Chapter 4 - Facility Requirements

Introduction

This chapter investigates the ability of the airport to meet current demand and, thus, the facilities required to meet forecasted needs as established in Chapter 3. The objective of this analysis is to determine the adequacy of existing facilities and determine improvements needed to satisfy future requirements.

Most importantly, this chapter will address two separate approaches for Plymouth: NPIAS and non-NPIAS. While assessing NPIAS-influenced improvements, a high-growth approach will be taken. This is because as a NPIAS airport, Plymouth would be eligible for funding through the Airport Improvement Program (AIP). The AIP brings with it additional funding that could promote aviation activity and growth far greater than an airport without this federal assistance. Contrarily, the non-NPIAS approach will involve a low-growth outlook for the airport. The major difference in these two paths is the availability of funding for future growth. Overall, this chapter will determine what, if any, additional facilities will be required to accommodate forecast activity. It will first address basic safety requirements required regardless of which approach the airport takes (NPIAS or non-NPIAS), followed by a discussion about the requirements the airport would need involving a low-growth and then high-growth scenario.

Existing Facilities

As mentioned in Chapter 3, the assets of the Plymouth Municipal Airport are generally in good condition Irrespective of which NPIAS approach the airport takes, some airport facilities will require attention to correct safety deficiencies. Primarily, issues involving obstructions and non-conforming activity in the Runway 12 RPZ should be addressed and are discussed later in this section.

Adequate Facilities

The airport adequately serves the needs the aviation community that frequents the airport. The facility provides a well-maintained turf runway, ample aircraft parking space during most days, and a terminal building that meets the basic needs of most visitors. The airport's turf runway is well-maintained and properly drained.

Safety Related Issues

The biggest concern the airport has, regardless of which approach they decide to take, are trees and small shrubs in the airport's protected airspace, primarily Part 77 approach surfaces on both runway ends. In addition, activity in the Runway 12 protection zone (RPZ) does not conform to FAA standards. However, both the trees and RPZ issue are tricky problems because the airport is currently under no obligation to remove or otherwise mitigate them. The only other concern is the condition of the historical hangar, which is in poor condition and needs to be structurally upgraded.

The Part 77 and RPZ issues will have to be dealt with if and only if the airport elects to join and is accepted into NPIAS, otherwise the airport sponsor is under no federal obligation to fix either issue. They are both local

concerns that the aviation community must accept as part of operating into or out of a non-federally obligated airport.

Runway Length Requirements

Regardless of which approach the airport takes, the required length of the runway should be evaluated. This assessment is then used to determine the optimum length and width regardless of funding opportunities, environmental concerns, including obstructions and other related issues.

The runway width is a function of FAA design criteria, and for Plymouth, that measurement is 60 feet. However, as a caveat, the current runway is much wider and will not have to be reconstructed to a more narrow width unless the FAA is paying to have it paved.

Table 4.6 - Runway/Airport Standards for ARC A-I (Small Aircraft)

Standard	Measurement (feet)
Runway Width	60
Runway Centerline to Edge of Aircraft Parking	125
Runway Shoulder Width	10
RSA Width	120
RSA Length Beyond Runway End	240
ROFA Width	250
ROFA Length Beyond Runway End	240
ROFZ Width	250
ROFZ Length Beyond Runway End	200
RPZ Inner Width	250
RPZ Outer Width	450
RPZ Length	1,000

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

The length is a function of aircraft operational characteristics, specifically the airport design aircraft. As noted in Chapters 2 and 3, the existing and future design aircraft is the Cessna 172 Skyhawk (or an aircraft of similar size and operating specifications). The analysis for 1P1 indicates that a C172 requires about 1,360 feet of runway for a takeoff while operating at maximum gross takeoff weight on a warm summer day (worse case conditions with a 10-knot headwind). The smaller Cessna 152 (two seats versus four) requires a little more than 1,000 feet, and a Piper Cherokee (PA-28) would need almost 1,700 feet under the same conditions.

Figure 4.1 shows the analysis of the aircraft discussed in the previous paragraph as well as several other typical general aviation aircraft, some of which would not, or do not operate from Plymouth. It is important to note that the distances discussed and shown are based on operating at Plymouth at maximum gross takeoff weight on a warm summer day. Operating at a reduced weight and during cooler temperatures would require a shorter runway, and vice versa.

The data indicate that the 2,380-foot runway is adequate for both the design aircraft and many other small general aviation aircraft that typically operate at Plymouth. However, the Runway

Low-Growth Non-NPIAS Airport

If the Sponsor decides to forgo the NPIAS path for the airport, the following facility requirements will be referenced. The difference in forecasted operations (See Chapter 3, Table 9) for Plymouth is a result of funding disparities. An airport included in NPIAS receives more annual funding than an airport not included in NPIAS, thus, in theory, the NPIAS airport will be better suited to accommodate higher volume of traffic.

Obstruction Removal Recommendations

Land adjacent to the Plymouth Municipal Airport produces many vegetative obstructions to the runway's Part 77 surfaces and the airport's Threshold Siting Surface (Chapter 3, *Obstruction Analysis)*. Of these various imaginary surfaces, the focus at Plymouth will be on the approach, primary, and threshold siting surfaces. The current obstructions identified in Chapter 3 (Figure 13) total 10.21 acres of obstructions to various surfaces. Table 4.1 identifies the obstruction acreage in each Part 77 surface; however, the airport is under no obligation to remove these obstructions if they do not join NPIAS.

Table 4.1 – Part 77 Obstructions

Surface	Acreage to be Mitigated	Notes
Runway 12 Approach Surface	0.96	Off-airport
Runway 30 Approach Surface	4.72	Off-airport
Runway 30 Siting Surface	4.53	Off-airport
Primary Surface	(various small shrubs)	On-airport

Airside Facility Capacities and Requirements

This section describes the airside requirements for Plymouth in order to keep up with demand in a non-NPIAS environment.

Runway Lighting

With safety being the catalyst behind the majority of all airport improvements, it is recommended that the airport light its runway with lighted cones. Not only will this provide an additional safety element for airport users during poor visual flying conditions, this will allow for nighttime use of the airport.

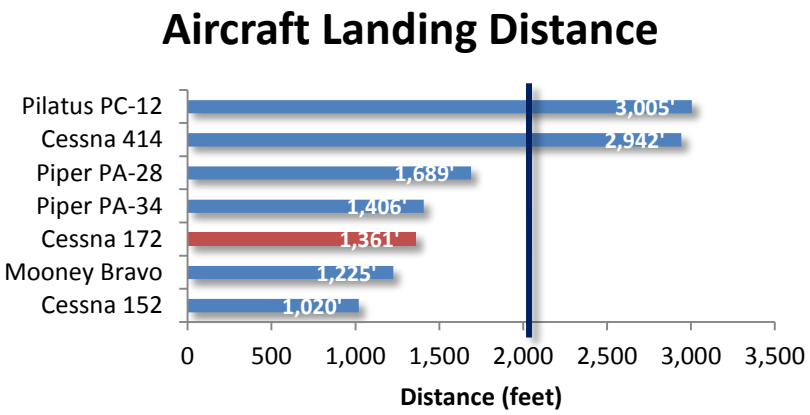

Figure 4.1 – Aircraft Takeoff Distances

Landside Facility Capacities and Requirements

This section describes the landside requirements for Plymouth in order to keep up with demand in a non-NPIAS environment.

