPs, particularly for vertically-guided procedures, additional trees may penetrate each surface. The image below depicts a potential additional required area of tree removal with Surface 6. Avigation easements would be recommended for such additional areas beyond the airport property. Additional depiction of the obstruction data pertaining to the existing and future surfaces is provided within the Airport Layout Plan (ALP).



4.2.2 Hangar and Terminal Development

As discussed within ***Chapter 3**,* 6B0 is forecasted to experience a growth in based and itinerant aircraft, resulting in an associated increase in hangar demand. The following concepts depict potential areas for hangar development and expansion. It is noted that all development will be market-driven, based on the demands and funded by the aircraft owner or developer.

When determining potential hangar layouts, the Vermont Agency of Transportation (VTrans) planning standards were used, including a 20-foot hangar separation and typical dimensions for small, medium, and large corporate hangars:

- Small Hangar: 60' x 60'
- Medium Hangar: 60' x 80'
- Large Hangar: 120' x 120'

4.2.2.1 *North Hangar Alternatives*

The North Hangar Development site makes use of undeveloped space immediately north of the existing T-Hangar and tiedown ramp. This site is generally graded adequately and allows approximately 4 to 5 acres of development space. A potential development layout (depicted in **Figure 4-1**) would allow a mix of Small and Medium box hangars in three rows, allowing for eight total. Additionally, there is sufficient space for a Large hangar on the northern end of the site. This would require an approximately 70,000 square foot (SF) expansion of apron pavement to allow for airside access, as well as additional pavement for automobile access and parking. In total, this alternative, if fully developed would increase hangar storage space by 46,800 SF, as depicted in **Table 4-2**. This area would also allow space for a second detention pond and a potential leech field site for wastewater.

Table 4-3 – Hangar Expansion

Hangar Type	Count
Small Hangar (60’ x 60’ – 3,600 SF)	5 (18,000 SF)
Medium Hangar (60’ x 80’ – 4,800 SF)	3 (14,400 SF)
Large Hangar (120’ x 120’ – 14,400 SF)	1 (14,400 SF)
Total	**9 (46,800 SF)**

Source: CHA, 2021.

In parallel to this master plan effort, VTrans is advancing the required VTANR operational stormwater permit, an Act 250 Land Use Permit amendment, and other advanced development approvals that could improving feasible and foster private development of this alternative. For Middlebury, the North Hangar Alternative is included in this ‘master permitting’ program.

4.2.2.2 *South Hangar Development*

In addition to the large area available on the northern side of the Airport, there is a smaller two-acre area available on the southern side. This site would ideally be utilized for development of single-bay T-Hangars. There is sufficient space for at least 16 hangar bays, though, based on demand, only eight are recommended during the planning period. Alternatively, the site could be used for additional box hangar and transient apron development. These scenarios are depicted in **Figure 4-2**. It is important to consider that there is a significant grade change (drop-off) from the Airport’s access road to the parallel taxiway. Development on sloping terrain is more costly, due to the need for cut or fill, additional grading/stabilizing, and storm drainage facilities. Large hangars are not considered feasible in the South Hangar Development alternative.

4.2.2.3 *Terminal and Itinerant Apron Development*

As identified in Chapter 3, the airport does not have a public terminal building, an identified facility requirement, which would include an itinerant aircraft apron and vehicle parking. Currently, the office portion of Building 8 is used as a makeshift terminal area providing minima amenities and a restroom. The development of a public terminal should provide paved ground access, be centrally located on the airport (where feasible), and in proximity to aircraft fueling. The building itself could range from 1,500 to 2,000 square feet and provide amenities typical of FBO terminals at small general aviation airports; such as a pilot lounge, restrooms, storage, office space, and meeting space.

Several locations and concepts are possible for a small terminal building; this section describes a few logical options:

- <u>North Terminal Building Concept</u> **(Figure 4-1)**: A small FBO Terminal with vehicle parking could be constructed adjacent to the existing tiedown apron, and just east of the fueling apron. This layout avoids the need to build an apron for visiting aircraft, as there is adequate space on the existing apron. Vehicle parking and an improved driveway would be provided and connect to Airport Road. Also shown is a potential new taxilane, connecting the fueling and tiedown aprons.

