4.0 DEVELOPMENT ALTERNATIVES

This chapter identifies various airport development alternatives for the Waterbury-Oxford Airport (OXC) that would satisfy the airfield and landside facility requirements identified in Chapter 3. The alternative identification and evaluation process is consistent with FAA guidelines and standards, and considers a variety of screening criteria. The major additional facility requirements for OXC include the following:

- Parallel Taxiway "B" Extension
- Additional Exit Taxiways
- Airport Service Road
- Obstruction Removal
- Approach Lighting System
- Additional T-hangar (36 bays)
- Additional Conventional Hangar Space (96,000 square feet)
- Maintenance Garage

The goal is to develop a recommended plan that improves airfield facilities and accommodates landside development that would meet user demands. As such, various development alternatives were identified and evaluated based on a range of criteria, including operational efficiency and safety, environmental impacts, and cost. Note that this Master Plan Update represents a preliminary evaluation of the potential impacts associated with each alternative. Before project development, environmental studies and permitting (appropriate to the specified project) would be required.

This chapter includes the following components:

- Airfield Alternatives
- Landside Alternatives
- Recommended Development Concept

4.1 Airfield Alternatives

Various airfield development alternatives were identified to satisfy the facility requirements presented in Chapter 3. The airfield alternatives focus on providing additional taxiway and lighting facilities, and improving operations and safety. No change or expansion to the current runway was considered in this study. The airfield alternatives under consideration are illustrated on Figures 4-1 through 4-4.

4.1.1 Parallel Taxiway "B" Alternatives

Several possible alignments were identified to provide a full parallel taxiway on the east side of the airfield. The alignments would extend parallel Taxiway "B" to the end of Runway 36, and would reduce runway crossings and occupancy time. As a taxiway extension would impact freshwater wetlands, various alignments were developed in an attempt to balance operational considerations with environmental concerns. Each alternative is illustrated on Figure 4-1.

- **Alternative 1A** – Provides the standard 400-foot runway-taxiway offset for Airport Reference Code (ARC) D-III, and extends Taxiway "B" on its current alignment. This alternative is ideal from an operational and safety standpoint by providing a straight taxiway with no interference to other airport facilities. The alignment would impact five to six acres of wetlands, and would require significant filling to raise the area to grade.

- **Alternative 1B** – A modification of Alternative 1A that would reduce wetland impacts by incorporating an acute angle entrance taxiway at the end of Runway 36. The angle would reduce the fill and embankment required in the wetlands located along the Airport's southeastern property line. The configuration would be similar to that currently provided on the northwest end of Runway 18.

- **Alternative 2** – Attempts to reduce wetland impacts by using an expanded 600-foot runway-taxiway offset, which circumvents much of the wetland area. This offset could reduce wetland impacts by over 50% compared to Alternative 1A. However, the layout would retain a forested wetland within the airfield, raising the chance for wildlife-aircraft strikes and introducing line-of-sight concerns. The layout connects to the proposed Hangar G development, forcing aircraft to taxi through a privately-leased apron area. The associated clearances of the Taxiway Object Free Area (TOFA) would occupy most of the Hangar G apron, create conflicts with tenant activities, and eliminate the ability to park business aircraft with wingspans over 49 feet. As such, the TOFA would functionally eliminate the use of the apron and impact hangar access. The layout also would increase the taxiway length and number of turns, resulting in an awkward airfield configuration.