Aircraft Parking

This section describes the needs at Plymouth in regard to aircraft parking. These needs are based on the previously mentioned based- and itinerant-aircraft operations forecasts.

Hangar Parking

If the same percentage of based aircraft continues to park in hangars (12%) throughout the planning period, then Plymouth has sufficient hangar space. Table 4.1 identifies hangar requirements for Plymouth.

Table 4.1 - Low-Growth Hangar Requirements

Condition	2015	2020	2025	2035
Based Aircraft	17	17	19	19
Percent of Based Aircraft in Hangars	12%	12%	12%	12%
Based Aircraft in Hangars	2	2	2	2
Existing Hangar Space	2	2	2	2
Surplus (Deficit)	**0**	**0**	**0**	**0**

Apron Parking

Currently, 12% of based aircraft at Plymouth use a hangar for aircraft parking (2 out of 17). The low-growth forecast predicts that two additional aircraft will be based at Plymouth by the end of the 20-year planning period (19 total). Over the 20-year planning period, it is assumed that Plymouth will accommodate two additional permanent aircraft. This, in turn, leaves a deficit of 703 square yards needed in order to accommodate low-growth forecasts. Table 4.2 identifies hangar space requirements throughout the 20-year planning period. Table 4.2 identifies itinerant aircraft apron space requirements.

Table 4.2 - Low-Growth Itinerant Aircraft Apron Requirements

Condition	2015	2020	2025	2035
Busiest Month (15% of annual ops)	455	461	494	502
Busiest Day (110% of PMAD)	16	16	18	18
Busiest Day Itinerant Ops (50% of busiest day)	8	8	9	9
Square Yards per Aircraft	230	230	230	230
Planned Apron Size (square yards)	**2,064**	**2,064**	**2,219**	**2,252**

Table 4.3 identifies based aircraft apron space requirements.

Table 4.3 - Low-Growth Based Aircraft Apron Requirements

Condition	2015	2020	2025	2035
Based Aircraft	17	17	19	19
Percent of Based Aircraft Using Apron	88%	88%	88%	88%
Based Aircraft on Apron	15	15	17	17
Apron Size Requirements (230 SY/AC)	**3,450**	**3,450**	**3,910**	**3,910**

Table 4.4 identifies total apron space requirements throughout the 20-year planning period. All figures are measured in square yards.

Table 4.4 - Low-Growth Apron Requirements (Total)

Condition	2015	2020	2025	2035
Itinerant Needs	2,064	2,064	2,219	2,252
Based Aircraft Needs	3,450	3,450	3,910	3,910
Total Apron Requirements	5,514	5,514	6,129	6,162
Existing Apron Size	6,292	6,292	6,292	6,292
Surplus (Deficit)	**778**	**778**	**163**	**130**

Over the 20-year planning period, it is assumed that Plymouth will accommodate two additional permanent aircraft. Aircraft parking is a relatively cheap, consistent, and reliable source of income for a small airport such as Plymouth.

Aviation Fuel System

Reinstalling a fuel system at Plymouth is a supplementary form of income for the sponsor and should be considered. Several location alternatives are described in the next chapter (See: Chapter 5, *Preferred Alternatives*).

Development Triggers

A development trigger is a threshold or an event that would prompt specific development at an airport. In the non-NPIAS scenario, all of the development triggers will be dependent upon user demand.

Although Plymouth is not funded by the FAA, it is still a public-use airport. The FAA can require obstructions to be removed from the airport's Part 77 surfaces, specifically the primary surface and the approach surface. With that, it is recommended that the sponsor plan to remove obstructions from the aforementioned surfaces in the near term (0 – 5 years). The airport should remove current obstructions with a plan in mind to remove the displaced threshold. If the threshold gets moved back to the runway end, the location of the Part 77 surfaces also change.

Lighting the turf runway is a safety issue. If demand for night operations at Plymouth becomes pronounced, the airport should take steps to provide a safe environment for airport users. Most likely, this will not happen until the intermediate term.

According to the forecasts described in Chapter 3 – *Forecasts*, aircraft apron parking will require additional space in the long term. From 2026 – 2035, the airport is expected to have a deficit of roughly 700 square yards. This is a modest, yet necessary, development recommendation. Itinerant aircraft apron parking is important at Plymouth considering the fly-in events and the seasonality of the airport's operations.

A fuel system installation at the airport is recommended strictly as an additional revenue source, if demand suggests, in the long term.

Table 4.5 describes a recommended timetable for when each recommendation should be accomplished over the 20-year planning period.

Table 4.5 – Timetable (Non-NPIAS)

Projects	Short Term (2016 – 2020)	Intermediate Term (2021 – 2025)	Long-Term (2026 – 2035)
Runway Lighting		X	
Obstruction Removal	X		
Remove Displaced Threshold	X		
Fuel System			X
Aircraft Parking			X

High-Growth NPIAS Airport

Joining NPIAS will provide the airport additional funds to accommodate growth; however it will also present the airport with further rules and restrictions. These regulations begin with potentially paving the runway and also include the need for larger safety areas, RPZs, and a multitude of airspace obstruction concerns. These concerns are boilerplate for any airport with aspirations of growth and generally lead to a safer aviation environment for airport users.

This section describes the requirements for Plymouth in order to keep up with demand after joining NPIAS.

Airside Facility Capacities and Requirements

This section describes the airside requirements for Plymouth in order to keep up with demand and FAA requirements if the airport joins NPIAS.

Runway

If the airport decides to join NPIAS, the FAA will most-likely require that the airport pave its runway. This introduces a slew of safety issues that will need to be mitigated. In order to comply with FAA regulations after paving the runway, the airport is best to choose from the two options below. Both options require the runway to be lighted.

Option One: The airport will leave the displaced threshold where it is currently located. This will allow the Runway Safety Area (RSA) for the approach end of Runway 30 to extend to its full length (240') beyond the threshold without incurring any property acquisition issues. All other protection areas (ROFA and ROFZ) for Runway 30 will be within standard.

The farm near the approach end of Runway 12 will create several issues with obstructions and protection-area regulations. Currently, there are three structures penetrating the Runway's approach surface. Those will need to be lighted (if approved by the FAA) or removed. Moreover, the Runway's RSA will need to extend 240 feet beyond the runway threshold. At this distance, the border of the RSA will be in the middle of a crop field. Therefore, property acquisition is recommended in order to mitigate these issues. In this scenario, the RPZ for Runway 12 will have multiple standing structures located within its boundaries. The FAA clearly states that a runway's RPZ must be "kept free of structures and any development that would create a place of public assembly[1]." Once the approach surfaces are cleared, obstructions in the Runway's transitional surface will

[1] FAA AC 150/5300-13A, Airport Design

need to be lighted or cleared. This task can be accomplished via easement acquisition or an outright purchase of the property.

Option Two: The airport will remove the displaced threshold for the approach end of Runway 30. This will allow for full use of the paved surface. If chosen, this scenario will require that the airport purchase land to the east of the airport. The purchased land will allow the runway's protection areas to conform to FAA regulations. Additionally, owning this land will provide and easier route to obstruction mitigation near the Runway 30 end.

The aforementioned issues mentioned in Option One regarding the approach end of Runway 12 will remain the same.

Taxiway

Considering the close distance between the runway and the aircraft parking area, the airport will need no more than two short, paved, and lighted taxiway stub providing access from the parking area to the runway. One stub will provide runway access for the historical hangar as well as the tie-down parking area. The second stub taxiway will provide runway access for the south hangar.