- South Terminal Building Concept **(Figure 4-2)**: This layout would include the same amenities as above, but would require the construction of all facilities, would be located at the very end of Airport Road, and require more grading and sitework to provide the building a 20,000 SF itinerant apron.

- Central Terminal Building Concept **(Figure 4-3)**: This concept is centralized on the airport with access via Airport Road. Located between two existing hangars the site is somewhat constrained; however, with only an additional ½ acre of aircraft apron, the terminal would connect with the existing itinerant apron and several existing hangars. Several variations on this concept are also possible. **Figure 4-4** depicted two additional options that require the relocation of an existing hangar, but enable a linear apron configuration, with 30,000 to 60,000 SF of new itinerant apron, and greater building separation from the Runway (i.e., if the hangar is relocated).

4.3 Recommended Plan

The Recommended Plan (**Figure 4-5**) depicts the alternatives recommended to be pursued as development projects in the future and lays the foundation for the Airport Layout Drawing (ALP). The following briefly summarizes recommended development and preferred concepts.

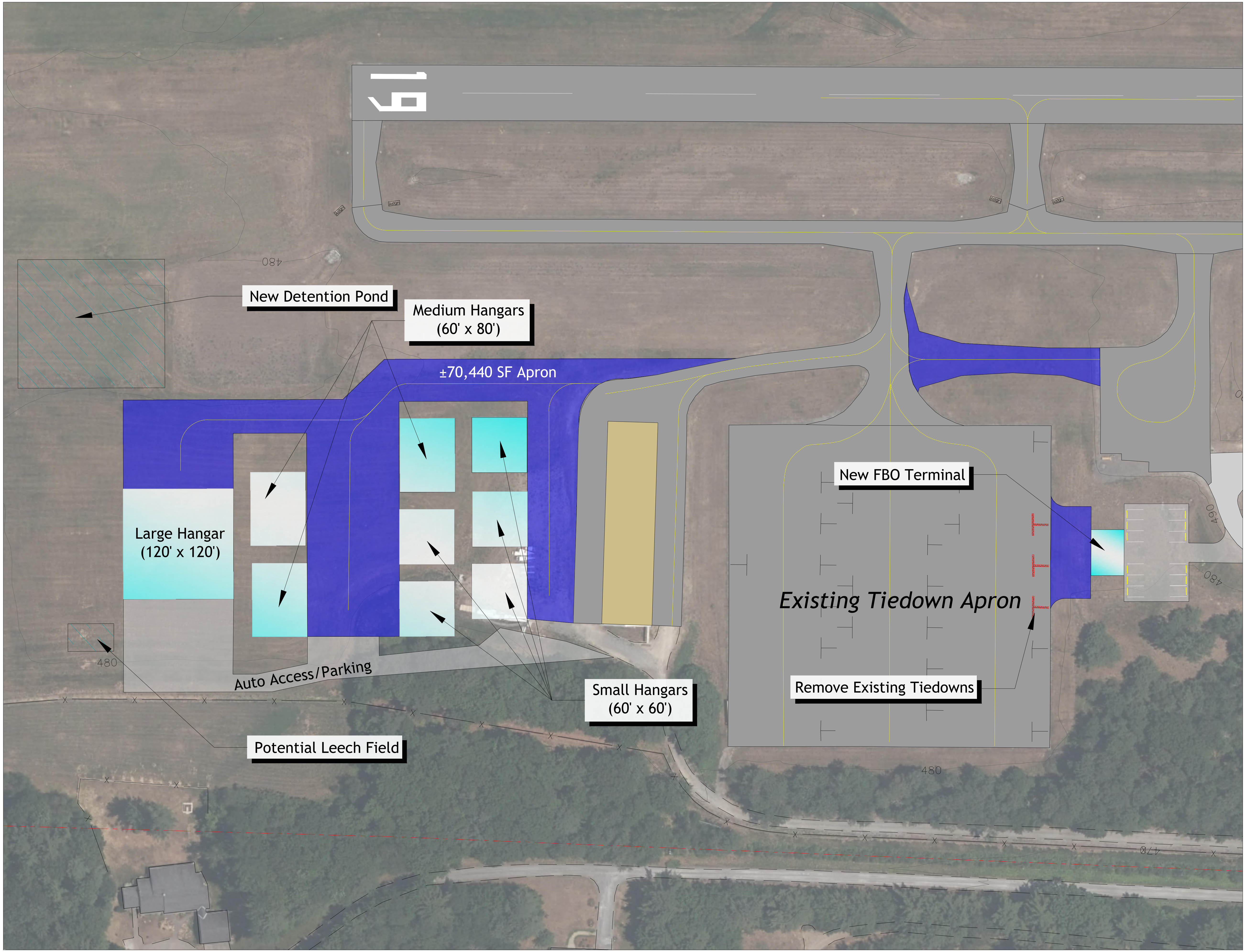
Navigation and Visual Aids
PAPIs are recommended on both runway ends to improve the safety and efficiency of landings. It is also recommended that VTrans pursue publication of GPS/RNAV instrument approach procedures (IAPs) on both runway ends. Note that FAA would determine the feasibility of one or both procedures.