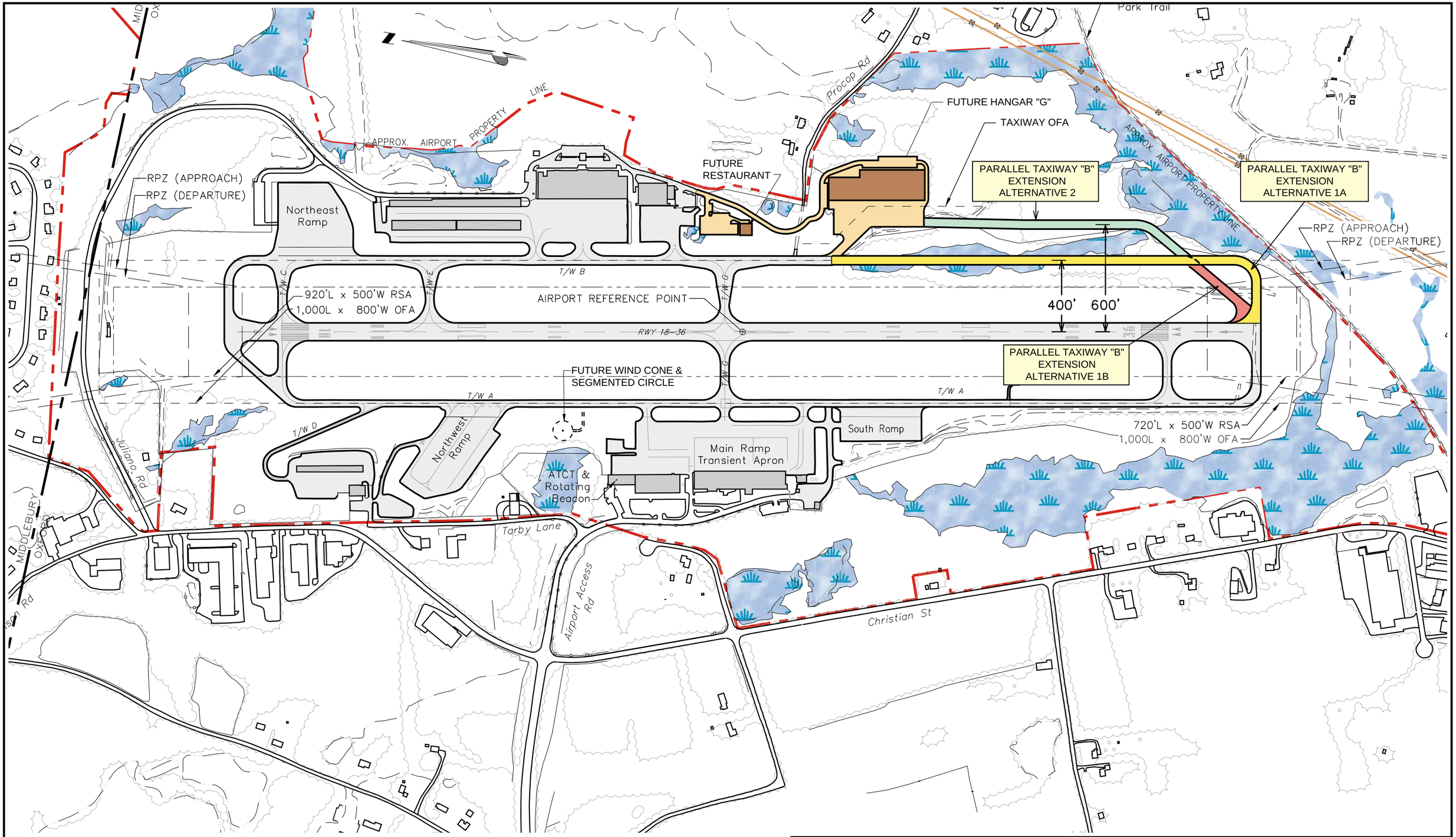

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Figure 4–1

PARALLEL TAXIWAY ALTERNATIVES

Connecticut Department of Transportation
Waterbury–Oxford Airport Master Plan
Oxford, Connecticut

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Note: Recommendation may include Option A or B, but not both.

FUTURE HANGAR "G"

FUTURE RESTAURANT

PARALLEL TAXIWAY "B" EXTENSION ALTERNATIVE 1A

EXIT TAXIWAY OPTION B

EXIT TAXIWAY OPTION D

EXIT TAXIWAY OPTION A

EXIT TAXIWAY OPTION C

FUTURE WIND CONE & SEGMENTED CIRCLE

AIRPORT REFERENCE POINT

920'L x 500'W RSA
1,000L x 800'W OFA

720'L x 500'W RSA
1,000L x 800'W OFA

TAXIWAY "D" WIDENING

RPZ (APPROACH)
RPZ (DEPARTURE)

APPROX. AIRPORT PROPERTY LINE

Northeast Ramp

Northwest Ramp

Main Ramp Transient Apron

South Ramp

ATCT & Rotating Beacon

RWY 18–36

T/W A

T/W B

T/W C

T/W D

T/W E

T/W G

Procop Rd

Park Trail

Juliano Rd

Tarby Lane

Airport Access Rd

Christian St

MIDDLEBURY

OXFORD

0 500 1,000
Scale in feet

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Figure 4–2

EXIT TAXIWAY ALTERNATIVES

Connecticut Department of Transportation
Waterbury–Oxford Airport Master Plan
Oxford, Connecticut

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RUNWAY PROTECTION ZONE (DEPARTURE)

RUNWAY PROTECTION ZONE (APPROACH)

WETLAND

RELOCATE FENCE

6% GRADE

SERVICE ROAD ALTERNATIVE 1A

WETLAND

SERVICE ROAD ALTERNATIVE 2

SERVICE ROAD ALTERNATIVE 1B

SERVICE ROAD ALTERNATIVE 1A

APPROX. AIRPORT PROPERTY LINE

REMOVE 3 TIE-DOWNS

Northeast Ramp

Hangar "F"

Double Diamond Hangar

7% GRADE

FUTURE RESTAURANT

FUTURE HANGAR 'G'

Procop Rd

T/W G

1,000L x 800'W OFA

920'L x 500'W RSA

T/W E

T/W B

FUTURE GRASS TIE-DOWNS

T/W G

AIRPORT REFERENCE POINT

RWY 18–36

PROPOSED SEGMENTED CIRCLE

T/W G

T/W A

T/W A

T/W D

Northwest Ramp

South Ramp

Main Ramp Transient Apron

ATCT & Rotating Beacon

Fuel Farm

Tarby Lane

Juliano Rd

MIDDLEBURY OXFORD RD

Benson Rd

Airport Access Rd

Christian St

0 400 800

Scale in feet

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Figure 4–3

SERVICE ROAD ALTERNATIVES

Connecticut Department of Transportation

Waterbury–Oxford Airport Master Plan

Oxford, Connecticut

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TWP 1446

APPROX. AIRPORT PROPERTY LINE

TWP 450

EXISTING TRANSMISSION LINE

TWP 1445

TWP 449

EXISTING TOWERS

TWP 1444

TWP 448

POTENTIAL ROAD

IN-PAVEMENT MALSR LIGHTS

POLE-MOUNTED LIGHTS

CONFLICT WITH TRANSMISSION LINE

END OF MALSR

SERVICE ROAD/ WALKWAY

MALSR SERVICE ROAD

State Park Trail

TWP 1443

EXISTING TRANSMISSION LINE

TWP 447

660 640 630 630 670 670 660 650 680 670 650 630 610 800 630 620 610 640 650 600 590 610

0 200 400

Scale in feet

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Figure 4–4

MALSR DEVELOPMENT

Connecticut Department of Transportation
Waterbury–Oxford Airport Master Plan
Oxford, Connecticut

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4.1.2 Exit Taxiway Alternatives

To satisfy the facility requirements, several exit taxiway locations were identified. If provided, these additional exits would reduce runway occupancy time and improve operational efficiency and safety for all users of the Airport. Exit taxiway locations were identified along several portions of the runway, as summarized below and illustrated on Figure 4-2. As multiple taxiway layouts may be recommended, they are referred to as options instead of alternatives.

- **Option A** – The highest demand for an additional exit taxiway is on the west side of the runway, between Taxiways "C" and "G." This location is the rollout point for landings on the predominately used Runway 36. Aircraft rollouts that bypass exit Taxiway "G" must currently travel an additional 2,500 feet for a west-side runway exit. Option A is located 1,600 feet beyond Taxiway "G" in order to be positioned opposite Taxiway "E." As such, Option A would also enable runway crossings.