Landside Facility Capacities and Requirements

This section describes the landside requirements for Plymouth in order to keep up with demand and FAA requirements if the airport joins NPIAS.

Aircraft Parking

Itinerant and based aircraft parking requirements are described in this section.

Hangar Parking

Currently, 12% of based aircraft at Plymouth use a hangar for aircraft parking (2 out of 17). The forecast predicts that five additional aircraft will be based at Plymouth by the end of the 20-year planning period (22 total). If 12% of Plymouth's based aircraft continue to park in a hangar, the airport may want to consider constructing an additional hangar. Table 4.7 identifies hangar space requirements throughout the 20-year planning period.

Table 4.7 - Hangar Requirements

Condition	2015	2020	2025	2035
Based Aircraft	17	17	20	22
Percent of Based Aircraft in Hangar	12%	12%	12%	12%
Based Aircraft in Hangars	2	2	2	3
Existing Hangar Space	2	2	2	2
Surplus (Deficit)	**0**	**0**	**0**	**(1)**

Apron Parking

The aircraft tie-down area needs to be expanded in order to accommodate forecasted growth. In order to calculate apron (tie-down) area size, the Peak Hour Operations calculation was used (Chapter 3, *Aviation*

Activity). Currently, 88% of the based aircraft are located on the apron. It is presumed that 100% of itinerant aircraft use the apron for parking. This is well outside of industry norms. Table 4.8 identifies the itinerant aircraft parking requirements.

Table 4.8 - Itinerant Aircraft Apron Requirements

Condition	2015	2020	2025	2035
Busiest Month (15% of annual ops)	455	460	521	585
Busiest Day (110% of PMAD)	16	16	18	21
Busiest Day Itinerant Ops (50% of busiest day)	8	8	9	10
Square Yards per Aircraft	230	230	230	230
Apron Size Requirements (square yards)	**2,064**	**2,064**	**2,339**	**2,625**

Table 4.9 identifies the apron requirements for based aircraft, which assumes that 13% of based aircraft will continue to park in hangars.

Table 4.9 - Based Aircraft Apron Requirements

Condition	2015	2020	2025	2035
Based Aircraft	17	17	20	22
Percent of Based Aircraft Using Apron	88%	88%	88%	88%
Based Aircraft on Apron	15	15	17	19
Apron Size Requirements (230 SY/AC)	**3,450**	**3,450**	**3,910**	**4,370**

Table 4.10 identifies the total apron requirements needed throughout the 20-year planning period. All measurements are in square yards.

Table 4.10 - Total Apron Requirements

Condition	2015	2020	2025	2035
Itinerant Needs	2,064	2,064	2,339	2,625
Based Aircraft Needs	3,450	3,450	3,910	4,370
Total Apron Requirements	5,514	5,514	6,249	6,995
Existing Apron Size	6,292	6,292	6,292	6,292
Surplus (Deficit)	**778**	**778**	**43**	**(703)**

Aviation Fuel System

Reinstalling a fuel system at Plymouth is a supplementary form of income for the sponsor and should be considered. If the runway is paved, this will draw more airport users which, in turn, will present the airport with an additional source of revenue if fuel prices are competitive. Several location alternatives are described in the next chapter (See: Chapter 5, *Preferred Alternatives*).

Development Triggers

If the sponsor decides to join NPIAS and NPIAS accepts, the airport will immediately be required to mitigate Part 77 surface obstructions. One method of mitigation is to light clusters of obstructions with a red

obstruction light. This is feasible for obstructions identified within the runway's transitional surface. Obstructions within other Part 77 surfaces will require trimming.

If the airport's runway is to be paved, its protection surfaces will change in dimension, extending beyond the runway's threshold. This will require several acres of land beyond both runway ends to be acquired by the airport sponsor.

In the intermediate term, and if the runway is paved, it is recommended that the airport construct a new fueling system. This will be an additional revenue source for the sponsor, especially considering the perceived influx of additional traffic with the new paved runway.

In the long term, the airport should expand its parking apron in order to accommodate forecasted demand. If the airport realizes the number of operations that is expected, the parking apron will require roughly 700 additional square yards of aircraft parking space. Additionally, if forecasted demand is realized, the airport should consider constructing one additional hangar in the long term.

Table 4.11 describes a recommended timetable for when each recommendation should be accomplished over the 20-year planning period.

Table 4.11 – Timetable (NPIAS)

Projects	Short Term (2016 – 2020)	Intermediate Term (2021 – 2025)	Long-Term (2026 – 2035)
Obstruction Removal	X		
Pave Infrastructure/Add TWY	X		
Land Acquisition	X		
Expand Tie-Down Area			X
Fuel System		X	
Construct Hangar			X
Clear or Light Transitional Surface	X		

Summary

This section provides a general description of recommended projects for Plymouth Municipal Airport over the 20-year planning period. These airport improvements will allow the airport to keep up with forecasted demand.

Non-NPIAS Improvements

If the Airport Sponsor chooses to refrain from joining NPIAS, the airport will continue to operate without federal support. This lack of additional funding is reflected in the forecasts with minimal traffic and based aircraft growth. In turn, Plymouth will not be required by the FAA to conform to NPIAS-regulated grant assurances and regulations.

It is advised that the airport remove or mitigate all obstructions to the airport's approach surface. Once complete, the airport can remove the displaced threshold for Runway 30, allowing aircraft to utilize the entire

length of the turf strip. This creates a safer aviation environment for airport users. Safety is catalyst for the majority of improvement projects at airports around the country, and Plymouth is no different. It is recommended that the airport light its runway in order to accommodate nighttime operations. Once the safety issues have been corrected, the airport can focus its resources on expanding the aircraft parking area near the terminal building. According to the low-growth forecasts, the airport will need to accommodate two additional based aircraft by the end of the planning period.

Lastly, the airport sponsor has expressed interest in making the airport self-sufficient. An efficient method for generating income is to install a fueling system of which the airport can charge a fuel flowage fee. It is recommended that – in the long term – Plymouth install a 3,000 gallon 100LL fueling system.

NPIAS Improvements

If the airport sponsor chooses to join NPIAS, the airport will undergo significant changes. These changes will position the airport to attract more traffic and, therefore, more income.

The airport will most likely be required to pave its runway, construct two taxiways, and pave the aircraft parking areas. Additionally, the aircraft parking area must be expanded to accommodate five additional aircraft. The construction of a hangar is recommended in order to keep up with forecasted aircraft parking demand. Aside from the parking expansion, these projects must occur in the near-term. However, the most pertinent safety issue will be the removal of all approach surface obstructions (vegetative and structural). Moreover, the airport will be required to purchase parcels of land adjacent to each runway end. This will ensure that the runway protections areas (RSA, ROFA, RPZ) are free and clear of any non-conforming issues. The airport will also need to light or clear obstructions to the transitional surface, which include obstructions that are both on and off airport property.

As mentioned in the previous section (Non-NPIAS Improvements), the addition of a 100LL fuel tank with self-service capabilities is recommended. However, considering the financial and traffic disparities between joining NPIAS and not joining NPIAS, it is recommended that the sponsor install a 10,000 gallon 100LL fuel tank if the decision is made to join NPIAS. A larger tank will accommodate an increase in aircraft operations that is inevitable with a paved runway.