Runway Lighting
In the mid or long-term, runway lighting is recommended to provide better availability of the airport, particularly during the evenings between November and April where daylight is inadequate for operations. In addition to the MIRL & MITL runway and taxiway edge lighting, a rotating beacon should be provided.

North Hangar Development
It is recommended that a mix of hangar be constructed on the site as depicted in **Figure 4-1**.

Central Terminal Building
This concept is recommended for the GA terminal building as the most prominent location at the airport, adjacent to the FBO facility, and close to fueling apron.

South Hangar Development
It is recommended that the south area be maintained for potential development of T-Hangar facilities, as depicted in **Figure 4-2**; allowing for eight bays in the near-term, with potential for future expansion.



VERMONT
AGENCY OF TRANSPORTATION

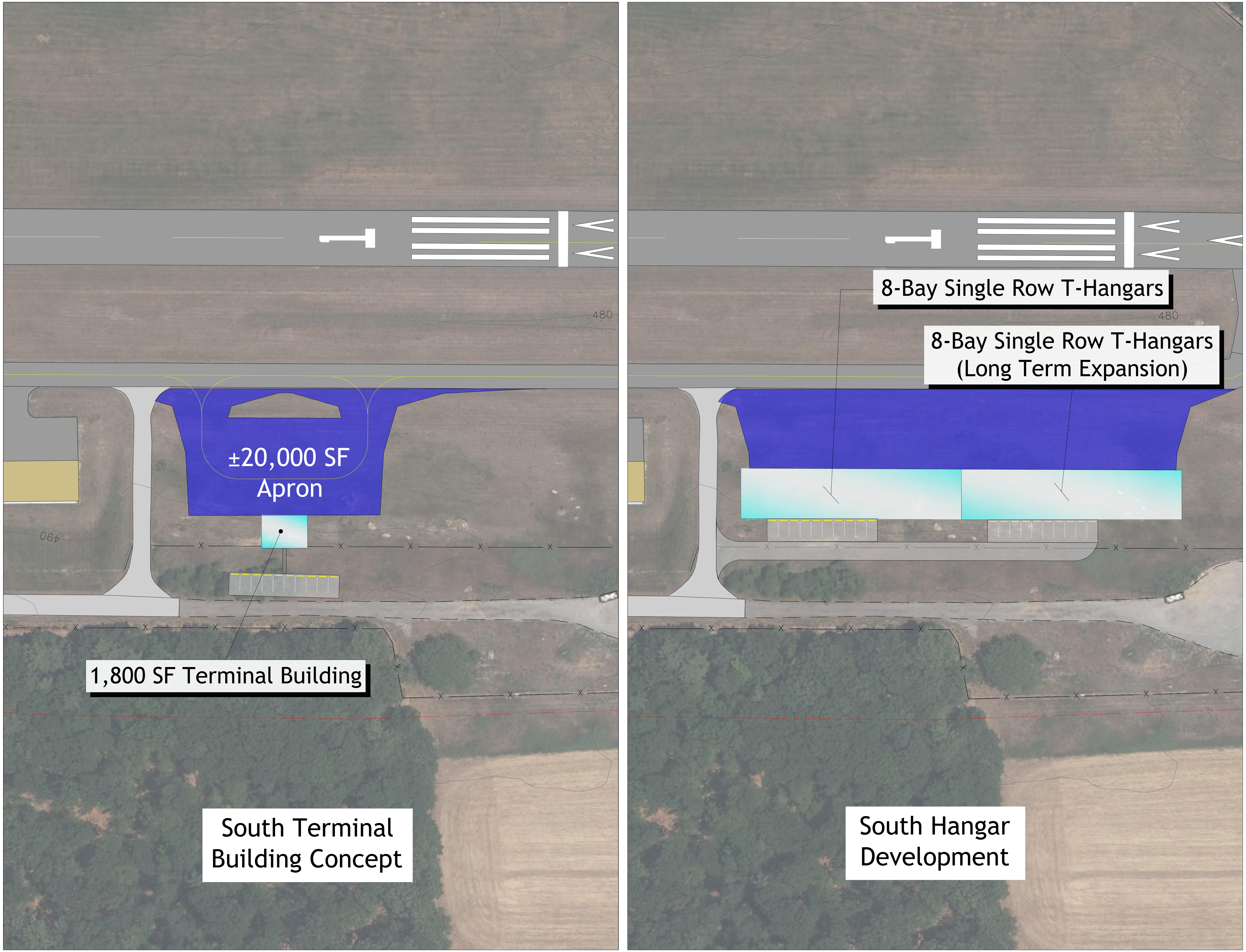
MIDDLEBURRY
STATE AIRPORT
MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 50 100 200