- **Option B** – Functionally, Option B serves the same purpose as Option A, but is located equidistant between existing Taxiways "C" and "G," which would further reduce runway occupancy time. However, as there is no corresponding exit on the east side of the runway, Option B would require construction on both sides of the runway to provide a runway crossing point.

- **Option C** – This option would provide both east- and west-side exits for landings on Runway 18. The depicted location is equidistant between the runway midpoint and the Runway 36 end, optimally positioned for landings that bypass Taxiway "G." An additional benefit of Option C is its location just north of the electronic glide slope antenna, which would avoid the glide slope critical area to the south, enabling use of the taxiway without interfering with ILS use. Note that the east-side exit would connect with an extension of parallel Taxiway "B." Thus, the parallel taxiway extension must be constructed prior to Option C.

- **Option D** – This option would provide an east-side exit taxiway opposite the existing west-side exit near the south end of the runway. The location would provide a symmetrical exit layout while reducing development costs. However, the location of Option D is 2,500 feet from Taxiway "G," and would therefore not substantially reduce runway occupancy time.

Note that Options A and B would provide an exit taxiway for Runway 36 landings, while Options C and D would provide an exit for Runway 18 landings. A recommendation for each runway end is desirable. Either Option A or B would provide adequate functionality; however, Option A provides an efficient layout with minimum cost. For Runway 18 activity, only Option C would satisfy the facility requirements.

4.1.3 Service Road Alternatives

An on-airport service road would be used by Airport and Fixed-Based Operator (FBO) personnel for the operation of fuel trucks, snow plows, and other service vehicles. The service road should be located clear of operational areas (i.e., runways, taxiways, and safety areas) to prevent interference with aircraft. Due to the Airport's physical constraints (i.e., wetlands, excessive grades), the alignment of any service road has several shortcomings. Three alternatives were investigated for the AMPU. Each alternative is illustrated on Figure 4-3.

- **Alternative 1A** – Provides a bi-directional service road around the north end of the airfield that remains outside of the RSA. Starting at the main ramp, the service road would run parallel to Taxiway "A" at an offset of 93 feet (the standard for ARC D-III, see Appendix B, *Taxiway Centerline to Movable Object*). To the north of Taxiway "D," the road would descend and cross a small wetland. The service road then continues around the north end of the Airport, requiring the relocation of the Airport security fence, and then turns south and up a 6% grade to the Northeast Ramp. On the east side of the runway, the service road would require the removal of three tiedowns, necessitate a 7% grade between the Hangar F and Double Diamond ramps, and conflict with proposed grass tiedowns adjacent to the proposed restaurant. In addition, Alternative 1A would traverse the relocated segmented circle (to the west of Taxiway "A"). The individual segments would therefore be converted from raised snow-shedding panels to flush/painted segments on pavement. This would require the area around the segmented circle to be plowed during each snow event.

  The advantage of Alternative 1A is its location outside the airfield operational areas. Disadvantages include the overall length, cost, number of turns, steep grades, and wetland impacts.

- **Alternative 1B** – An essentially scaled-back version of Alternative 1A that eliminates the service road section around the north end of the airfield. Alternative 1B would still separate vehicles from aircraft on parallel Taxiways "A" and "B," but would require vehicles to cross the north end of the runway. Vehicle operators would be required to obtain clearance from Air Traffic Control (ATC) for runway crossings. Alternative 1B avoids wetland impacts and reduces construction costs, but does not have the safety advantage of Alternative 1A. Alternative 1B could be developed in the near-term, with the remaining sections of Alternative 1A added in the future.

- **Alternative 2** – This alternative would provide the bi-directional service road around the north end of the airfield that remains outside of the RSA. The service road would start at the fuel farm along Tarby Lane and follow the property line before joining the alignment of Alternative 1A. This alternative provides direct access to the fuel farm and the east side of the Airport. Access to the ramps on the west side of the runway would be provided by the existing access road to the Northwest Ramp.

Both Alternatives 1A and 2 have safety benefits; however, high costs and operational and environmental impacts would be created. Alternative 1B could be pursued in the near-team, providing some of the desired benefits of a service road. Note that each alternative would have some steep grades that may be difficult for fuel trucks to negotiate.

4.1.4 Obstruction Removal

As discussed in Chapter 3, the Runway Protection Zone (RPZ) is primarily designated to protect people and property on the ground; however, the FAA considers the clearing of all objects within the RPZ a safety benefit, particularly objects that obstruct the FAR Part 77 Approach Surface.

Beyond the southern end of the Airport, a major 115 K.V. transmission line traverses the existing RPZ, as illustrated on Figure 4-4. The line contains four circuits on a set of parallel utility towers (with two circuits per tower in a vertical configuration). Towers 448, 1443, and 1444 are located within the existing RPZ, and Towers 448, 449, and 1444 penetrate the 50:1 Approach Surface by over 30 feet, and also penetrate the steeper 34:1 surface.

Northeast Utilities owns the line and is considering service upgrades in the vicinity of the RPZ. ConnDOT is working with Northeast Utilities on the obstruction issue in an effort to potentially lower or bury the power line. Such a project would improve safety and land use compatibility in the area south of Runway 36.

Three potential options to eliminate the Approach Surface obstructions and improve safety include:

- Complete relocation of the utility line
- Reconfiguration of the towers into a system with four parallel lines on towers with significantly lower heights
- Burying the section of the line within the RPZ and Approach Surface (approximately 0.4 of a mile)

The first two options to relocate or lower the line would require significant right-of-way acquisition to accommodate the relocated or additional required towers. Due to the inherent difficulty of property acquisition and impacts to affected land owners, burying the lines is typically the preferred option in similar cases. This is also the preferred option from an aeronautical perspective, as the lines are completely eliminated from the Approach Surface and RPZ.

Unfortunately, burial of a 115 K.V. line is very expensive, with an order of magnitude cost of $4 million for well under a mile of line. Although the safety benefit of line burial is clear, funding availability is a significant challenge to be addressed by the FAA and ConnDOT.