Table 4.12 summarizes all necessary improvements.

Table 4.12 - Summary of Requirements

Airport Asset	Current Condition	Non-NPIAS	NPIAS
Runway Length	2,380' x 90'	2,380' x 90'	2,380' x 90'
Runway Threshold Displacement	300'	0	0
Runway Surface	Turf	Turf	Paved
Runway Lighting	None	Lighted Cones	Lighted (In-Ground)
Taxiways	None	None	2 TWY Stubs
Hangar Space	2	2	3
Apron Space (SY)	6,292	6,995	6,995
Obstruction Clearing (Acres)	None	10.21	27.73
Fueling System	None	3,000 gal 100LL	10,000 gal 100LL

Chapter 5 – Development Alternatives

Introduction

The purpose of this section is to identify and evaluate reasonable development alternatives for Plymouth Municipal Airport that not only meet the demand levels outlined in Chapter 4, but also are constructible, minimize environmental impacts, and are financially feasible. The underlying objective is to meet the identified needs for both capacity and safety requirements and recommendations for the entire airfield operation and infrastructure. This Chapter reviews airport land available for future development and evaluates realistic airport layouts that incorporate recommended facilities identified in Chapter 4.

This Chapter will follow the same format as the previous chapters. Alternatives will be presented for both NPIAS – High Growth (HG) and non-NPIAS – Low Growth (LG) scenarios as well as "full-build" scenario that will identify airport infrastructure in a maximum capacity situation.

Various alternatives will be presented, each covering a series of proposed concepts that focus on similar scenarios. These range from a No-Build option to a "Full-Build" concept, with numerous LG and HG options in between. It is important to note that no single alternative addressed in this chapter is a stand-alone option. In fact, ideas and concepts can be mixed and matched to produce the town's preferred or recommended alternative. A summary and graph is provided at the end of this chapter that recaps the options presented.

Assumptions

It is important to address several key assumptions and project needs that were developed in earlier parts of this study before any alternatives can be analyzed. These assumptions are part of the foundation upon which the alternatives are developed.

1. The airport will remain a public-use, general aviation airport during the entire 20-year planning period;
2. The existing types of aircraft using the airport are not expected to change significantly throughout the planning period and the existing mix of operations is forecasted to remain primarily single-engine aircraft;
3. Available runway length meets the needs of a majority of the current fleet and existing critical aircraft; and
4. The ARC of A-I will remain the same throughout the 20-year planning period.

Development Alternatives Analysis

This subsection identifies alternatives for locating the recommended facility improvements throughout the long term. Improvements identified throughout the 20-year planning period in Chapter 4 of this master plan include the following:

- Remove 300' threshold displacement;
- Expand aircraft parking apron by 700 square yards; and
- Identify space for one additional hangar.

Graphics of each alternative discussed are located at the end of this chapter.

No Build Alternative

The realization that in the end, the town of Plymouth may elect to "do nothing" is considered and is presented as the No-Build Alternative. This is also an important concept to assess because if the town moves forward with other "development" options, there is a realistic chance that sooner or later the town will need an Environmental Assessment (EA). And an EA always requires a discussion about this concept.

This alternative assumes no further improvements from a safety and capacity standpoint. With no improvements made to the airport over the course of the 20-year planning period, it is assumed the airport will deteriorate into an unusable condition. This alternative would result in a negative economic impact and is not a recommended alternative.

Alternatives Analysis: Non-NPIAS – Low Growth (LG)

This section will analyze recommended improvements for Plymouth under the non-NPIAS no-growth and LG scenario. If the Sponsor continues to remain a public-use, non-FAA funded airport, this Chapter will illustrate various actions the airport can take in order to become a safer, more efficient infrastructure asset for the town of Plymouth, the region, and the state of New Hampshire.

Common Development Recommendations for LG Alternatives

There are several options common to the two alternatives. These are discussed first followed by an assessment of each of the two alternatives.

- ***Hangar Development***
  In addition to apron improvements, the airport must plan to accommodate at least one additional aircraft hangar throughout the 20-year planning period.

- ***Fuel System***
  As a supplementary source of revenue, the sponsor should consider constructing a 100LL fueling system. In the low-growth scenario, a 2,000 – 3,000 gallon tank is recommended. However, the

actual tank size is not as important as having a supply of fuel to sell. A larger tank permits the buyer to order larger quantities, which helps reduce the wholesale price of fuel.

- ***Obstruction Mitigation***
  The airspace surrounding 1P1, in particular the Part 77 approach surfaces, have considerable penetrations, significantly increasing safety concerns for airport users. These obstructions are on and off airport property and include some wetland clearing.

- ***Avigation Easement Acquisition***
  In order to clear vegetation obstructions, the airport must acquire avigation easement rights on at least eight separate parcels of land.

- ***Install Runway Edge Lights***
  Safety is the primary concern for this airport improvement. Aside from a lighted windcone, the airport does not currently provide any NAVAIDS for nighttime operations. The FAA requires low-intensity edge lighting for turf runways. Lighted runway edge lights are an efficient way of providing airport users a safe aviation environment after dark. In particular, with the rapid development of solar powered LED lights, the cost of installation and very low operating cost makes this option a very real possible alternative for Plymouth. Each light unit is individually lit and would not require any underground wiring.

LG Alternative I

Figure 5.1 (end of the chapter) depicts the development identified in LG Alternative I.

Landside

In order to secure the aircraft from any future vandalism, a partial-perimeter fence is proposed. This security feature will require approximately 1,500 feet of fabric at a height of 8 feet with barbed wire lining the top. A manual vehicle gate is proposed for access to the perimeter road near the end of Runway 30. In addition, one pedestrian gate is proposed near the Terminal Building. Entry through both gates shall be code-restricted. Design and construction of a partial-perimeter fence is estimated to cost $53,000.

The proposed 3,000 gallon 100LL fuel system will be constructed 320 feet southwest of the Terminal Building between the runway and the historical hangar. A self-serve, credit card system with an above ground tank is recommended. The upfront investment for this fueling system is projected to be $175,000.

An approximate 3,500 square foot hangar is proposed in the long-term. The location of this hangar is shown in Figure 5.1. This 60’ x 80’ conventional hangar will occupy roughly the same footprint as the

south hangar and have space available for two to three small aircraft. This project is estimated to cost $440,000[20].

Airside

The major concern for airside development at Plymouth is mitigating the obstructions to Part 77 surfaces surrounding the airport. The Part 77 surfaces affected include the 20:1 visual approach surface, the primary surface, and the 7:1 transitional surface. These imaginary surfaces are intended to protect pilots from hazards. In this case, it is not required that the airport mitigate these safety concerns because the airport does not receive funding by the FAA. However, Plymouth is still considered a public-use airport and should take steps to mitigate safety issues. It is recommended that the airport clear approximately 34 acres of vegetation obstructions. Of that, 20 acres are off airport property. This clearing is expected to cost $170,000.

The 20 acres of off airport obstruction clearing is important because of the required easement acquisitions necessary for vegetation removal. As previously mentioned, the airport will need to purchase easements from eight parcels adjacent to airport property. The eight parcels identified are identified by the town as:

- Tax Map 205, Lots 1-2
- Tax Map 206, Lots 12-13 and 16-18
- Tax Map 213, Lot 34

The cost of the easements is expected to be $180,000.