LEGEND

Airport Property Boundary
Ground Contour (Feet MSL)
RPZ Runway Protection Zone
New Buildings
New Airside Pavement
New Landside Pavement

Figure 4-1
North Development Area



VERMONT AGENCY OF TRANSPORTATION

MIDDLEBURRY
STATE AIRPORT
MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

0 50 100 200

LEGEND

- Airport Property Boundary
- Ground Contour (Feet MSL)
- Runway Protection Zone
- New Buildings
- New Airside Pavement
- New Landside Pavement

Figure 4-2
South Development Area

VERMONT
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MIDDLEBURRY
STATE AIRPORT
MASTER PLAN UPDATE

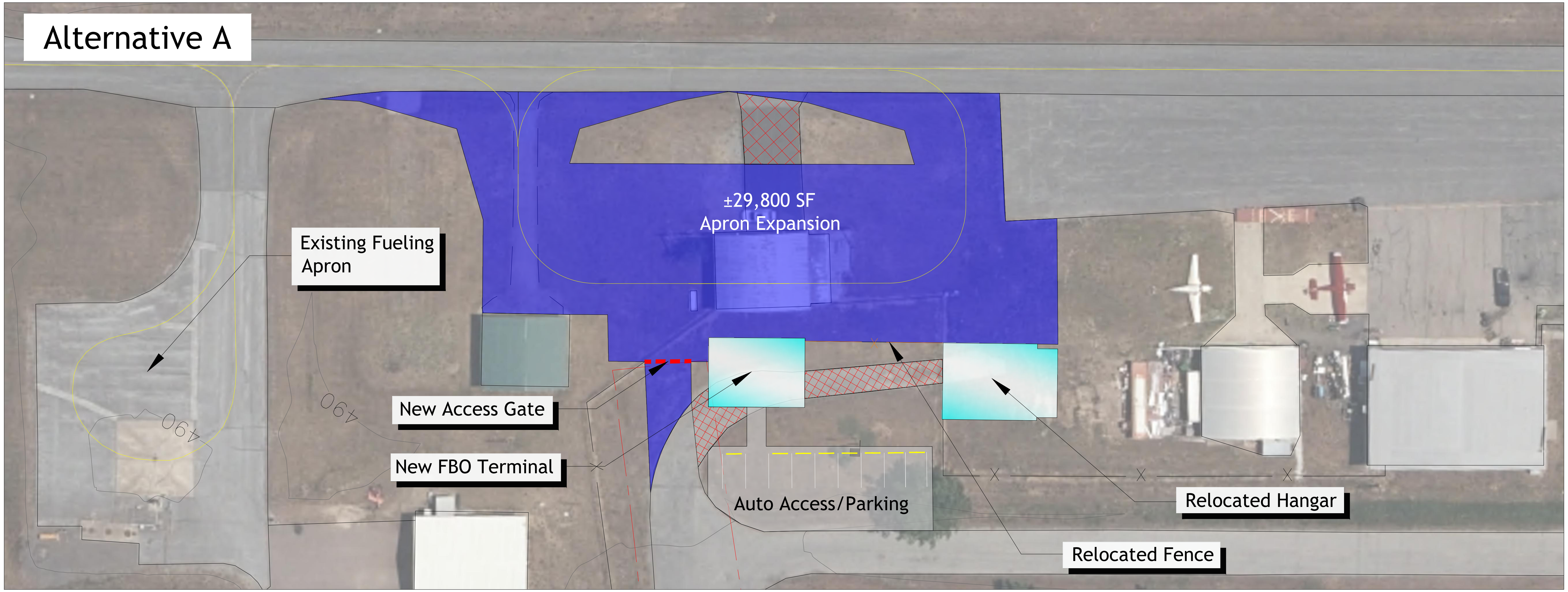
GRAPHIC SCALE (FEET)