4.1.5 Approach Lighting System

Chapter 3 recommended a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) for Runway 36 at OXC. MALSR systems extend 2,400 feet from the associated runway end, and include a series of lights mounted at 200-foot increments. The lights are intended to be placed at the same elevation as the runway end, but may extend upward at a maximum slope of 2% (50:1) where necessary. The basic MALSR layout for Runway 36 is illustrated on Figure 4-4.

As the terrain beyond the end of Runway 36 drops from 680 feet MSL to 610 feet MSL, a MALSR tower system would be required. This would consist of a system of individual tower/pole mounted lights along an unpaved service road. Property easements would be required to install the system.

As shown on Figure 4-4, the MALSR installation would conflict with the existing electrical transmission line discussed above. Furthermore, the existing utility towers are higher than the maximum allowable height of the MALSR system. As such, burial of the utility line, as discussed in Section 4.1.4, is considered a prerequisite to the installation of the Runway 36 MALSR. The light towers and service road may impact some wetland areas and could conflict with the State Park Trail.

From an aeronautical perspective, the MALSR is recommended as it would significantly enhance pilot reference during low visibility conditions and could reduce the approach visibility minimum to as low as ½ mile. An initial Benefit/Cost Analysis (B/CA) was prepared due to the cost of the MALSR system, which identified a favorable B/C ratio of slightly over 1.0 (see Appendix C). A ratio of 1.0 or higher is typically required for FAA funding consideration.

4.1.6 Airport Design Standards

As discussed in Chapter 3, a few design standard deficiencies will occur at OXC due to the anticipated change in the ARC from D-II to D-III. This change affects the standard taxiway width and separation (i.e., offset) from parallel taxiways, taxilanes, and aircraft parking. Four deficiencies were previously identified for OXC, as listed in Table 4-1.

TABLE 4-1 – DESIGN STANDARD DEFICIENCIES			
Design Criteria	**Existing**	**Standard** *ARC D-III*	**Offset per Design Aircraft***
Runway Centerline to Aircraft Parking	475 feet	500 feet	400 feet
Taxiway "A" Width	40 feet	50 feet	39 feet
Taxiway Centerline to Aircraft Parking	75 feet	93 feet	75 feet
Taxiway Centerline to Taxilane Centerline	130 feet	152 feet	122 feet
*Offsets calculated per FAA AC 150/5300-13, and the specific undercarriage width and wingspan of the future Design Aircraft. Also see Appendix B.			

Table 4-1 also identifies the calculated requirement for the future design aircraft at OXC (i.e., the Gulfstream V) per FAA Advisory Circular 150/5300-13. As shown for each deficient item, the Airport currently provides an adequate offset for the Gulfstream V. This is due to the relatively narrow undercarriage width and wingspan of the future design aircraft, in comparison to most aircraft in ARC D-III. Additional details are provided below.

- The runway centerline to aircraft parking offset should ideally be 500 feet to keep parked aircraft outside the Primary Surface. However, allowances for reduced apron offsets are common and typically do not cause safety concerns. A 400-foot offset prevents aircraft from parking within the Runway Object Free Area (ROFA) and may be adequate at OXC.

- The width of Taxiway "A" is 40 feet. For the undercarriage width of the Gulfstream V, a taxiway width of only 39 feet would provide adequate safety (16.3-foot undercarriage width x 1.15 + 20 feet = 39 feet).

- The taxiway centerline offset to aircraft parking on the Northeast, Northwest, and South Ramps is currently 75 feet. This offset is adequate for the 93-foot wingspan of the Gulfstream V [(93 feet x 1.4 + 20 feet] / 2 = 75 feet).

- The Taxiway "B" centerline to the parallel taxilane centerline (along the T-hangars) is currently 130 feet. For the design aircraft, the calculated offset required is 122 feet (93 foot wingspan x 1.2 + 10 feet = 122 feet)

The above calculations identify that OXC currently provides a reasonable level of safety for the future design aircraft without relocating existing facilities. Thus, no alternatives were developed for the relocation of these facilities. However, as each of these offsets are less than the formal Design Standard, an FAA Modifications-to-Design-Standard is required. As such, these pre-existing "nonconforming conditions" must be listed and approved by the FAA on the OXC Airport Layout Plan (ALP).

4.2 Landside Alternatives

This section describes the landside alternatives developed for OXC to satisfy the facility requirements presented in Chapter 3. The alternatives consist of T-hangar, conventional hangar, and maintenance garage developments – the primary landside deficits identified for OXC. The landside alternatives under consideration are illustrated on Figures 4-5 and 4-6.

4.2.1 T-Hangar Options

The OXC requirements for T-hangar space were estimated from industry planning standards and through discussions with airport tenants and management. The analysis identified a current deficit of 30 T-hangar bays, which is anticipated to increase to 36 by 2023. To satisfy the facility requirements, several development locations and configurations were identified, as summarized below and illustrated on Figure 4-5. As multiple layouts could be recommended, they are referred to as options instead of alternatives.

- **Option A** – This option provides three new T-Hangar buildings adjacent to the Northeast Ramp, and could accommodate up to 36 bays. The area contains an existing parking lot, with descending grades and adjacent wetlands. Option A would require substantial filling and embankment to raise the area up to the grade of the Northeast Ramp (over 100,000 cubic yards of fill may be required). Construction procedures could be implemented to avoid impacts to the adjacent wetland. The automobile parking lot located at this site would be relocated.

- **Option B** – This option includes the redevelopment of the existing Northeast Ramp to provide up to 30 T-hangar bays. The development would remove all but six of the existing tiedowns. As such, the development essentially replaces tiedowns with T-hangars. As the Airport has a tiedown surplus and T-hangar deficit, this option would provide an overall benefit to Airport tenants. The existing grade and drainage system of the Northeast Ramp could accommodate T-hangars with little re-grading necessary.