Lighting the runway is also a safety concern for airport users. The proposed edge lights can be solar-powered, which avoids trenching and high-powered voltage regulators, and could ease the maintenance costs for the Sponsor. The FAA requires runway edge lights be spaced at 200± feet intervals. Given this, the airport would need to install 24 lights. The cost for lighting the runway for night operations is projected to be $24,000.

This alternative also removes the displaced threshold on the approach end of Runway 30. This does not affect the obstructions to be removed according to the Part 77 20:1 Visual Approach Surface. Removing the displaced threshold will only require the removal of four cones that delineates the Runway's current threshold.

Summary of LG Alternative I

Table 5.1 lists a summary of costs for low-growth Alternative I.

[20] It is important to note that this size hangar is simply an example and the final size would be a matter of demand and Sponsor preference.

Table 5.1 – Low Growth Alternative I Summary of Costs

Category	Project	Estimated Cost
Landside	Construct Fence	$53,000
	Install Fuel System	$175,000
	Construct Hangar	$440,000
	Total Landside	**$668,000**
Airside	Obstruction Mitigation	$170,000
	Easement Acquisition	$180,000
	Runway Edge Lights	$24,000
	Remove Displaced Threshold	$0
	Total Airside	**$374,000**
	Total Overall	***$1,042,000***

LG Alternative II

Figure 5.2 (at the end of this chapter) depicts the development proposed for LG Alternative II.

Landside

This alternative proposes a relocation of the current based aircraft apron parking area. The new location will be south of the runway. The itinerant parking will remain adjacent to the Terminal Building. This provides an additional safety barrier between Quincy Road and parked aircraft. No new areas will need to be cleared, however some area may need to be graded in order to provide access to the runway from the new parking location. Figure 5.2 shows this proposed project. The approximate cost for this project is projected to be $15,000.

Partial-perimeter fencing is proposed for this option. The details and costs are the same as proposed in LG Alternative I at $53,000.

The proposed 100LL fuel system will be constructed in the same location as described in LG Alternative I. This provides easy access from the runway as well as the itinerant aircraft parking apron. The cost is expected to be the same as in Alternative I at $175,000.

Additional hangar space is needed in the long-term, as described in Chapter 4 – Forecasts. The Sponsor has expressed interest in constructing a 50’ x 147’ T-hangar structure in order to accommodate additional hangar requests. This proposed project will provide six additional hangared parking spots in order to accommodate future demand as well as provide an additional source of income for the Sponsor. The cost of this project is expected to be $360,000.

Airside

The major concern for airside development at Plymouth is mitigating the obstructions to various Part 77 surfaces surrounding the airport. The Part 77 surfaces affected include the 20:1 visual approach surface, the primary surface, and the 7:1 transitional surface. These imaginary surfaces are intended to protect pilots intending to use the airport from hazards to air traffic. In this case, it is not required that the

airport mitigate these safety concerns because the airport does not receive funding by the FAA. However, Plymouth is still considered a public-use airport and should take every step to mitigating all safety concerns. It is recommended that the airport clear approximately 34 acres of vegetation obstructions. Of that, 20 acres are off airport property. This clearing is expected to cost $170,000.

The 20 acres of off airport obstruction clearing is important because of the required easement acquisitions necessary for vegetation removal. As previously mentioned, the airport will need to purchase easements from eight parcels adjacent to airport property. The eight parcels identified are:

- Tax Map 205, Lots 1-2
- Tax Map 206, Lots 12-13 and 16-18
- Tax Map 213, Lot 34

The cost of the easements is expected to be $180,000.

For this alternative, installing solar powered runway edge lights is consistent with the description in LG Alternative I. A total of 24 edge lights are recommended at a cost of $24,000.

This alternative also removes the displaced threshold on the approach end of Runway 30. This does not affect the obstructions to be removed according to the Part 77 20:1 Visual Approach Surface. It is still recommended that all obstructions to Part 77 imaginary surfaces be mitigated.

Summary of LG Alternative II

Table 5.2 identifies a cost summary of the low-growth Alternative II.

Table 5.2 – Low Growth Alternative II Summary of Costs

Category	Project	Estimated Cost
Landside	Construct Fence	$53,000
	Install Fuel System	$175,000
	Construct T-Hangar Unit	$360,000
	Relocate Apron Parking	$15,000
	Landside Cost	**$603,000**
Airside	Obstruction Mitigation	$170,000
	Easement Acquisition	$180,000
	Runway Edge Lights	$24,000
	Remove Displaced Threshold	$0
	Airside Cost	**$374,000**
	Overall Cost	***$977,000***

Summary of Low Growth (LG) Alternatives

Table 5.3 identifies a cost summary of all proposed low-growth development alternatives. It is important to remember that these are planning-level costs, which means costs are liable to fluctuate in the engineer's cost estimate.

Table 5.3 – Low Growth Development Summary of Costs

Alternative	Project	Estimated Cost
I	Construct Fence	$53,000
	Install Fuel System	$175,000
	Construct Hangar	$440,000
	Obstruction Mitigation	$170,000
	Easement Acquisition	$180,000
	Runway Edge Lights	$24,000
	Remove Displaced Threshold	$0
	Alternative I Cost	**$1,042,000**
II	Construct Fence	$53,000
	Install Fuel System	$175,000
	Construct T-Hangar Unit	$360,000
	Relocate Apron Parking	$15,000
	Obstruction Mitigation	$170,000
	Easement Acquisition	$180,000
	Runway Edge Lights	$24,000
	Remove Displaced Threshold	$0
	Alternative II Cost	**$977,000**

Alternatives Analysis: NPIAS – High Growth (HG)

This section analyzes Plymouth's options as a member of the National Plan of Integrated Airport Systems (NPIAS). NPIAS contains all commercial service airports, all reliever airports, and selected general aviation airports. This system identifies nearly 3,400 existing and proposed airports that are significant to national air transportation and thus eligible to receive Federal grants under the Airport Improvement Program (AIP). Joining NPIAS is contingent upon, firstly, the Sponsor's approval and, secondly, acceptance into the program by the FAA.

If the airport successfully integrates into NPIAS, its approved development projects will be funded through the Airport Improvement Program (AIP) at a ratio of 90% (FAA), 5% (State), and 5% (Local). The Sponsor will be subjected to various grant assurances in accordance with the FAA's "Assurances" document[21]. The airport will also be required to conform to dimensional standards set forth in FAA AC 150/5300-13A, *Airport Design*.

[21] http://www.faa.gov/airports/aip/grant_assurances/media/airport-sponsor-assurances-aip.pdf

HG Alternative I

Figure 5.3 (end of chapter) depicts the development identified in HG Alternative I.

Landside

In the long-term, the airport will need 700 additional square yards of turf apron parking space. This is to accommodate growing demand for itinerant aircraft parking. This alternative proposes the construction of the required apron space east of the terminal building. This will require approximately 500 square feet of tree clearing on airport property. The cost of expanding the airport's apron space for this alternative is expected to be approximately $8,000.

In addition to apron parking space, the airport will need to plan for at least one additional hangar over the course of the 20-year planning period. The new conventional hangar is proposed for construction adjacent to the existing south hangar. As shown in Figure 5.3, the proposed hangar is 60' x 80', or roughly the same dimensions as Plymouth's south hangar. It must be noted that this size can change depending on what the Sponsor decides is best for the airport. The cost of constructing an additional conventional hangar at Plymouth is expected to be $440,000.