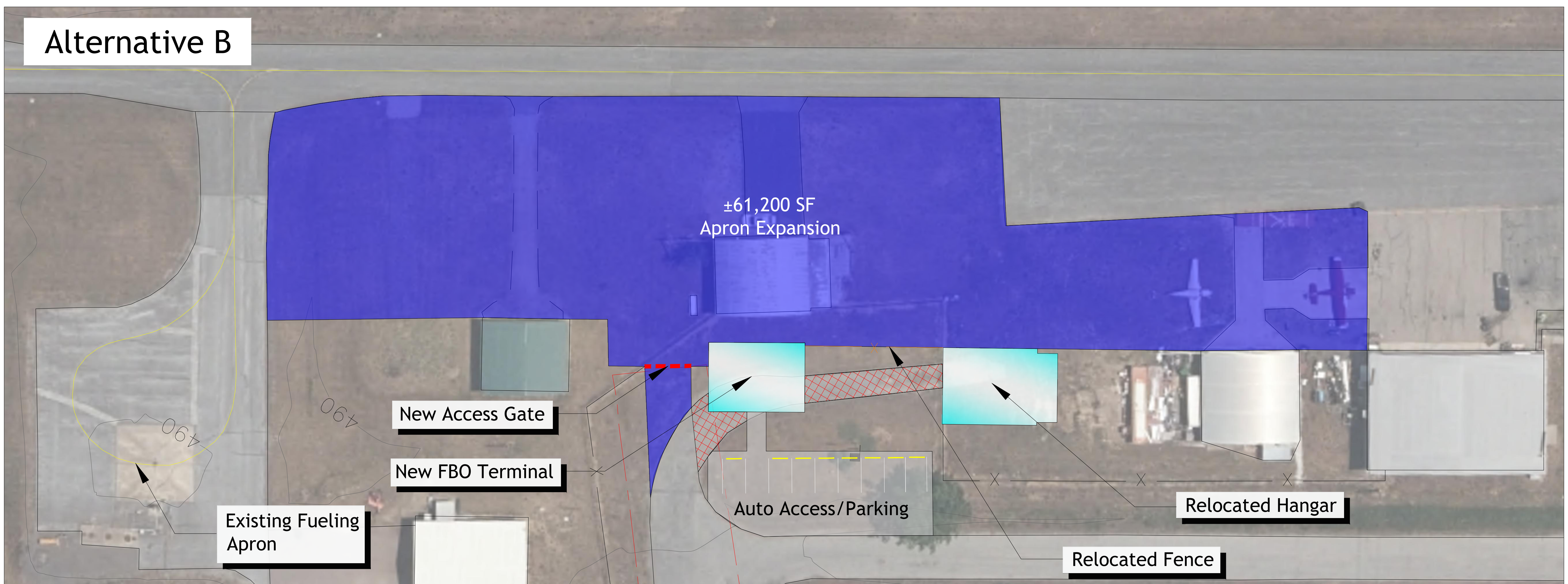
0 30 60 120

LEGEND

- Airport Property Boundary
- Ground Contour (Feet MSL)
- Runway Protection Zone
- New Fence
- New Buildings
- New Airside Pavement
- New Landside Pavement