- **Option C** – This option is similar to Option B in that it would replace existing tiedowns with T-hangars. The Northwest Ramp could accommodate up to 32 T-hangar bays with some minor re-grading. Parking and airfield access is readily available at this site, which significantly reduces development costs.

- **Option D** – This final option would completely reconstruct the area adjacent to the Northwest Ramp. Option D would relocate or replace existing hangars and tiedowns, provide additional T-hangars bays, and eliminate Taxiway "D." The development would include approximately 150,000 cubic yards of fill to raise the area to the elevation of the Northwest Ramp. The new apron could accommodate 46 T-hangar bays and 20 tiedowns, for a net increase of 36 bays and 5 tiedowns. A new auto parking lot would be constructed with a new access road from Tarby Lane. The option has the benefit of large size and integration with the Northwest Ramp. Cost would be the primary disadvantage. Depending on the unit cost for fill, the grading alone could exceed $1 million.

With a surplus of approximately 35 tiedowns, some of the existing tiedown positions could be converted to T-hangars, as included under Options B and C. However, as discussed in Chapter 3, some new apron development would be required for T-hangars and/or tiedowns in order to avoid an ultimate deficit of both storage methods.

PARKING
EXPAND BASIN
T-HANGAR DEVELOPMENT OPTION A
T-HANGAR DEVELOPMENT OPTION B
RPZ (DEPARTURE)
RPZ (APPROACH)
MAJOR FILL REQUIRED
APPROX. AIRPORT PROPERTY LINE
PARKING
Northeast Ramp
FUTURE RESTAURANT
FUTURE HANGAR 'G'
Procop Rd
T/W B
T/W E
T/W C
T/W G
1,000L x 800'W OFA
920'L x 500'W RSA
AIRPORT REFERENCE POINT
RWY 18–36
T-HANGAR DEVELOPMENT OPTION D
T/W A
T/W A
MAJOR FILL REQUIRED
Northwest
T-HANGAR DEVELOPMENT OPTION C
South Ramp
Main Ramp Transient Apron
ATCT & Rotating Beacon
HANGAR RELOCATION OR REPLACEMENT
PARKING
Juliano Rd
MIDDLEBURY
OXFORD
Benson Rd
Tarby Lane
Airport Access Rd
Christian St

0 400 800
Scale in feet

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Figure 4–5
T-HANGAR DEVELOPMENT OPTIONS
Connecticut Department of Transportation
Waterbury–Oxford Airport Master Plan
Oxford, Connecticut

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CONVENTIONAL HANGAR OPTION A

APPROX. AIRPORT PROPERTY LINE

RUNWAY PROTECTION ZONE (DEPARTURE)

RUNWAY PROTECTION ZONE (APPROACH)

Northeast Ramp

FUTURE RESTAURANT

Procop Rd

FUTURE HANGAR 'G'

CONVENTIONAL HANGAR OPTION B

1,000L x 800'W OFA

920'L x 500'W RSA

T/W C

T/W E

T/W B

T/W G

AIRPORT REFERENCE POINT

PARALLEL TAXIWAY "B" EXTENSION ALTERNATIVE 1A

RWY 18–36

TRANSIENT RAMP EXPANSION

CONVERT 5 STATE TIE-DOWNS

T/W A

T/W A

T/W D

Northwest Ramp

RELOCATED FUEL TRUCKS

ATCT & Rotating Beacon

Main Ramp Transient Apron

South Ramp

EXPAND SOUTH RAMP

MAINTENANCE GARAGE

Juliano Rd

MIDDLEBURY

OXFORD

Benson Rd

Tarby Lane

CONVENTIONAL HANGAR OPTION C

Airport Access Rd

Christian St

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Scale in feet

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Figure 4–6

CONVENTIONAL HANGAR DEVELOPMENT OPTIONS

Connecticut Department of Transportation

Waterbury–Oxford Airport Master Plan

Oxford, Connecticut

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4.2.2 Conventional Hangar Options

The requirements for conventional hangar space at OXC include a long-range (e.g., 2023) deficit of 96,000 square feet. With the construction of Hangar G, the deficit would be reduced to approximately 33,500 square feet. Three development options were identified to provide for the remaining hangar area. Note that two of the three sites are also the subject of one of the T-hangar development options discussed above.

- **Option A** – Conventional Hangar Option A includes the redevelopment of the existing Northeast Ramp to provide a 25,000 to 35,000 square-foot hangar facility. The development would displace all 40 existing tiedowns on this ramp, requiring replacement of at least some of these parking positions to accommodate light aircraft. The existing grade, drainage, access, and adjacent automobile parking make the Northeast Ramp an ideal location for hangar development. However, note that the conversion of tiedown positions to conventional hangars typically displaces the light aircraft tenant, as conventional hangars traditionally serve turboprop and jet aircraft. Conversely, the conversion of tiedowns to T-hangars is often an upgrade in storage type, as tiedowns and T-hangars typically serve the same light aircraft tenants.

- **Option B** – This option includes a new hangar development area adjacent to proposed Hangar G, and is essentially an expansion of the Hangar G project with an additional 30,000 square foot hangar. However, with additional fill and grading, this site could accommodate up to 60,000-square-feet of hangar, which would integrate well into the current planned development. However, costs would be substantially higher than Option A, as all new site work would be required. Note that this site is located nearly two miles from the Airport Access Road.

- **Option C** – This option includes the redevelopment of the existing Northwest Ramp. Similar to Option A, this development would displace all 50 existing tiedowns on the ramp. The existing grade is well-suited for hangar development; however, the adjacent automobile parking is located at an elevation 30 feet below the apron. No pedestrian access is currently provided between the parking and development site.

Based on current on-airport land use, and to prevent displacement of light aircraft tenants, Option B is considered the best alternative for additional conventional hangar storage at OXC. For both conventional and T-hangar development, the existing topography and other site conditions at OXC create challenges for all future hangar developments.