This alternative proposes the construction of a 5,000 – 10,000 gallon 100LL fuel dispensing system. The increase in size from the low growth alternatives is due to the expected increase in operations at Plymouth should the Sponsor become FAA-funded. And as discussed earlier, the larger the tank the better the cost savings in the wholesale price of fuel.

The system will be located 320 feet west of the terminal building. Considering that in this alternative, the airport is regulated by applicable FAA standards, the storage tank must be 15 feet from the property line and no less than five feet from the nearest "important" building[22]. Costs for this proposed project are projected to be $225,000.

The fuel farm requires additional security measures. A partial-perimeter fence is also proposed in this alternative to suit National Fire Protection Agency (NFPA) standards. However, the fence is not a full perimeter barrier. Instead, the proposed fence provides a safety measure between Quincy Road and airport property. The proposed fence will not only appeal to NFPA safety measures, but it also appeals to the Sponsor's safety concerns for based aircraft. This project requires 1,500 feet of length at a height of 8 feet with barbed wire lining the fence top. The cost of this proposed project is expected to be $53,000.

Airside

This alternative proposes installing low-intensity runway edge lighting (LIRL). There are two options for lighting. Solar-powered edge lights can be self-contained, negating the need to construct an entire circuit. Solar-lights also reduce energy and maintenance costs in the long-term. Runway edge lighting should be placed at intervals of 200', thus the airport will need 24 edge lights and 12 threshold lights.

[22] NFPA 30, *Flammable and Combustible Liquids Code, 2012 Edition*

Purchase and installation costs for solar-powered edge lights are projected to be $97,000. The second option is normal, circuited edge lights. Three-wire, parallel circuit edge lights are allowed for runways shorter than 4,000 feet. In total, the runway will need approximately 5,000 feet of trenching and cable for this improvement. With each light roughly $200, the cost for this improvement is expected to be $47,000.

Along with edge lighting, the airport will need to clear approximately 20 acres of off airport obstructions and 14 acres of on airport obstructions. The airport will need to purchase easements from eight parcels adjacent to airport property. The eight parcels identified are:

- Tax Map 205, Lots 1-2
- Tax Map 206, Lots 12-13 and 16-18
- Tax Map 213, Lot 34

The cost of the easements is expected to be $180,000.

Once the easements are acquired, the Sponsor can begin clearing the off airport obstructions. The cost of the obstruction clearing, roughly 34 acres in total, is expected to be $170,000.

Removing the displaced threshold that is currently in place at Plymouth is also proposed in this alternative. Considering the runway is to remain turf in this alternative, its RSA terminates at the threshold. This means that land on either end of the turf runway would not need to be purchased in order to provide sufficient safety areas. The removal of the displaced threshold is not expected to cost anything.

Summary of HG Alternative I

Table 5.4 lists the expected costs for HG Alternative I.

Table 5.4 – High Growth Alternative I Summary of Costs

Category	Project	Estimated Cost
Landside	Expand Parking Apron	$8,000
	Construct Hangar	$440,000
	Install Fuel System	$225,000
	Construct Fence	$53,000
	Landside Cost	**$726,000**
Airside	Obstruction Removal	$170,000
	Easement Acquisition	$180,000
	Runway Edge Lights	$97,000 $47,000
	Remove Displaced Threshold	$0
	Airside Cost	**$451,000** **$397,000**

Overall Cost	***$1,173,000 $1,123,000***

HG Alternative II

Figure 5.4 (end of chapter) depicts the proposed projects detailed in HG Alternative II.

Landside

Whereas HG Alternative I maintains turf surfaces within the airport operations area (AOA), this alternative proposes the construction of paved landside infrastructure. Furthermore, the based aircraft parking area will be relocated to south of the runway and 700 square yards will be added in order to accommodate growing demand. Overall, this project proposes approximately 124,000 square yards of landside paving.

In addition to paving the landside surfaces, Plymouth must conform to lighting and marking standards set forth in FAA AC 150/5340-1L, *Standards for Airport Markings*. This includes taxiway stub boundary marking with reflective barriers, mandatory holding signs, and pavement marking. The overall cost of paving is expected to be approximately $864,000, including the cost for installing proper edge lighting and navigation aids.

This alternative proposes the construction of one conventional hangar located adjacent to the south hangar. Its dimensions will be the same as the south hangar. Construction costs are expected to be $440,000.

A 100LL fuel farm is proposed for this alternative. The safety details as described in HG Alternative I are to remain to the same. Costs for this proposed improvement are expected to be $225,000.

A partial-perimeter fence is proposed for this alternative. The fence will require approximately 1,500 feet of fabric at a height of 8 feet with barbed wire lining the top. The expected cost for this improvement will be $53,000.

Airside

In this alternative, the main focus is on paving the runway, removing the displaced threshold, and ensuring all obstructions to surrounding airspace are mitigated. Paving the runway introduces a slew of FAA regulation differences from a turf runway. Chiefly, the runway's protection zones will shift. For example, with a turf runway, the runway safety area (RSA) ends at the runway's threshold. With a paved runway, however, the RSA extends 240 feet beyond the threshold. This will require the airport to purchase approximately two acres adjacent to the approach end of Runway 30 (map 206, lot 13) and approximately 1.7 acres of land adjacent to the Runway 12 end (map 205, lot 1). The cost of purchasing this land outright is expected to be $12,000.

This alternative requires approximately 20 acres of off-airport obstruction clearing and 14 acres of on-airport clearing. Acquiring avigation easements are necessary in order to mitigate the delineated obstructions. The off-airport lots are identified as:

- Tax Map 205, Lots 1-2
- Tax Map 206, Lots 12-13 and 16-18
- Tax Map 213, Lot 34

The cost for acquiring avigation easements is expected to be $180,000.

Once the easements are secured and the land is purchased, the Sponsor will clear delineated obstructions. The cost of the obstruction clearing, roughly 34 acres in total, is expected to be $170,000.

Paving the runway will require a full update to the airport's electrical system due to the required runway and associated taxiway lighting improvements. For runways shorter than 4,000 feet, the FAA allows a low-intensity parallel circuit. This is a single-phase, 3-wire system and typically provides a lower-cost installation as compared to a series-circuit installation. The cost for installing the aforementioned parallel circuit and the associated taxiway lights is expected to be $60,000.

This alternative proposes removing the current displaced threshold, which means that approximately 214,200 square feet of pavement will need to be laid. In terms of depth, three inches of bituminous surface (asphalt), six inches of supplemental aggregate as a base, and 27 inches of sub-base material. Overall, the cost of this improvement is expected to be $1,300,000, or $6.07 per square foot.

Summary of HG Alternative II

Table 5.5 lists a cost estimate for the improvements proposed in HG Alternative II.

Table 5.5 – High Growth Alternative II Summary of Costs

Category	Project	Estimated Cost
Landside	Pave AOA/Install Navigation Aids	$864,000
	Construct Hangar	$440,000
	Install Fuel System	$225,000
	Construct Fence	$53,000
	Landside Cost	**$1,582,000**
Airside	Pave Runway	$1,300,000
	Edge Lighting System	$60,000
	Purchase Land	$12,000
	Acquire Easements	$180,000
	Mitigate Obstructions	$170,000
	Airside Cost	**$1,722,200**
	Overall Cost	***$3,304,000***

Summary of High Growth Alternatives

Table 5.6 (next page) identifies a cost summary of all proposed low-growth development alternatives. It is important to remember that these are planning-level costs, which means costs are liable to fluctuate in the engineer's cost estimate.