Figure 4-3
Central Terminal Building Concept





VERMONT
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MIDDLEBURRY
STATE AIRPORT
MASTER PLAN UPDATE

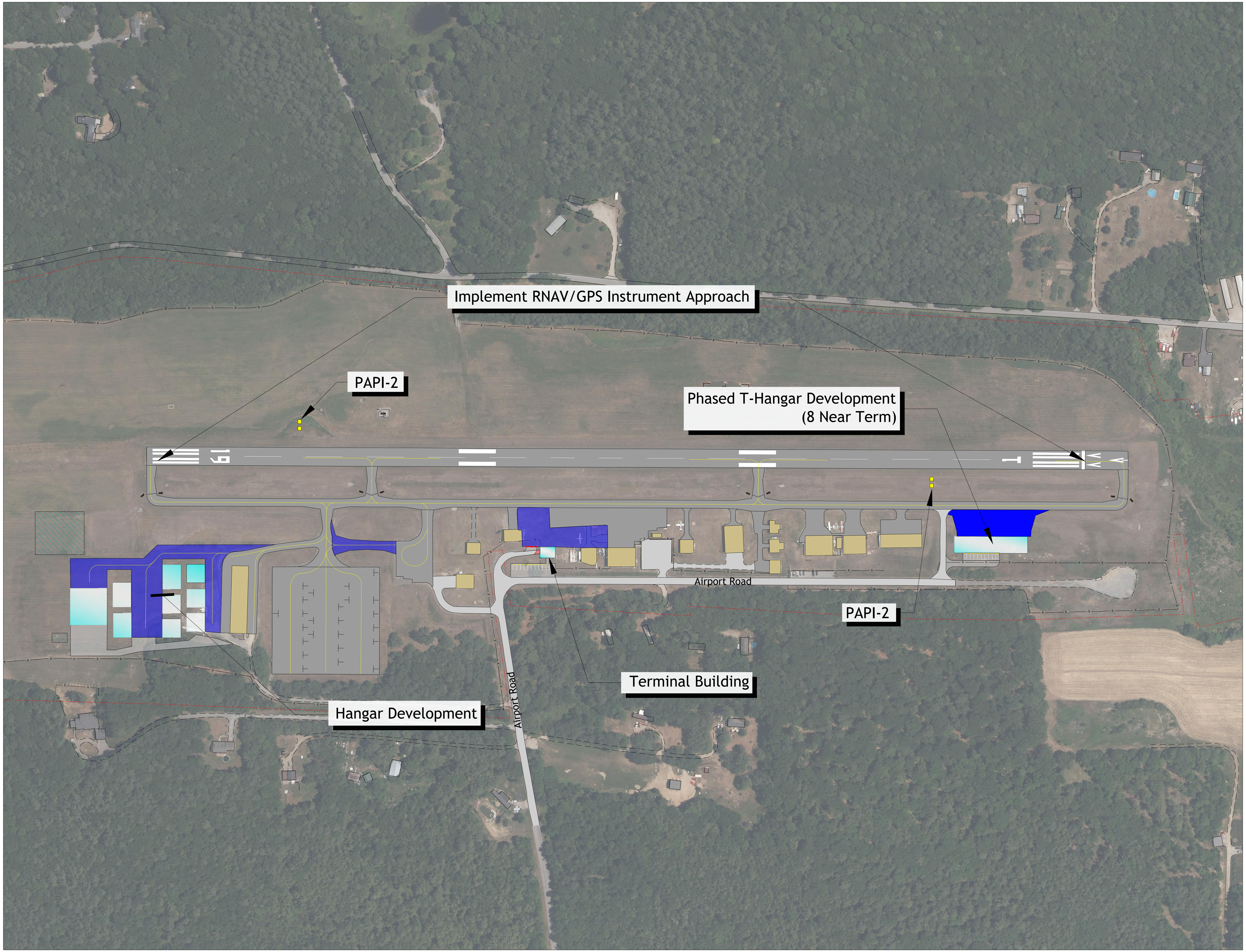
GRAPHIC SCALE (FEET)

0 30 60 120

LEGEND

- Airport Property Boundary
- Ground Contour (Feet MSL)
- RPZ Runway Protection Zone
- New Fence
- New Buildings
- New Airside Pavement
- New Landside Pavement
- Pavement Removal

Figure 4-4
Central Terminal Concept Options
(Alternative Layouts)



VERMONT
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MIDDLEBURRY
STATE AIRPORT
MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

0 150 300 600

LEGEND

Airport Property Boundary

Ground Contour (Feet MSL)

RPZ Runway Protection Zone

New Buildings

New Airside Pavement

New Landside Pavement

Figure 4-5

Recommended Plan