4.2.3 Transient Apron Expansion

The requirement analysis for the transient apron indicated a current 1,000 square yard deficit. The deficit is anticipated to increase to 5,000 square yards by 2023. A single option to expand the existing transient airport is depicted on Figure 4-6. The expansion includes:

- 3,300 square yards of new apron

- Relocation of the fuel truck parking
- Conversion of five State tiedowns to transient parking (1,700 square yards)
- Expansion of the South Ramp to accommodate the converted tiedowns

Together, these items would provide an additional 5,000 square yards of apron for transient parking, for a total area of approximately 13,000 square yards.

4.2.4 Maintenance Garage/Equipment Building

The airport facility requirements include an additional vehicle garage/equipment building of 2,400 square feet. A location for the garage/building is currently reserved adjacent to the existing garage, as illustrated on Figure 4-6.

4.3 Recommended Airfield Concepts

An evaluation of the airfield development alternatives provided several short-term (within the next 5 years) and long-term (within the next 6 to 20 years) recommendations for implementation at OXC, as summarized in Table 4-2. Each of these recommendations would improve the operational safety and efficiency of the OXC airfield, and would also reduce delays. Recommendations are provided for new taxiways, a service road, obstruction removal, and approach lights, as illustrated on Figure 4-7 (last page of Chapter 4).

4.3.1 Taxiway Recommendations

The primary airfield safety improvement for OXC is a full parallel taxiway for the east side of the runway (i.e., extension of Taxiway "B"). Of the several possible alignments, Alternative 1B provides the best balance between operational considerations and environmental concerns, and is therefore recommended for implementation.

Alternative 1B provides the standard 400-foot runway-taxiway offset for Airport Reference Code (ARC) D-III, extending Taxiway "B" on its current alignment to provide a straight taxiway with no interference to other airport facilities. The alignment would impact Wetland #1 (i.e., 3.8 acres), as filling the area would be required to match the grade of the existing airfield. However, Alternative 1B avoids impacts to the larger Wetland #13 by incorporating an acute angle entrance taxiway at the end of Runway 36. The angle would reduce the fill and embankment required along the Airport's southeastern property line, and would be a similar configuration to that currently provided on the northwest end of Runway 18.

Wetland #1 is the closest wetland to the runway and runs parallel to the airfield for its entire length. Wetlands can be safety hazards due to their attraction to wildlife (FAA Advisory Circular 150/5200-33A). As such, removal of Wetland #1, with off-site mitigation, could have a potential safety benefit for the Airport. A Conceptual Wetland Mitigation Plan was developed (Appendix D) due to the significant wetland impacts associated with this recommendation.

Alternative 2, which avoids most of Wetland #1, could create a potential safety hazard by incorporating a wildlife attractant within the operational airfield. That configuration could cause taxiing aircraft to flush birds and mammals into the path of arriving and departing aircraft. FAA Advisory Circular 150/5200-33A, *Hazardous Wildlife Attractants on or Near Airports*, provides guidelines to reduce such wildlife hazards.

In addition to extending Taxiway "B," several exit taxiway locations are also recommended to enable aircraft to efficiently exit the runway, thereby minimizing occupancy time. In the short-term, Exit Taxiway Option A is recommended, as it provides an additional exit for landings on Runway 36, the more frequently used runway end. It would also be beneficial to provide additional exits for aircraft landings on Runway 18 (i.e., Options C and D), which are recommended in the long-term. Option C would enable aircraft landings on Runway 18 to exit either to the left or right. Option D would provide an east-side exit for landings on Runway 18, as well as a secondary/bypass entrance and holding location for Runway 36 departures.

TABLE 4-2 – EVALUATION OF AIRFIELD ALTERNATIVES					
Alternative/ Option	**Environmental Impact**	**Operational Efficiency**	**Safety**	**Cost***	**Recommended**
EXTEND PARALLEL TAXIWAY "B"					
Alt 1A	4.3 acres of wetland	Straight taxiway with standard 400-foot ARC D-III offset - no other facility impacts.	Reduces runway crossings & occupancy time. Wetland removal may reduce potential airfield wildlife hazard (would include off-site mitigation).	$5,200,000	No
Alt 1B	3.8 acres of wetland	Similar to Alt 1A, with a 45-degree angled entrance to Runway 36. No impacts to other facilities.		$4,300,000	Yes - Short-Term[1]
Alt 2	1.5 acres of wetland	Requires taxiing through privately-leased apron area & includes multiple turns.	Reduces runway crossings & occupancy time, but includes potential airfield wildlife attractant.	$3,600,000	No
EXIT TAXIWAYS					
Option A	N/A	Provides exit for landings on Runway 36 at rollout point.	Reduces runway occupancy time, increasing airfield safety & efficiency for all Airport users.	$325,000	Yes - Short-Term
Option B	N/A	Provides exits for landings on Runway 36 equidistant between Taxiways "C" & "G."		$420,000	No
Option C	N/A	Bi-directional exits for landings on Runway 18.		$420,000	Yes - Long-Term
Option D	N/A	East-side exit for landings on Runway 18, entrance/holding area for Runway 36 takeoffs.		$325,000	Yes - Long-Term
SERVICE ROAD					
Alt 1A	< 0.5 acres of wetland	Full service road that remains clear of the operational airfield & RSA, includes several turns & steep grades.	Full separation of aircraft & ground vehicles.	$1,400,000	Yes - (As Modified) Long-Term
Alt 1B	Avoids wetland impacts	Partial service road that crosses the north end of the airfield (instead of remaining outside the RSA), still requiring ATC clearance.	Partial separation of aircraft & ground vehicles.	$500,000	Yes - Short-Term[2]
Alt 2	Avoids wetland impacts	Provides access to fuel farm within security area.	Partial separation of aircraft & ground vehicles, avoids fuel truck use of public roads.	$360,000	Yes - (As Modified) Long-Term

TABLE 4-2 – EVALUATION OF AIRFIELD ALTERNATIVES (CONTINUED)					
Alternative/ Option	**Environmental Impact**	**Operational Efficiency**	**Safety**	**Cost***	**Recommended**
OBSTRUCTION REMOVAL					
Utility Tower/Tree Removal	< 0.1 acres of wetland (estimated)	Enables landings on Runway 36 during poor weather conditions.	Clears obstructions from FAR Part 77 Approach Surface.	$5,000,000	Yes - Long-Term
MALSR					
Installation of MALSR (Runway 36)	< 0.1 acres of wetland (estimated)	Reduces the approach visibility to as low as ½ mile for Runway 36.	Enhances runway visibility for pilots.	$700,000	Yes - Long-Term

*Planning level estimates
[1]Design, EA, and permitting would occur in the short-term; wetland mitigation and construction would occur in the long-term.
[2]The portion on the west side of the airfield would be constructed in the short-term; the portion on the east side of the airfield would be constructed in the long-term.