Table 5.6 – High Growth Development Summary of Costs

Alternative	Project	Estimated Cost
I	Expand Apron Parking	$8,000
	Construct Hangar	$440,000
	Install Fuel System	$225,000
	Construct Fence	$53,000
	Mitigate Obstructions	$170,000
	Acquire Easements	$180,000
	Runway Edge Lights	$97,000 $57,000
	HG Alternative I Cost	**$1,173,000** **$1,123,000**
II	Pave AOA/Navigation Aids	$2,224,000
	Construct Hangar	$440,000
	Install Fuel System	$225,000
	Construct Fence	$53,000
	Purchase Land/Acquire Easements	$192,000
	Mitigate Obstructions	$170,000
	HG Alternative II Cost	**$3,304,000**

Full-Build Landside Alternative

Figure 5.5 (at the end of this chapter) shows all development proposed in this alternative. All proposed development in this alternative will occur south of the runway. Furthermore, all aircraft operating surfaces (parking aprons, taxilanes, and taxiways) will remain turf. For this alternative, it is assumed that the Sponsor will forgo membership into NPIAS.

At the request of the Sponsor and as detailed in the Project Scope, this section analyzes a scenario in which the south landside portion of 1P1 is built to full capacity. For all intents and purposes, a 6-unit, 60’ x 158’ structure is used for the T-Hangar areas and a 60’ x 80’ structure is used for the conventional hangar areas.

This alternative proposes the construction of five conventional hangars. Typically, these types of hangars can accommodate one or more single-engine aircraft. The hangars proposed are slightly larger than the hangar currently situated south of the runway. This type of hangar is typically privately owned and the land on which the hangar sits is leased to aircraft owners. The cost of constructing five conventional hangars is expected to be $2,200,000. This cost is all-encompassing, including engineering and electrical fees.

Two rows T-Hangars are proposed in this alternative. Each row will consist of 6 units and be measured as 60’ x 158’, to be located west of the AWOS-III. Each unit of these types of hangar is typically individually owned by the aircraft operator(s) and can be a solid source of additional revenue for the airport sponsor. This project is expected to cost $700,000, which accounts for sod or seed that will need to be

laid in order to provide a grass surface for taxiing aircraft. Currently, the area is being used by the adjacent property for farming purposes.

In addition to the aforementioned hangar developments, this full-build alternative includes designating more apron space for use by based aircraft. The itinerant aircraft apron parking will remain in its current location adjacent to the terminal building. Apron space will create a buffer between the runway and the hangar development. This will ensure any building height restrictions due to protection zones and imaginary surfaces will be accounted for. In total, this proposed project will add approximately 8,300 square yards of additional apron space. As previously mentioned, this area will remain a turf surface. The cost for this project is expected to be $20,000 due to probable surface grading projects.

Full-Build Landside Alternative Summary

Table 5.2 identifies a cost summary of the proposed projects for this alternative.

Table 5.5 – Full-Build Landside Cost Summary

Project	Cost
Conventional Hangar Construction	$2,200,000
T-Hangar Construction	$700,000
Additional Apron Space	$20,000
Total Cost	**$2,920,000**

Summary of Proposed Development Alternatives

Figure 5.6 (next page) depicts an overview of the proposed projects for each tract (NPIAS vs. Non-NPIAS) and each tract's associated alternatives.

The main focus, regardless of which route the Sponsor decides to pursue, is to increase safety on and around the airport; including mitigating considerable vegetative obstructions, constructing a partial-perimeter fence, and installing runway edge lights. Associated tasks include acquiring avigation easements and purchasing adjacent land parcels in order to gain access to various obstructions located off airport property.

Secondary concerns include installing a fuel system, expanding and relocating the based-aircraft parking apron, and adding a conventional hangar or a T-hangar unit. These improvements are derived from operations and based-aircraft forecasts throughout the 20-year planning period.

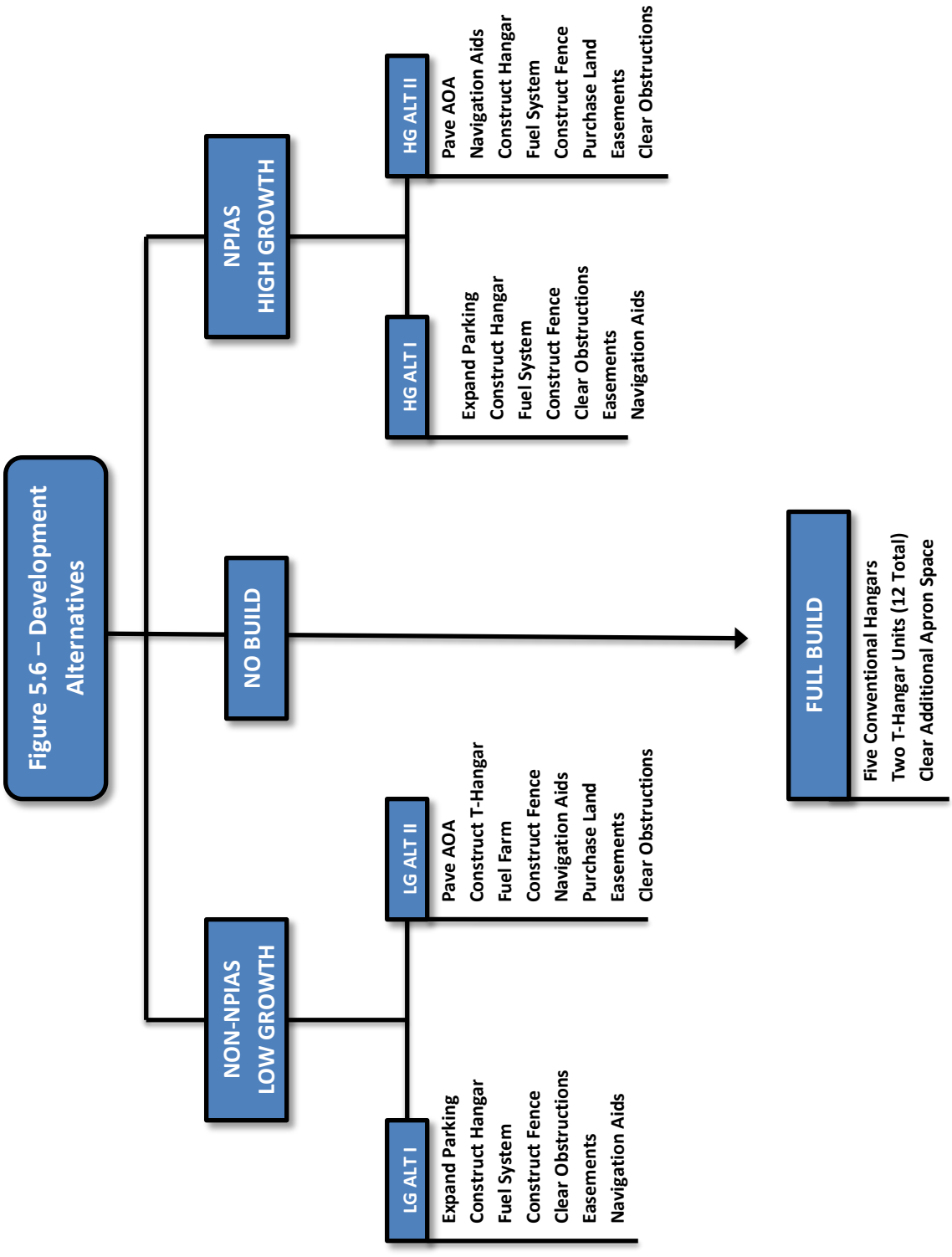
Figure 5.6 – Development Alternatives
NO BUILD
NPIAS HIGH GROWTH
HG ALT II
Pave AOA
Navigation Aids
Construct Hangar
Fuel System
Construct Fence
Purchase Land
Easements
Clear Obstructions
HG ALT I
Expand Parking
Construct Hangar
Fuel System
Construct Fence
Clear Obstructions
Easements
Navigation Aids
NON-NPIAS LOW GROWTH
LG ALT II
Pave AOA
Construct T-Hangar
Fuel Farm
Construct Fence
Navigation Aids
Purchase Land
Easements
Clear Obstructions
LG ALT I
Expand Parking
Construct Hangar
Fuel System
Construct Fence
Clear Obstructions
Easements
Navigation Aids
FULL BUILD
Five Conventional Hangars
Two T-Hangar Units (12 Total)
Clear Additional Apron Space

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LEGEND	EXISTING
AIRPORT PROPERTY LINE	
ABUTTERS' PROPERTY LINE	
OBJECT–FREE AREA (OFA)	OFA
RUNWAY SAFETY AREA (RSA)	RSA
PROPOSED FENCE	x x
PROPOSED AVIATION USE	
PROPOSED HANGARS	
PROPOSED FUEL FARM	
WETLANDS	

N

0 100' 200'

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FIGURE 5.1

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LEGEND	EXISTING
AIRPORT PROPERTY LINE	
ABUTTERS' PROPERTY LINE	
OBJECT–FREE AREA (OFA)	OFA
RUNWAY SAFETY AREA (RSA)	RSA
PROPOSED FENCE	x x
PROPOSED AVIATION USE	
PROPOSED HANGARS	
PROPOSED FUEL FARM	
WETLANDS	

N

0 100' 200'

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FIGURE 5.2

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LEGEND	EXISTING
AIRPORT PROPERTY LINE	
ABUTTERS' PROPERTY LINE	
OBJECT–FREE AREA (OFA)	OFA
RUNWAY SAFETY AREA (RSA)	RSA
PROPOSED FENCE	x x
PROPOSED AVIATION USE	
PROPOSED HANGARS	
PROPOSED FUEL FARM	
PROPOSED FUEL FARM	
WETLANDS	

N

0 100' 200'

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FIGURE 5.3

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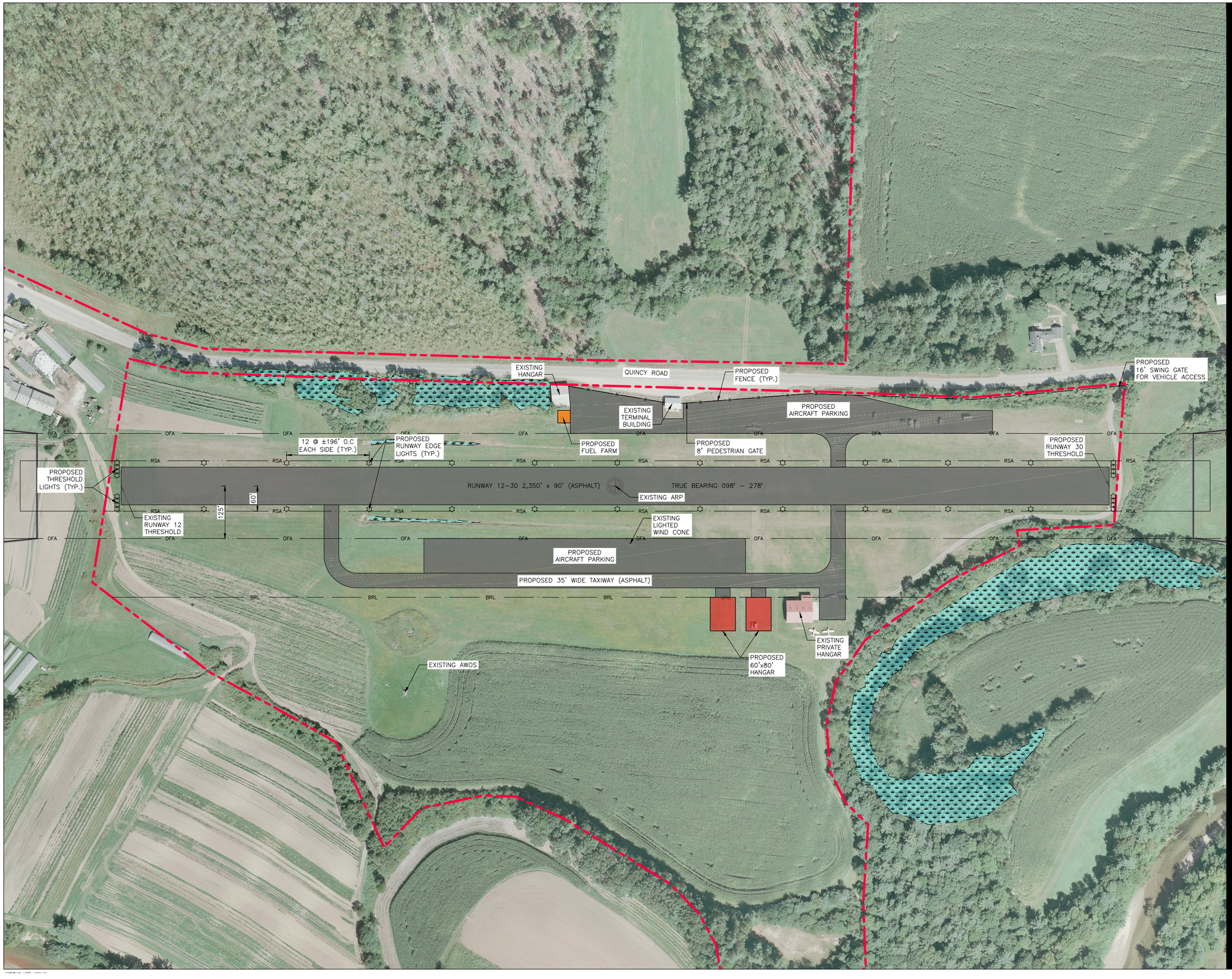

LEGEND	EXISTING
AIRPORT PROPERTY LINE	
ABUTTERS' PROPERTY LINE	
OBJECT-FREE AREA (OFA)	OFA
RUNWAY SAFETY AREA (RSA)	RSA
PROPOSED FENCE	x x
PROPOSED PAVEMENT	
PROPOSED HANGARS	
PROPOSED FUEL FARM	
WETLANDS	

N

0 100' 200'

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FIGURE 5.4

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LEGEND	EXISTING
AIRPORT PROPERTY LINE	
ABUTTERS' PROPERTY LINE	
OBJECT–FREE AREA (OFA)	OFA
RUNWAY SAFETY AREA (RSA)	RSA
PROPOSED FENCE	x x
PROPOSED AVIATION USE	
PROPOSED HANGARS	
PROPOSED FUEL FARM	
WETLANDS	

N

0 100' 200'

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FIGURE 5.5

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