After presenting the airfield alternatives to the Study Advisory Committee, it was suggested that alternatives also be considered to reduce the non-standard 3% grade of Taxiway "D." The FAA recommends that taxiways have no more than a 2% grade for small aircraft.[1] Due to large elevation differences between Taxiway "A" and the Executive Flight Services Ramp, Taxiway "D" cannot be reconstructed on its current alignment to enable an acceptable grade. Thus, a new alignment is recommended (see Figure 4-7). The recommended alignment connects Taxiway "D" to the Northwest Ramp, eliminating the current connection to Taxiway "A." This would include the construction of approximately 1,100 feet of new taxiway, and enable a taxiway grade of 2%. Removal of the existing taxiway pavement is also recommended. Due to the significant amount of fill required for this project, the total cost is estimated to be approximately $1 million.

4.3.2 Service Road Recommendation

An on-airport service road is recommended to segregate airport vehicles from the operational airfield. Based upon the many development issues described previously, it is likely that a service road would be built in phases as funding becomes available. In general, a modification of Service Road Alternatives 1A and 1B is recommended (see Figure 4-7). The sections of the road parallel to the runway could be implemented in the short-term, and the section around the north end of the runway could be constructed in later phases of the planning period. The section around the north end of the runway has been refined to reduce the number of turns, thereby providing a more efficient layout; however, minor impacts to Wetlands #2 and #5 (up to 0.1 acres total) would be unavoidable.

[1]The FAA recommends a maximum taxiway grade of 2% for Categories A & B aircraft, which are the primary users of Taxiway "D." For larger aircraft (Categories C & D), the FAA recommends a maximum taxiway grade of 1.5% - this would apply to the parallel and exit taxiways at OXC.

4.3.3 Obstruction Removal

To improve safety within the RPZ and remove obstructions to the Approach Surface, burial of the Northeast Utilities electrical transmission lines and removal of the associated towers is recommended. This project would improve safety and land use compatibility, but would require several million dollars in construction costs. This project is recommended in the long-term; however, funding could be a primary issue for its implementation.

In addition, trees located in undeveloped areas off airport property penetrate the Approach Surface. If the utility towers are removed, trees would become the controlling obstruction. As such, the feasibility of selectively removing trees should also be considered as part of any project to bury the utility line. The Airport Layout Plan (ALP) drawing set depicts the identified tree obstructions.

4.3.4 Approach Lighting System

From an aeronautical perspective, the MALSR is recommended, as it would significantly enhance pilot reference during low visibility conditions, potentially reducing the approach visibility minimum to as low as ½ mile. The Benefit/Cost Analysis (B/CA) for the MALSR system identified a favorable B/C ratio of slightly greater than 1.0 (see Appendix C). As discussed above, the transmission line obstructions must be addressed prior to construction of the MALSR. Therefore, this project is recommended in the long-term planning horizon. Potential MALSR impacts are addressed in Chapter 5.

4.3.5 Airfield Recommendation Summary

The airfield recommendations for OXC include the following:

Short-Term
- Parallel Taxiway Alternative 1A
- Exit Taxiway Option A
- Airport Service Road (section west of runway)

Long-Term
- Exit Taxiway Option C and D
- Airport Service Road (sections east of runway, north of runway, and to fuel farm)
- Obstruction Removal (electrical transmission towers and trees)
- Runway 36 Approach Lights (i.e., MALSR)
- Taxiway “D” Relocation

4.4 Recommended Landside Concepts

An evaluation of the landside development alternatives provided several short-term (within the next 5 years) and long-term (within the next 6 to 20 years) recommendations for implementation at OXC, many with modifications and refinements, as summarized in Table 4-3. In general,

these recommendations would improve and expand the facilities used for the storage/maintenance of aircraft and airport equipment. The recommendations are illustrated on Figure 4-7 (last page of Chapter 4).

4.4.1 T-Hangars & Apron Tiedowns

The identified requirement for T-hangar space includes the addition of 36 bays, without converting a significant number of existing tiedown spaces into T-hangar development (i.e., maintaining the current number of tiedowns throughout the planning period). To satisfy this requirement, the recommendations include a mix of new T-hangar development (i.e., Option A) and T-hangar construction on existing aprons (i.e., Option B) with the replacement of converted tiedowns in alternate locations.

Both T-hangar Options A and B are recommended, with some refinements. Option A could provide up to 36 bays adjacent to the Northeast Ramp, which would satisfy the long-term facility requirement. As the Option A development area requires substantial filling and embankment, this option could be scaled back during the design phase in order to reduce development costs. Thus, Option B is also recommended to support the T-hangar demand (short- or long-term), and could be more readily implemented, as it involves the construction of T-hangars on the existing Northeast Ramp.

Implementation of Options A and B would consolidate all recent and future T-hangar development in the vicinity of the Northeast Ramp. As Option B would eliminate up to 30 tiedowns, locations for tiedown replacement are also identified on Figure 4-7. Note that the construction of the Northeast Ramp was funded by FAA grants, and was last resurfaced in 1992. As such, the Northeast Ramp must remain available as public use tiedowns for a fixed period of time (typically 20 years). Development of T-hangars prior to 2012 could require reimbursement of a portion of the grant funding, or replacement of the tiedowns in another location (without FAA funding assistance).

TABLE 4-3 – EVALUATION OF LANDSIDE ALTERNATIVES					
Alternative/ Option	**Aircraft Storage Provided (maximum)**	**Facility Impacts**	**Environmental Impacts**	**Cost***	**Recommended**
T-HANGAR - 36 Bays Required by 2023					
Option A	36 Bays	Parking lot removed/relocated	Measures to prevent wetland impacts could be implemented	$2,300,000	Yes - Short-Term
Option B	30 Bays	Approx. 30 tiedowns removed	None - redevelopment of existing Northeast Ramp	$860,000	Yes - Short-Term
Option C	32 Bays	50 tiedowns removed	None - redevelopment of existing Northwest Ramp	$920,000	No
Option D	46 Bays, 20 Tiedowns	Existing facilities replaced. Net increase of 36 bays, 5 tiedowns.	Measures to prevent wetland impacts could be implemented	$4,100,000	No
CONVENTIONAL HANGAR - 33,500 sf Required by 2023					
Option A	35,000 sf	40 tiedowns removed	None - redevelopment of existing Northeast Ramp	$2,900,000	No
Option B	60,000 sf	None, new development	Measures to prevent wetland impacts could be implemented	$4,500,000	Yes - Long-Term
Option C	35,000 sf	50 tiedowns Removed	None - redevelopment of existing Northwest Ramp	$2,900,000	No
*Planning Level Costs					

The two recommended locations for additional/replacement tiedowns include expansions of the South Ramp and Executive Flight Ramp. The terrain adjacent to both of these ramps descends quickly beyond the edge of pavement, and would therefore require filling activities to accommodate new tiedowns. By limiting the size of the expansion to approximately 15 new tiedowns in each area, the fill required and associated costs could be kept at a moderate level.

In summary, the recommendations for T-hangars and apron tiedowns incorporate several areas of the Airport and maximize development flexibility. The recommended plan includes two locations for new T-hangars and two locations for additional tiedowns. These new facilities would be developed privately through leasing agreements with ConnDOT. Thus, the multiple locations would provide the flexibility that is critical to developers that typically customize layouts to accommodate their specific needs.

4.4.2 Conventional Hangars

The requirement for conventional hangar space at OXC includes approximately 33,500 square feet of additional area after 2015. Although three development options were identified, only

Conventional Hangar Option B avoids significant displacement of existing tiedowns. Option B would also consolidate all new conventional hangar development along Taxiway "B," segregating corporate activity from transient and light aircraft. Although significant fill and grading would be necessary, the site of Option B could accommodate all anticipated long-term requirements. Development would require associated supporting facilities (i.e., access road, parking, apron, and connector taxiway). It is also noted that the extension of parallel Taxiway "B" would be a prerequisite to the development of this hangar option.

4.4.3 Landside Recommendation Summary

In addition to the options listed above, other recommendations include an expansion of the transient apron and the construction of an equipment building (see Figure 4-7). Overall, the landside recommendations provide for additional hangar development on the east side of the airfield, with incremental apron and tiedown expansion on the west side of the airfield. The landside recommendations for OXC include the following:

Short-Term
- A Combination of T-Hangar Options A and B
- Expansion/Additional tiedowns on the South Ramp*
- Expansion/Additional tiedowns at the Executive Flight Ramp*
- Construction of an equipment building

*Potentially required if T-Hangar Option B is implemented

Long-Term
- Conventional Hangar Option B
- Expansion of the Transient Apron

The specific configuration of any hangar development would be refined during the design process. The layout illustrated on Figure 4-7 provides a logical configuration of the position and size of future facilities, and their integration with the airfield.

MIDDLEBURY
OXFORD
PARKING
T-HANGAR DEVELOPMENT OPTION B
APPROX. AIRPORT PROPERTY LINE
T-HANGAR DEVELOPMENT OPTION A
RPZ (APPROACH)
RPZ (DEPARTURE)
RELOCATE FENCE
N.E. Ramp
RESTAURANT
Procop Rd
HANGAR "G"
CONVENTIONAL HANGARS OPTION B
Larkin State Park Trail
APPROX. AIRPORT PROPERTY LINE
EXISTING TRANSMISSION LINE
PARALLEL TAXIWAY "B" EXTENSION ALTERNATIVE 1B
WETLAND 13
RPZ (APPROACH)
RPZ (DEPARTURE)
BURY SECTION OF TRANSMISSION LINE
POTENTIAL ROAD
EXISTING TOWERS
6% GRADE
T/W B
T/W C
T/W E
T/W G
920'L x 500'W RSA
1,000L x 800'W OFA
AIRPORT REFERENCE POINT
WETLAND 1
400'
EXIT TAXIWAY OPTION D
IN-PAVEMENT MALSR LIGHTS
POLE-MOUNTED LIGHTS
END OF MALSR
SERVICE ROAD ALT. 1
RWY 18-36
EXIT TAXIWAY OPTION A
TRANSIENT RAMP EXPANSION
EXIT TAXIWAY OPTION C
SERVICE ROAD/ WALKWAY
MALSR SERVICE ROAD
WETLAND 5
T/W A
WETLAND 2
Juliano Rd
TAXIWAY "D" RELOCATION
T/W D
Northwest Ramp
South Ramp
720'L x 500'W RSA
1,000L x 800'W OFA
Main Ramp Transient Apron
RELOCATED FUEL TRUCKS
ATCT & Rotating Beacon
EXPAND SOUTH RAMP
APRON EXPANSION
EQUIPMENT BUILDING
Tarby Lane
SERVICE ROAD ALT.2
Airport Access Rd
Christian St
Benson Rd

LEGEND

- Wetlands
- 100-Year Floodplain (approx.)
- 500-Year Floodplain Bounday (approx.)

0 600 1,200
Scale in feet

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DATE: JULY 2006
SCALE: AS NOTED

Figure 4-7

RECOMMENDED PLAN

Connecticut Department of Transportation
Waterbury-Oxford Airport Master Plan
Oxford, Connecticut